Establishing the resilient response of organisations to disruptions: an exploration of organisational resilience

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Establishing the Resilient Response of Organisations to Disruptions: An Exploration of Organisational Resilience

by

Kevin John Burnard

Doctoral Thesis
Submitted in partial fulfilment of the requirements for the award of Doctor of Philosophy of Loughborough University
01/03/2013

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Dedication

This thesis is dedicated to the memory of my father,

Stephen John Burnard (1954 – 2011)
Abstract

The focus of this thesis is to investigate resilience at an organisational level. The research aims to identify and establish the features of resilience within the response of an organisation to disruptive and crisis events. Natural disasters, pandemic disease, terrorist attacks, economic recession, equipment failure and human error can all pose both a potentially unpredictable and severe threat to the continuity of an organisation’s operations. As a result, disruptive events highlight the need to develop robust and resilient organisational and infrastructural systems capable of adapting and overcoming complex disruptive events.

Following a grounded theory approach, the research explores the features of resilience related to organisational responses through actively engaging with organisations involved within critical infrastructure in the UK. Within this context, resilience relates to the competitiveness and adaption of an organisation during periods of adversity and crisis. The mechanisms of organisational resilience strive to improve an organisation’s situational awareness, reduce organisational vulnerabilities to systemic risk environments and restore efficacy following the impacts of a disruption (Burnard and Bhamra, 2011). Allowing an organisation to not only respond effectively to turbulence and uncertainty but also seek potential opportunities for organisational development within disruptive events.

The research extends to encompass the strategic processes involved within resilience and the mitigation of disruptive events, including organisational preparations, crisis management and decision making. This is achieved through the development of an organisational survey, qualitative organisational case studies and the construction of causal networks related to response and adaption. Through this, the research identifies the nature of disruptive events, the features of an effective response, and the need to develop rational, specific and focused response strategies towards addressing disruptive events. As such, the research contributes to both the growing theoretical and empirical development of organisational resilience.
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Chapter 1 - Introduction

1.1. Resilience

Countries, communities, institutions, organisations and individuals are all subject to a diverse and ever changing risk environment. Events such as the Aisin Seiki plant fire (February 1997), the Chi-Chi earthquake (September 1999), the Indian Ocean Tsunami (December, 2004), Hurricane Katrina (August 2005), the Haiti Earthquake (January 2010) and the Tohoku Earthquake and Tsunami (March 2011), all highlight the devastating implication that disasters and disruptive events can carry.

Subsequently, organisations must strive and continually adapt in order to sustain competitiveness and remain viable within uncertain environments. The diverse threats that this often turbulent environment poses vary in both severity and magnitude and may originate internally or externally to a system or network. Through turbulent economic, social and environmental periods; organisations and their wider networks will experience disruptions and discontinuities. These disruptions can pose several threats to the performance and competitiveness of an organisation. Subsequently, understanding the features that allow for successful adaption is essential within the volatile business environment in which modern organisations operate. This research forms an investigation into the concept of resilience within organisation. Specifically, the research focuses on the organisational factors and capabilities that influence the response of an organisation to disruptive events.

Since the seminal work of Holling in 1973, the concept of resilience has gained increasing prominence and support within the academic community. Given the potentially devastating implications of disruptions, understanding the dynamics of successful adaption of organisation yields an important avenue for research. Resilience relates to the strategic position of an organisation, and is delivered through embedded capabilities and functional processes. Resilience relies on an organisational ability to develop and maintain adaptive, proactive and reactive strategies within addressing both internal and external change. Within the context of the response of an organisation to a disruptive event, resilience forms an emergent property within
organisational systems that relates to the inherent and adaptive qualities and capabilities that enables an organisation’s adaptive capacity during periods of adversity. Resilience supports the ability to develop a structured (controlled) and rational (specific) approaches towards addressing disruptive and crisis events.

Resilience is both a multifaceted and multidimensional concept. Within organisations, resilience resides in both the individual and organisational responses to turbulence and discontinuities. This involves both the ability to withstand systematic discontinuities as well as the capability to adapt to new risk environments. Although there is growing recognition of the concept within academic publications, the concept and features of organisational resilience have remained largely undefined and ambiguous.

While business indicators such as Business Continuity Planning and Management follow primarily a reactive approach, the concept of resilience is much more overarching. Resilience resides in the individual, organisational and infrastructural contexts. Resilience involves both the ability to withstand systematic discontinuities as well as the capability to adapt to risk and uncertainty. Resilience is based on the organisational processes and resources focused on developing the competence and growth of an organisation. Organisational level resilience is thereby based on the capability to restore function, effectively process environmental feedback and flexibly rearrange and transfer knowledge and resources to overcome a disruptive event.

1.2. Research Aim

The focus of this thesis is to investigate resilience at an organisational level. Following an investigative approach, the research explores the features of organisational resilience in relation to the response and adaption of an organisation to a disruption. The research specifically seeks to identify and establish the features of a resilient response to turbulence and discontinuity at the organisational level. Through this, the thesis strives to identify the critical success factors within an effective response and outline how an organisation can take a proactive approach to managing its adaptive capacity and capability. The research aim is as follows:
The aim of the research is to develop an understanding and theoretical foundation for the concept of resilience within the response of an organisation to disruptive events.

Through this aim, the research looks to explore several aspects of resilience. However, specific attention is spent exploring the development of an organisation’s adaptive capacity and the effective utilisation of organisational capabilities. Through this the research focuses on addressing organisational performance and competitiveness during turbulent periods. This is achieved through four specific research objectives presented within the following section.

1.3. Research Objectives

1.3.1. Research Objective 1 (RO1)
To critically review literature and other secondary data sources related to resilience and other associated concepts.

1.3.2. Research Objective 2 (RO2)
To investigate the implications of disruptive events on the performance of organisations. Identifying how organisations are able to effectively meet core business objectives during disruptions and periods of adversity.

1.3.3. Research Objective 3 (RO3)
To identify the critical stages and elements within the response of an organisation to a disruptive or crisis event. Identifying the linkages and relationships between organisational variables and resilience.

1.3.4. Research Objective 4 (RO4)
To investigate the organisational factors influencing resilience and an organisation’s ability to respond effectively to disruptive and crisis events. Identifying the influence and strategic implications of resilience on organisational responses.

1.4. Outline of Thesis

Chapter 1 provides an outline and context for the research demonstrating the direction and general context for the thesis. The concept of resilience within
organisations is introduced providing a context for subsequent chapters. The research problem and objectives are outlined and discussed as well as the contribution of the research. The chapter also provides a description of the methodology followed within the research.

Chapter 2 presents a literature review across several streams and trends of literature. The chapter outlines the foundations and various conceptualisations of resilience within academia, including Ecological and Engineering Resilience, Socio-Ecological Resilience, Community Resilience and Organisational Resilience. Literature related to Crisis Management, Risk Management and Business Continuity Management is also presented.

Chapter 3 outlines the methodology and research design followed. The research follows both an organisational survey and multiple case study design, incorporating both qualitative and quantitative elements.

Chapter 4 outlines the conceptual and theoretical work related to the development of a conceptual framework for organisational responses. The chapter also details the research protocols employed. Both a case study protocol and grounded theory coding protocol are followed.

Chapter 5 details the development and deployment of an organisational survey towards exploring organisational resilience. The chapter presents descriptive statistics and an exploratory factor analysis.

Chapter 6 presents the findings from each individual case study organisation. The ‘within case’ analysis presents evidence across four organisations related to organisational dynamics, approaches to resilience and the response of the organisations to disruptive events. Causal networks are developed for each individual case.

Chapter 7 presents a cross-case analysis of the case study organisations. A discussion is then raised, presenting the key features identified within the organisational case studies. A cross-case causal network is then developed following this analysis.
Chapter 8 presents the research output and discussion of the research findings. This chapter presents a discussion of the major findings and a typology of organisational resilience. Following the grounded theory approach, a literature review linked to the findings of the research is presented. Following the typology of organisational resilience a generalised causal network related to the response of an organisation is presented.

Chapter 9 presents the final research conclusions.
Chapter 2 - Literature Review

2.1. Introduction

Literature relating to resilience is spread across a several disciplines creating a diverse and varied literature base. The term resilience is used within a wide variety of fields including psychology, ecology, metallurgy, organisational theory, systems engineering, supply chain management, strategic management and safety engineering. The following chapter outlines several key theories and works within the literature base towards identifying important concepts and constructs.

2.2. Literature Review Overview

The following sections detail the literature related to disruptive events and other key streams of literature including organisations as complex adaptive systems, risk and uncertainty, crisis management, risk management and business continuity. Following this a detailed review of literature related to resilience will be presented. This chapter addresses the research objective RO1 (presented within Chapter 1, section 1.3).

The concept of ‘resilience’ has greatly increased in prominence both within academia and industry over recent years (Bhamra et al, 2011). Resilience relates to the adjustment of an element or system following the influence of a perturbation or disturbance (Holling, 1996). As highlighted by several authors (Seville et al, 2006; Crichton et al, 2009; Gibson and Tarrant, 2010; Lengnick et al, 2010), through the cultivation of resilience within a system, it may be possible to not only overcome potential disruptions but transcend these events and develop a more robust system. As such, resilience can be viewed as the emergent property of systems that relates to the inherent and adaptive qualities and capabilities that enable a system’s adaptive capacity during turbulent periods. The mechanisms of organisational resilience thereby strive to improve situational awareness, reduce organisational vulnerabilities to systemic risk environments and restore efficacy following the events of a disruption (Burnard and Bhamra, 2011).
The concept has received little systematic empirical work and independent attention (Sutcliffe and Vogus, 2003). Predominately, resilience based literature has been conceptual, focusing on developing a static knowledge base for the area through establishing the fundamental concepts and principles (Jong and Ferguson-Hessle, 1996). The literature based within the context of resilience as well as the literature within related areas can be grouped broadly into three general areas of classification. These correlate to the elements of resilience as identified by Ponomarov and Holcomb (2009). These include:

- Readiness and Preparedness
- Response and Adaption
- Recovery or Adjustment

Within a specific resilience based context, although several authors attempt to broadly cover all of these general areas within a study, individually each area has received little empirical based study and conceptual development. Predominantly, it is only through the research of resilience related areas that the individual classifications have received any attention. As a result a diverse literature base has developed.

Table 2-1 - Overview of Literature Review

<table>
<thead>
<tr>
<th>Ecological</th>
<th>Individual</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Adaptive Capacity</td>
<td>- Adjustment/ Change</td>
</tr>
<tr>
<td>- Adjustment/ Change</td>
<td>- Behaviour</td>
</tr>
<tr>
<td>- Perturbation</td>
<td>- Competence</td>
</tr>
<tr>
<td>- Resources/ Capabilities</td>
<td>- Resources/ Capabilities</td>
</tr>
<tr>
<td>- Response</td>
<td>- Turbulence/ Uncertainty</td>
</tr>
<tr>
<td>- Self Organisation</td>
<td></td>
</tr>
<tr>
<td>- Stability Domains</td>
<td></td>
</tr>
<tr>
<td>- Systems</td>
<td></td>
</tr>
<tr>
<td>- Turbulence/ Uncertainty</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Community/ Socio-Ecological</th>
<th>Organisational/ Supply Chain</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Adaptive Capacity</td>
<td>- Adaptive Capacity</td>
</tr>
<tr>
<td>- Adjustment/ Change</td>
<td>- Adjustment/ Change</td>
</tr>
<tr>
<td>- Development/ Opportunity</td>
<td>- Complexity</td>
</tr>
<tr>
<td>- Redundancy</td>
<td>- Development/ Opportunity</td>
</tr>
<tr>
<td>- Resources/ Capabilities</td>
<td>- Resources/ Capabilities</td>
</tr>
<tr>
<td>- Response</td>
<td>- Response</td>
</tr>
<tr>
<td>- Self Organisation</td>
<td>- Risk</td>
</tr>
<tr>
<td>- Systems</td>
<td>- Strategy/ Planning</td>
</tr>
<tr>
<td>- Turbulence/ Uncertainty</td>
<td>- Vulnerability</td>
</tr>
</tbody>
</table>
Although some areas of resilience have received significant academic attention and empirical study, such as ecological systems (Holling, 1973; Gunderson, 200; Carpenter et al, 2001) and to a lesser extent socio-ecological systems (Walker et al, 2002; Walker et al, 2004). Areas such as organisational level resilience have been largely neglected. As a result there is a need to conduct good quality empirical based research to fully develop the area and truly recognise the potential of developing the resilient characteristics within organisations. Table 2-1 presents an overview of each of the four identified disciplines (Ecological, Individual, Community/ Socio-ecological, Organisational/ Supply Chain) within the literature review; each of these disciplines will be discussed further in subsequent sections. In relation to resilience, the table provides an overview of the major concepts related to each discipline.

A growing body of work has developed following community level resilience (Norris et al, 2008) and supply chain resilience (Rice and Sheffi, 2005); although the importance of organisational resilience is recognised within these areas, there has been little specific focus on the organisational level. As a result there is a need to develop a solid conceptual and theoretical base for organisational resilience in order to enable meaningful studies to evolve.

Appendix A presents a concept matrix of literature pertinent to resilience. The matrix of resilience literature presents the research contributions regarding perspectives taken, concepts discussed and the research methodologies utilised; 74 papers are contained within this matrix (published between 1976 and 2010).

2.3. Organisations as Complex Adaptive Systems

Organisations are governed by nonlinear relationships and as a result can be regarded as dynamic systems (Thietart and Forgues, 1995). The composition of the ‘modern’ organisation is a complex network on interrelated linkages. An ‘organisation’ can therefore be expressed by four different yet related definitions (Lock, 1994). Firstly, an organisation can be defined as a systematic arrangement or division of work, activities or tasks between individuals and groups. This ‘systematic arrangement’ requires the necessary allocation of resources to achieve common objectives. Secondly, the organisation forms a cohesive social group composed of formal relationships and
duties between organisational members, which are combined to achieve common objectives. Thirdly, an organisation can be expressed as the complete aggregation of human and material resources towards achieving specific objectives. Finally, an organisation will institute a structure of authority and responsibility relationships within a cohesive social system (Lock, 1994). As such influence is spread through multiple organisational actors, with differing agenda, both internal and external to the organisation, coordinating their actions to exchange information and interact (Thietart and Forgues, 1995).

Both communities and organisations have both been conceptualised as complex systems by a variety of authors (Dooley, 1997; Comfort et al, 2001; Crichton et al, 2009). A complex system is composed of interconnected agents that form a network of linkages that interact non-linearly. This interaction gives rise to emergent behaviour (Dooley, 1994). The systems interactions within the network feed back creating a loop and reinforcing the cause and effect relationship between system agents. In order to sustain the internal complexity of the system, constant energy and interaction between the system and the environment is required. This creates a dissipative system through the constant exchange of energy and resource. As such, complex systems are evolutionary and react to local information and are thereby capable of self organisation (Andriani, 2003). As identified by Comfort et al (2001) when an environments complexity increases, possibly through high impact or disruptive events, system performance decreases, as the system is unable to process the amount and range of information required to adequately establish coordination across the components of the response system. This is a result of the system requiring a significant increase in information exchange, communication and coordination in order to integrate the multiple levels of system operation and decisions caused by the increase in environmental and system complexity. As a result of this, in order to establish a strategy for reducing risk in uncertain environments it is proposed that a system should create a balance between anticipation or preparedness and resilience (Comfort et al, 2001).

Organisations have also been theorised as complex adaptive system to enable a more holistic view of organisational behaviour (Dooley, 1997). The issue in the management
of any viable system, such as an organisation, is the issue of managing complexity, as it is complexity that threatens to overwhelm a system’s regulators (Beer, 1984). This is reflected by Comfort et al. (2001) who identify that organisational performance significantly declines in environments of increased complexity. Through utilising the complex adaptive systems view a better understanding of the relationship between organisational elements and the environment can be gained and aid in the management of complexity.

The complex adaptive systems view has developed from the discovery of chaotic dynamics within system behaviour (Dooley, 1997). A complex adaptive system is an interconnected network of elements that exhibit adaptive behaviour in response to changes in both the environment and within the systems elements (Pathak et al., 2007). Nonlinear flows of resources and information are characteristic of complex adaptive systems, as the systems elements interact within each other and with the external environment (Dooley, 1997). The consequence of these interactions between system elements is that the system evolves and learns. In addition to this, a complex adaptive system is capable of self-organising behaviour. New organisational structure, patterns and properties may then spontaneously emerge without being externally imposed by the system (Pathak et al., 2007).

Several authors (Turner et al., 2003; Coiera, 2007; Govindaraj, 2008; Powley, 2009) have also defined organisations as ‘socio-technical systems’. A socio-technical system is concerned with the interactions and linkages between the psychological and social factors (such as the needs and demands of the human component of organisations) and an organisation’s structural and technical requirements (Mullins, 2007). Therefore, as shown by Coeira (2007), the socio-technical perspective attempts to understand the contribution of elements at the human social level to the performance of technical systems. Within the domain of nuclear power, Govindaraj (2008) outlines possible frameworks for characterising a socio-technical system. It is noted that within complex interconnected systems, safety and reliability are essential elements, and as such, understanding the human and system interactions is essential in anticipating issues before they lead to unfavourable events. It is therefore important to understand
that within organisations, systems have both social and technical consequences (Coiera, 2007).

2.4. Organisational Crisis and Disruptive Events

Crisis stand to threaten the reputation, operation, and survival of organisations and in severe instances impact the lives of individuals and communities. Many definitions and typologies of crises and disruptive events have been developed across several contexts, creating a diverse literature base. All, however, emphasise the dramatic implications that crises can carry. Extreme and disruptive events pose an ever present threat to the continued operation and continuity of an organisation. As shown by Wilson et al. (2010), there are a variety of perceptions related to the definition of an extreme event. Extreme events are a broad category of disruptive events or ‘exogenous jolts’ (Meyer, 1982) that organisations must face. Wilson et al. (2010) therefore define extreme events as “determined within organizational context; characteristically unprecedented or unplanned occurrences that impact upon business as usual through the disruption or destruction of key resources”.

Disruptive events can have grave implications for individuals, communities, organisations and countries alike. Although often used interchangeably, as outlined by Shaluf et al. (2003) disasters and crises are two distinct events, where crises are broadly characterised as being more comprehensive and potentially disruptive events. Dalziell and McManus (2004) offer a broad definition, identifying that a disaster occurs when an individual, community or organisation is forced from one stable state or equilibrium to another. Dalziell and McManus (2004) also identify the point at which an organisation is said to have overcome a disaster. This point is reached when emphasis is no longer placed on ‘damage control’ but instead on recovery. Through this focus shifts from the immediate crisis mitigation to longer term strategies and planning (Dalziell and McManus, 2004). Although there is a certain level of ambiguity within the notion of organisational stable states. However, ‘disasters’ remain a multifarious concept, composed of many different elements that seem to defy any precise definition (Alexander, 2004).
Disasters and crises seemingly result from combinations of hazards, conditions of vulnerability and an inability to reduce the consequences of risk. Disasters and crises relate to events that produce greater losses or implications than the effected systems or communities are capable of coping with (Lindell et al, 2006). The complexity and uncertainty associated with these events means that it is often only through hindsight that disasters and crises look like the events that individuals, communities, organisations and countries should have prepared for. However in complex environments or within systems under significant pressure from disruptions, system elements have limited capacity to anticipate every challenge and discontinuity that could possibly occur (Sutcliffe and Vogus, 2003). As identified by Shaluf et al (2003), disruptive events also stand to temporarily overwhelm the response capacity of effected systems through both natural and man-made events. These events can vary in both severity and magnitude, causing extensive damage, economic loss, disruption, injury or in severe instances loss of life. As such, there has been a growing amount of evidence from several large scale incidents over the past decade that have highlighted the need to develop organisational and infrastructural systems capable of adapting and overcoming complex disruptive events. An event in one area can often have disastrous effects in another (Juttner, 2005). As such, risk can take many forms and is highlighted in many recent highly publicised events including the 2004 Indian Ocean Tsunami, the 2010 Haiti and Chile Earthquakes, the recent global financial crisis and the 2010 eruption of Icelandic volcano Eyjafjallajokull.

Emergencies are typically ‘unforeseen but predictable, narrow scope events’ that occur relatively regularly and as such often refer to an imminent threat (Lindell et al, 2006). While emergencies may be considered tragedies for those involved, emergencies typically have limited wider implications for the systems and people involved, while crises are of a complete different magnitude and character (Boin and McConnel, 2007). Crises are inherently equivocal events (Reynolds and Seeger, 2005) and can often result from unconnected and seemingly inconsequential events (Maitlis and Sonenshein, 2010). As outlined by Rosenthal and Kouzmin (1997), crises are situations that threaten the high-priority goals of an effected system, and as such
present an immediate threat to the core values of a system and must be addressed and overcome under conditions of deep uncertainty (Boin and McConnel, 2007).

Crises refer to high-impact, low-probability (HILP) events that threaten the fundamental goals and objectives of an organisation (Weick, 1988; Sheffi, 2005; Sheffi, 2007) and can be broadly characterised into four distinct categories; conventional crises, unexpected crises, intractable crises and fundamental crises (Gundel, 2005). However as outlined by Pearson and Mitroff (1993), any event that poses a direct threat to the reputation or viability of an organisation should be considered a crisis. Crises can also be defined as a ‘decisive moment’ or a situation that has reached a critical phase (Davies and Walters, 1998) in which important decisions related to threats and opportunity have to be made under considerable time constraints (Shaluf et al, 2003). As outlined by Pearson and Clair (1998), crisis events (HILP) are largely defined through ambiguity within cause, effect and an effective outcome or means for resolution. Crises also restrict the amount of time available to respond before the situation changes. This means that crises are often characterised by the necessity to make critical choices (Rosenthal and Kouzmin, 1997).

Pearson and Mitroff (1993) state that crises are high magnitude events that require immediate attention and response from an organisation. These events are significant enough to challenge the existing structure, continuity of operations or in severe instances the survival of the organisation (Faulkner, 2001). Disruptive events are further complicated as crises are typically outside of the control of an organisation and involve an element of surprise (Pearson and Mitroff, 1993). Although each crisis event will be unique to some extent, Faulkner (2001) outlines several key characteristics of crises and highlights the complexity and broad impact of disruptive events. Crisis events may involve 1) a triggering event in which the latent threat is transformed into an active crisis; 2) a high threat level further compounded by an element of surprise and urgency; 3) a short decision time; 4) a perception of an inability to cope among those directly affected; and 5) a turning point which may carry both positive and negative connotations.
A crisis refers to an abnormal or irregular situation or event that threatens the operations, staff, customers or reputation of an organisation (Low et al., 2003). Crises can be broadly classified or grouped into four broad categories, these include:

- Acts of nature
- External man-made events
- Internal unintentional events
- Internal intentional events

Crises present a variety of threats that vary in both magnitude and severity (Burnett, 1998). However, any event that directly impacts a service or operation upon which individuals, or an organisation, are dependent or reliant upon will be perceived as a crisis to those impacted. As such, crises are specific to those affected and will be experienced differently by various organisations (Wilson et al., 2010). Staw et al. (1981) identify that a crisis occurs when three conditions are present within a system. A crisis can be induced when there is a major threat to survival, the system has little time to react and when the threat is unanticipated. These conditions are then modelled in relation to information seeking to illustrate the performance of an organisation during a crisis. However, the approach of Staw et al. (1981) purely focuses on a rigid organisational response and as a result the model of information seeking behaviour provides a limited understanding of the impact of a threat.

Crises may also not affect an organisation in isolation. In addition to the direct impact of the event on the organisation and its operations (including products and services), a crisis can have implications for stakeholders, including competitors and other external parties (Pearson and Mitroff, 1993).

Organisations are vulnerable to countless types of potential crises. As such, it is an impossibility to develop adequate contingencies for every possible eventuality. Although each event poses a unique threat to the organisation and its members, there is a level of commonality between different types of crises. Davies and Walters (1998) identified four phases within crises. Although, each crisis event requires a distinct approach, understanding the escalation and progression of crises allows for a level of structure to be introduced into the management of disruptive events. The phases of crises include the pre-incident or ‘prodromal crisis’ stage in which relates warnings of the impending threat or crisis; the crisis impacting the organisation termed the ‘acute
crisis’; the ‘chronic crisis’ or the post event phase of recovery; and finally the ‘crisis resolution’ which relates to the recovery of the organisation from the event. Various threats and opportunities are presented within each of these phases.

2.5. Risk and Uncertainty

Risk within a system can take many forms. Risk is about future happening and is pervasive. As a result of this, risk management is an integral component of successful organisational strategy and operation. There is always uncertainty about the future and it is this ‘uncertainty’ that brings risk (Waters, 2007). Subsequently, risk and uncertainty can be defined as follows (Smith, 2003):

- Risk is the implication of a phenomenon being uncertain
- Implications of an uncertain phenomenon can be wanted or unwanted
- Uncertainties and their implications need to be understood to be managed successfully

As a result of this the term “risk” can be defined through two basic components (Moore, 1983). Firstly, risk relates to future outcomes which can take a number of forms, some of them commonly unfavourable. There is also a non-zero probability that the less favourable outcome will occur. Although uncertainty and risk can be thought of as the same entity, there is a subtle distinction between the two factors. ‘Uncertainty’ means that it is possible to list the events that might take place in the future; however it is impossible to predict their relative likelihoods. While ‘risk’ means that it is possible to predict the relative probability that an event might occur in the future (Waters, 2007).

There are several approaches to classifying risk (Frame, 2003). These include pure risk, business risk, project risk, operational risk, technical risk and political risk. These risk categories are not mutually exclusive, meaning that risks in one area can have implications for another. However, as noted by Tchankova (2002), sources of risk could also be represented by the environment in which they arise. For example, risk could be defined through the physical environment, social environment, political environment, operational environment, economic environment, legal environment or
the cognitive environment. Meaning that any specific classification of risk may prove highly subjective.

Growth in the economy, changing consumer preferences, the climate for labour relations and most technological progress are all exogenous events, part of an external environment to which an organisation reacts and which it does not fully control. These events all highlight the borderless nature of risk (Smith and Fischbacher, 2009). To ensure the success and progression of the business or enterprise, entrepreneurs and managers require the ability to seize the opportunities identified and avert the threats presented by the external environment. Large organisations can and do take large risks and withstand a high level of uncertainty. This is possible provided that each individual risk could not threaten the existence or money making power of the organisation. If the projects are dependent on the same single risk, the organisation would be placed potentially in a position where success is dependant on a single outcome (Smith, 2003; Waters, 2007; Smith and Fischbacher, 2009). Thereby significantly increasing the risk to the organisation.

Some organisations will be more willing to take risks and seize potential opportunities while others will follow a more passive behaviour (Harwood et al, 2009). This relates to the risk ‘propensity’ of an organisation. The risk propensity is the ‘inclination’ of an organisation to take risk. The risk propensity of an organisation can directly affect decision making behaviour and the subsequent strategic and operational decisions (Harwood et al, 2009). This may be due to individuals being risk adverse and thereby unwilling to take any uncertain action when starting from a position of low risk (Werner, 2009).

2.6. Addressing Disruptions

Following the occurrence of a disruption or the escalation of a crisis, many parties could be affected (Low et al, 2010). Additionally, disruptions can take several forms and have far reaching consequences and implications. Technological discontinuities, regulatory upheavals, geographical shocks, shifting functions and services of industry, industry disintermediation, abrupt shifts in consumer preferences and increased competitors all contribute to a seemingly increasing turbulent environment (Hamel
It is therefore important to understand the elements of disruption and the risks that a disruption can pose.

![Risk-Hazard Model](image1)

![Pressure-and-Release Model](image2)

Turner et al (2003) identify two frameworks for vulnerability that address the impact of disruptive events on coupled human-environmental systems (such as socio-technical systems) with complex relationships and linkages. The Risk-Hazard model, shown in Figure 2-1, addresses the impact of a threat as a function of exposure to the hazard and the sensitivity of the element exposed to the hazard. Although this model does identify several key features of a disruptive event, there are several shortcomings, and as a result the Pressure-and-Release model, shown in Figure 2-2,
was developed. Within the Pressure-and-Release model, risk is defined as a function of perturbation and the vulnerability of the exposed element. Through this a more complete view of a disruptions effect is achieved as the model directs attention to the conditions that cause vulnerability and make threat exposure unsafe (Turner et al, 2003).

The Pressure-and-Release model developed by Turner et al (2003) creates a framework that allows for the conditions that increase a systems vulnerability to be identified and assessed. However, the framework does not characterise the features of a disruption or outline the fundamental dynamics of an organisation’s response and recovery. Without these features an incomplete model of organisational disruption is generated. Rice and Sheffi (2005) identify that a disruption will affect the performance of an organisation. As such, an organisation’s response can be characterised through eight stages, these are shown in Figure 2-3. These include:

1) Preparation
2) Disruptive Event
3) First Response
4) Initial Impact
5) Full Impact
6) Recovery Preparations
7) Recovery
8) Long Term Impact

Figure 2-3 - Impact of a Disruption (Adapted from Rice and Sheffi (2005))
Organisations rarely, and if so briefly, operate in an environment of stable equilibrium given the nature of turbulent environments (Hamel and Valikangas, 2003). The demands and requirements of the business environment are continually changing. Organisations must deal with regular discontinuities and disturbances, these typically take the form of low-impact/ high-probability (LIHP) events (Sheffi 2005), and the mitigation procedures and practices of such events are well developed within management research. However, high-impact/ Low-probability (HILP) events require planning and action outside the normal channels of response for many organisations. Therefore developing organisational systems with the ability to adapt to more dramatic threats, such as HILP events, is a growing area of interest.

Organisations are subjected to a broad risk environment and an uncertain future characterised by both internal and external risks and discontinuities. The borderless nature of risk (Smith and Fischbacher 2009) and changing environmental conditions (Hamel and Valikangas, 2003) have dramatically increased the possibility of breakdowns and disruptions to organisational systems due to changes in cultures, priorities, resources, and management systems (Crichton et al, 2009). In recent times the organisational landscape has been characterised by HILP events such as the economic downturn, fluctuating market conditions (stock market crash), natural disasters, terrorism, legal and regulatory actions, scandals and changing customer demands. An organisation’s inability to adapt to many of these HILP events can be seen as a result of systemic organisational inadequacies. The determinants of these events can be as far reaching as their consequence. HILP events have highlighted a much broader array of social and technological issues than previously encountered. Organisations are required to not only develop emergency procedures and plans to ensure future continuity and operation (Cerullo and Cerullo 2004), but develop both the ability to withstand systematic discontinuities as well as the capability to adapt to new risk environments (Starr et al, 2003; Crichton et al, 2009). As such organisations are required to develop the necessary attributes in order to ensure survival.
2.6.1. Crisis Management

Crisis management relates to four activity areas of risk reduction, readiness, response and recovery through which organisations address the complexity and impact of disruptive events (Evans and Elphick, 2005). Crisis management therefore forms a multidisciplinary activity that encompasses all aspects of an organisation’s operations and forms a critical component within strategic management (Gundel, 2005). Crisis management within organisations relates to preparations and activities both before and after the onset of an event. Crisis management involves a concerted effort to initially prevent a crisis from developing and establishing prior preparations towards limiting an events impact. The initial stages of crisis management thereby relate to an organisation’s ability to effectively interpret events, recognising both the potential impact and scale of the event. Following the onset of an event, crisis management activities must focus on supporting an effective organisational response to the demands of the situation and provide plans and resources towards the recovery of the organisation (Rosenthal and Pijenburg, 1990). Reilly (1993), purports however, that crisis management actually relies on three fundamental processes: problem perception, analysis, and decision making.

Crisis management involves the development and effective implementation of management strategies towards the resolution and recovery from disruptive events (Laws and Prideaux, 2006). These activities begin with pre-crisis planning and preparations, and are activated to respond to a crisis as it unfolds and develops. Following the escalation of a crisis, strategies are implemented towards the recovery of the organisation from the event. Crisis management thereby involves the development and implementation of plans, procedures and mechanisms towards the detection of threats (potential crises), prevention and preparations, damage containment, business recovery, organisational learning and redesign (continuous improvement) (Pearson and Mitroff, 1993). Subsequently, flexibility within management, effective communication and information management, including reliability of information, are all enhancing factors within efficient crisis management (Khodarahmi, 2009). As noted by Burnett (1998), not all crises are similar and the same organisational response across all crises may not be suitable or valid. Instead,
organisations are required to develop strategic actions in order to ensure resolution and avoid potential impact associated with a particular crisis or disruptive event. It is hoped that through effective crisis management an event will not escalate into a full blown crisis scenario.

Both prior to and following an event, decision making forms an integral component within crisis management, however, the impact of crises stands to disrupt the routine functions of an organisation’s operations and activities and places considerable stress on the individuals involved. This can restrict the ability of the organisation to make effective and quality decisions during periods of adversity. The nature and complexity of crisis situations also stands to further restrict or at the very least constrain the opportunity and ability to manage disruptive events through a linear procedure (Boin, 2009). As identified by Smith (2005), crisis management is often seen in terms of business continuity management and the development of contingency plans to allow organisations to overcome the demands of a particular crisis or disruptive event. However, although prior preparations form an essential element within the response of an organisation to a disruptive event, crisis management should involve the development of organisational capabilities to prevent the occurrence of crises (Pearson and Mitroff, 1993). Subsequently, Smith (2005) suggests the development and cultivation of resilience within the organisation in order to address the demands of disruptive events. As such, crisis management can be viewed as both the proactive position of an organisation towards preventing the occurrence of disruptive events and also, the active process used within the mitigation of crises following the occurrence of an event.

2.6.2. Risk Management

Risk is an inherent component of an organisation’s operations and activities (Tchankova, 2002). This is complicated further as within highly connected organisations, critical risks can occur anywhere within the organisational network and at any level (Galloway and Funston, 2000). The effective management of risk, across the organisational network, thereby becomes a critical function within the performance of an organisation.
Risk management forms a continuous process that depends on fluctuations both within the internal and external operating environment of an organisation. These fluctuations can carry dramatic implications and subsequent risks for an organisation and as such require continuous attention, identification and control. Risk management thereby forms an iterative four stage process. Identify and classify a potential risk, analyse the risk, respond to the risk and then finally monitor the risk (Bandyopadhyay et al., 1999; Maytorena, 2001; Williams et al., 2006). In operational terms, risk management aims to provide decision makers with a systematic approach to coping with risk and uncertainty (Williams et al., 2006).

2.6.3. Business Continuity Management

The objective of business continuity management is to ensure the uninterrupted availability of key business resources during periods of organisational disruption (Tammineedi, 2010). The focus is within identifying and managing potential risks which threaten to impact and disrupt organisational processes and operations, effectively mitigating identified risks (Gibb and Buchanan, 2006). Additionally, the focus is to return the organisation to a previous state of stability without significant disruption to the organisation.

"Business survival depends on the assured continuity of core business activities and supporting services: business continuity (BC). Plans are therefore developed to provide this assurance." (Morwood, 1998)

As such, business continuity management seeks to establish an holistic view within establishing continuity within an organisation’s operations (Tammineedi, 2010) and preparing procedures to ensure the continued operation and survival of the organisation when faced with the impact of disruptive events (Low et al., 2003). As outlined by Low et al. (2003), business continuity management is composed of five critical components. These include:

1) Understanding the organisation - Using business impact and risk assessment to identity the critical deliverables, evaluate recovery priorities and assess risk factors
Determining an effective business continuity management strategy - Identifying alternative strategies in order to mitigate loss, and determining each strategy’s potential effectiveness

Developing and implementing a business continuity management response - Developing a response and supportive processes to address business continuity challenges

Maintaining and auditing business continuity management – Ensuring any and all plans are fit for purpose, kept up to date and meet required standards (quality assurance)

Establishing a business continuity culture within the organisation - The need to ensure that a continuity culture is embedded in the company by raising awareness throughout the key stakeholders, and offering training to key staffs on BCM issues

Business continuity management refers to the process of anticipating incidents that could affect or impact critical functions and processes within an organisation and ensuring that the organisation is able to respond effectively in a planned and controlled manner (Low et al, 2003). Business continuity management forms an important management process through which organisational success and performance during periods of turbulence is dependent on the collective and concerted efforts of every individual within an organisation. Business continuity management follows a well structured and comprehensive methodology in order to achieve a structured approach towards developing a suitable business continuity plan. This allows organisations to develop pragmatic and cost effective recovery plans, but enable organisations to operationalise plans towards achieving critical processes during disruptive events. As such, the focus of effective business continuity planning is within minimising the sustained impact of a crisis on an organisation’s operations.

Business continuity planning refers to the identification and protection of critical business activities, processes and resources in order to maintain an acceptable level of performance during periods of adversity (Low et al, 2003). Business continuity planning involves developing procedures for organisational elements and units that will ensure critical business processes continue once the organisation is impacted by
an event. This involves ensuring that an organisation is able to respond effectively to a disruptive event through establishing measures and procedures to ensure disaster preparedness (Botha and Von Solms, 2004). Business continuity also focuses on achieving a cost effect recovery of business activities following the impact of an event (Morwood, 1998). As identified by Lindström et al (2010), business continuity planning is useful as a supportive tool to address disruptive events and not only as a guide for predefined situations. Effective business continuity planning thereby supports an organisation’s ability to resume operations as soon as possible following an event (Low et al, 2003).

Business continuity refers to more than establishing certain contingency plans and avoiding and mitigating risk. The process refers to the ability of an organisation to facilitate a focused and coordinated response to deal with a situation (possibly disruptive) once the consequences are known (Low et al, 2003). The accepted standard for business continuity management is the British Standard 25999. This Standard establishes the governing processes, principles and terminology within business continuity management. The objective of this Standard is to provide a basis for understanding, developing and implementing business continuity operations within an organisation.

2.7. Overview of Resilience

As identified through various sources of evidence relating to organisational disruptions, the concept of ‘resilience’ is a central theme. The term resilience is used in a wide variety of fields, that include ecology (Walker et al, 2002) metallurgy (Callister, 2003), individual and organisational psychology (Barnett and Pratt 2000) (Powley, 2009), supply chain management (Sheffi, 2005), strategic management (Hamel and Valikangas, 2003) and safety engineering (Hollnagel, 2006). Although the context of the term may change, across all of these fields the concept of resilience is closely related with the capability and ability of an element to return to a stable state after a disruption. When the notion of resilience is applied to organisations, this definition does not drastically change. Resilience is therefore related to both the individual and organisational responses to turbulence and discontinuities. However, resilience is not
a synonym for business continuity or emergency management (Gibson and Tarrant, 2010). Instead resilience provides a much greater overarching concept towards systems, beyond organisations merely responding effectively to disruptive events.

The concept of resilience is deeply rooted within the context of ecology. The term was first introduced by C. S. Holling in 1973 within the seminal work titled “Resilience and Stability of Ecological Systems”. The work has formed the foundation for most studies within the concept of ecological resilience as well various other forms of resilience. Holling (1973) outlines how altering views of behaviour within ecological systems can create different approach to the management of resources. To this end, Holling (1973) presents the viewpoints of ‘resilience’ and ‘stability’. These have been further extended to form the terms ‘ecological resilience’ and engineering resilience’ (Gunderson, 2000; Walker et al, 2002). The resilience viewpoint emphasizes the domains of attraction and the need for persistence through defining resilience as a measure of systems persistence and the ability to absorb disturbances and still maintain the same relationships between system entities. While the stability viewpoint emphasizes maintaining the equilibrium within a predictable world and accumulating excess resources with minimum fluctuation of the system. The stability viewpoint is therefore defined as the ability of a system to return to an equilibrium state after a disturbance (Holling, 1973).

The insight into ecological systems and the conceptual development of ecosystem behaviour provided by Holling (1973) has proved the foundation for many authors including Walker (1992), Gunderson (2000), Carpenter et al (2001), Folke et al (2002), Walker et al (2002) and Cumming et al (2005). These works are largely based within ecological system but extend to socio-ecological systems and concepts of sustainability. A socio-ecological system is a system including both people and natural elements.

Within all fields (including the wider context of organisations) the concept of ‘resilience’ is directly related to the response of an element or system to a disturbance. Following Cummings et al (2005) approach, resilience can be defined as the ability of
the system to maintain its identity in the face of internal change and external shocks and disturbances (Cumming et al, 2005).

Environmental ecosystems will continually experience disturbances and perturbations (Petchey and Gaston, 2009). There is an ever-changing biodiversity through the introduction of new species, predation, extinction, changing environmental conditions and fluctuating resources within an ecosystem. This fluctuating biodiversity can have profound consequences on the performance of an ecosystem (Yachi and Loreau, 1999). Subsequently, a resilient ecosystem can be defined as a system that maintains a general structure, levels of processing, and delivery of services during disturbances. As defined by Holling (1973), resilience determines the persistence of relationships within an ecological system and is a measurement of the system’s ability to absorb disruptions of state variables, driving variables, and parameters, and continue to endure (Holling, 1973). This is further developed when considering population and ecological resilience which considers resilience as the rate of return to the pre-disrupted state (Petchey and Gaston, 2009).

2.7.1. Definition of Resilience

As shown by several authors, the concept of resilience is both multidisciplinary and multifaceted. The notion of resilience is firmly grounded within ecology and the working definitions used by many authors developed following Holling (1973) original research relating to ecosystem stability. There have been several definitions proposed for resilience, each slightly altered dependent on context. Table 2-2 identifies several of these and highlights the distinction between each definition. Although several slightly different definitions have been proposed, following Holling (1973) definition, resilience can be classified as either ecological resilience or as engineering resilience. Both of these definitions relate to the response of a system to perturbation, however differ distinctly is categorising the resilience of a system.

Table 2-2 - Definitions of Resilience

<table>
<thead>
<tr>
<th>Author</th>
<th>Context</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bodin and Wiman</td>
<td>Physical</td>
<td><em>The speed at which a system returns to equilibrium after displacement,</em></td>
</tr>
<tr>
<td>(2004)</td>
<td>Systems</td>
<td><em>irrespective of oscillations indicates the elasticity (resilience).</em></td>
</tr>
<tr>
<td>Author(s)</td>
<td>Domain</td>
<td>Definition</td>
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<tr>
<td>-------------------</td>
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</tr>
<tr>
<td>Holling (1973)</td>
<td>Ecological</td>
<td>The measure of the persistence of systems and of the ability to absorb change and disturbance and still maintain the same relationships between state variables.</td>
</tr>
<tr>
<td>Walker et al (2004)</td>
<td>Ecological</td>
<td>The capacity of a system to absorb a disturbance and reorganise while undergoing change while retaining the same function, structure, identity and feedback.</td>
</tr>
<tr>
<td>Gunderson (2000)</td>
<td>Ecological</td>
<td>The magnitude of disturbance that a system can absorb before its structure is redefined by changing the variables and processes that control behaviour.</td>
</tr>
<tr>
<td>Tilman and Downing (2004)</td>
<td>Ecological</td>
<td>The speed at which a system returns to a single equilibrium point following a disruption.</td>
</tr>
<tr>
<td>Walker et al (2002)</td>
<td>Socio – Ecological</td>
<td>The ability to maintain the functionality of a system when it is perturbed or the ability to maintain the elements required to renew or reorganise if a disturbance alters the structure of function of a system.</td>
</tr>
<tr>
<td>Carpenter et al (2001)</td>
<td>Socio – Ecological</td>
<td>The magnitude of disturbance that a system can tolerate before it transitions into a different state that is controlled by a different set of processes.</td>
</tr>
<tr>
<td>Bruneau et al (2003)</td>
<td>Disaster Management</td>
<td>The ability of social units to mitigate hazards, contain the effects of disasters when they occur and carry out recovery activities that minimise social disruption and mitigate the effects of future earthquakes.</td>
</tr>
<tr>
<td>Paton et al (2000)</td>
<td>Disaster Management</td>
<td>Resilience describes an active process of self-righting, learned resourcefulness and growth. The concept relates to the ability to function at a higher level psychologically given an individual’s capabilities and previous experience.</td>
</tr>
<tr>
<td>Coutu (2002)</td>
<td>Individual</td>
<td>Resilient individuals possess three common characteristics. These include, an acceptance of reality, a strong belief that life is meaningful and the ability to improvise.</td>
</tr>
<tr>
<td>Hamel and Valikangas (2003)</td>
<td>Organisational</td>
<td>Resilience refers to the capacity to continuous reconstruction.</td>
</tr>
<tr>
<td>Horne and Orr (1998)</td>
<td>Organisational</td>
<td>Resilience is the fundamental quality to respond productively to significant change that disrupts the expected pattern of event without introducing an extended period of regressive behaviour.</td>
</tr>
<tr>
<td>McDonald (2006)</td>
<td>Organisational</td>
<td>Resilience conveys the properties of being able to adapt to the requirements of the environment and being able to manage the environments variability.</td>
</tr>
</tbody>
</table>

Ecological resilience can be defined as the amount of disruption a system can absorb before the system alters its structure or changes stable states. While engineering resilience relates to the speed at which the system returns to a single equilibrium point following a disruption (Gunderson, 2000). The fundamental distinction between
these definitions is therefore the existence of single or multiple equilibrium points within a system. While engineering resilience defines a system as having a single equilibrium point or stability domain, the ecological perspective defines multiple stability domains that system can transition between. This is shown in Figure 2-4.

The figure represents the hypothetical trajectory for a system over time. The black circles represent a system’s position following the trajectory at any given moment in time. Within the engineering resilience perspective, a system will have a single stability domain forming a ‘basin of attraction’. The basin of attraction constitutes the initial conditions that a system will tend towards (Walker et al, 2004). As such, the ecological resilience perspective creates a diverse ‘stability landscape’ formed from multiple basins of attraction.

![Stability Domains within Resilience](Adapted from Gunderson (2000))

It is clear from the evidence of the literature review, complex systems tend to follow the ecological resilience perspective. The resilience of ecosystems and socio-ecological systems all follow this definition, and recognise the fluctuating trajectory of a system’s progression through turbulent periods. Authors addressing resilience within communities, enterprises and supply chains, also adapt the ecological perspective defined by Holling (1973). Through this, dynamic systems (such as organisations) do not tend towards a stable or single equilibrium state, instead the system will follow an ‘adaptive cycle’ (Holling, 2001). Instead of the system tending towards a stable basin of attraction, the system will evolve through four phases towards adapting to disturbances. This involves the rapid growth and exploitation of a system’s resources, conservation, followed by the creative destruction of the system boundaries and
finally the renewal and reorganisation of the system. Through this a dynamic system is able to self organise, adapt and learn from disruptions. Following this cycle it can be concluded that ecological resilience is composed of three primary elements (Carpenter et al, 2001). These include:

- The amount of change that a dynamic system can sustain while retaining the same controls, structure and function.
- The degree to which the system is capable of self organisation without influence from external factors.
- The degree to which a system develops the capacity to learn and adapt in response to disturbances.

Norris et al (2007) states that within community level resilience, resilience emerges from a set of adaptive capacities and is therefore the process of linking resources to a desired outcome. A similar perspective is used by Dalziell and McManus (2004), through defining resilience as the qualities that allow a system to cope, adapt and recover from disruptive events.

2.7.2. Ecological and Engineering Resilience

Change within ecological systems is not a continuous or gradual process. Instead it is episodic in nature, with gradual periods of accumulation of natural capital (such as nutrients), interspersed with rapid releases and the reorganisation of the accumulated capital (Holling, 1996; Bergen et al, 2001). The rapid release and reorganisation of the ecological systems accumulated capital may be the result of either internal or external natural processes or other disruptions such as human intervention (Gunderson, 2000). Unpredicted or rare events (such as hurricanes and other disasters) may also shape the structure of the system, causing it to alter to an unpredictable configuration. As such, ecological systems do not have a single equilibrium point or single steady state; instead the system may have multiple states of equilibrium to maintain structure and diversity (Holling, 1996; Carpenter et al, 2001)). Due to this, systems will have multiple emergent future outcomes and configurations that are unpredictable. The management of these systems thereby has to be flexible and adaptive.
Within ecological science two differing definitions of resilience has been developed. The difference between the two definitions rises through different aspects of stability being emphasized. This has consequences for managing the systems. The ecological perspective promotes the view that system elements can learn from and adapt to the inherent uncertainty and complexity of a system (Gunderson, 2000). While the engineering perspective may promote a more rigid ‘command and control’ response of system variables (Walker et al, 2002).

The two views of resilience can be characterised as either ‘engineering resilience’ or ‘ecological resilience’. This is illustrated within Figure 2-5. The engineering perspective places emphasis on efficiency, constancy and predictability. While the ecological perspective places focus on persistence, change and unpredictability (Gunderson, 2000; Walker et al, 2002; Cumming et al, 2005).

In relation to this, engineering resilience focuses on stability near a single equilibrium point. The resilience of the system is then defined as the speed at which the system returns to that single equilibrium point. While within ecological resilience the system will have multiple equilibrium points that the system may transfer between, this is reflected in Figure 2-6. When the system is subjected to a disturbance the system may transfer into a new domain of behaviour. The system will have been transferred from

**Figure 2-5 - Classification of Resilience**

(Adapted from Holling (1996))
one stability domain (equilibrium point) to another. Within this definition, ecological resilience is defined as the magnitude of disturbance that the system can absorb before the system alters its structure or changes stable states. Ecological resilience therefore relates to the width or limit of a stability domain (Gunderson, 2000). This change between stability domains is achieved through changing the variables and processes that control system behaviour (Holling, 1996). The rate at which the system returns to an equilibrium point within this definition is regarded as a measure of the systems ‘stability’ (Gunderson, 2000).

Within the differing views of stability, engineering resilience focuses on maintaining efficiency of function within a system. While the ecological resilience perspective draws attention towards maintaining the existence of function. Within the engineering perspective there is also an implicit assumption of global stability or a single stability domain. If the system were to begin to transition to a different operating stability domain, system safeguards or controls should be put in place to prevent the transition. Through the ecological perspective of resilience, the system may be allowed to operate at the edge of stability as there are no safeguards or controls in place. This may prove beneficial to the system as operating at the edge of stability may allow the system to generate new opportunities for the system to develop.
There are several authors that hold the engineering perspective as a working definition of resilience. Within ecology many of these definitions relate to the stability of ecological systems. Authors Tilman and Downing (1994) studied the relationship between biodiversity and ecosystem population and functioning. The research formed an 11 year study of grasslands in Minnesota which indicated that more diverse plant communities were more resistant and recovered more fully from the impact of drought. The study outlines resilience as an important factor of ecosystem stability and is defined as the speed of recovery (Tilman and Downing, 1994).

Pimm (1991) acknowledges Holling (1973) definition of resilience as “interesting” within his work relating to ecological stability and that resilience relies on a variety of factors. However, Pimm (1991) defines resilience in relation to populations as the rate at which population density returns to equilibrium after a disturbance has occurred away from an equilibrium point or stability domain. This follows the engineering perspective and provides a comparable measure of resilience and population dynamics for both communities and ecosystems. In addition to presenting several measures for the description of response to disturbance, Neubert and Caswell (1997) also provide an engineering measure for resilience within ecological systems. Here the measure of resilience is taken as the rate at which perturbations decay within a stable ecological system. Although several other variables are required to calculate the stability of a system and generate a complete understanding of a systems response to perturbations, including ‘reactivity’, the engineering perspective of resilience is a central theme within the research.

Within ecological systems, resilience is achieved through the variety of functional groups and the accumulated capital that provides the system with the necessary resources for recovery and renewal (Gunderson, 2000). As such there is an interesting relationship between system diversity and resilience. Walker (1992) proposed that within ecological systems, present species could be divided into two distinct groups. These are classified as species that are system ‘drivers’ or species that are more passive and classified as system ‘passengers’. The system drivers are the determinant species that determine the future of an ecosystem, while the more passive passenger species do not significantly alter the ecosystem (Gunderson, 2000). Removing the
passenger species has little effect on the ecosystem, while the removal of driver species can have a significant impact on the ecosystem. The removal of a driver species from an ecosystem will cause a cascade effect within the ecosystem (Walker, 1992).

However, as the conditions of the ecosystem change, possible through either internal or external change, the roles of species within the ecosystem may also change (Gunderson, 2000). Therefore the passenger species provide the potential for becoming future driver species and ensuring the continued function of the system. As a result, the ecological resilience of the system lies within the diversity of the system drivers and in the number of system passengers. This diversity within the system provides robustness to the ecosystems function and provides an element of resilience to the system behaviour (Gunderson, 2000). The relationship between driver and passenger species within an ecosystem, and the connection between diversity and resilience, highlights the concept of ‘redundancy’ (Walker, 1992) within a system. The concept of redundancy is subsequently linked to the concept of resilience and as a result appears within a wide range of related literature including socio-ecological system, community, individual psychology, supply chain and organisational theory.

The engineering perspective of resilience developed from traditions in engineering to design systems with a single operating objective (Gunderson, 2000). While the ecological perspective involves a much more dynamic definition, where the possibility of multiple equilibrium points is recognised. The central difference between the two definitions of resilience is therefore the assertion of the existence of multiple stable domains within a system (Walker et al, 2004). If the system or a system characteristic has a single equilibrium point, then the definition of resilience as a measure of return time can be held. However if multiple stability domains exist then the resilience of the system can be defined as the tolerance of the system to perturbations that facilitate the system transitioning between stable domains (Gunderson, 2000).

2.7.3. Socio-Ecological Resilience

The concept of resilience within ecological systems relates to the functioning of systems under disruptive conditions and is often described as a ‘buffer capacity’
(Adger, 2000). This buffer capacity relates to the ability of the system to adapt before the system changes its structure by altering the governing variables and processes that control behaviour. Through an interdisciplinary study within ecology and sociology, Adger (2000) notes that due to the difficulty in accurately establishing the relationships between variables, such as diversity and resilience, within socio-ecological systems, resilience is often a difficult phenomenon to observe. However, regardless of this difficulty a number of conceptual and empirical studies have been conducted within the field of socio-ecological resilience.

Carpenter et al (2001) presents a study comparing the resilience properties of two well studied contradicting socio-ecological systems. Through this the authors are able to explore the multi-level meaning of resilience and related concepts. The study of the agricultural lake district in North America and the rangelands of New South Wales in Australia highlight the factors pertaining to the ability of a system to remain within the same domain, the ability of a system to self organise and the adaptive nature of socio-ecological systems.

The study showed that the probability of a socio-ecological system retaining the same controls for structure and function (domain of attraction) is related to the slowly changing variables that determine the boundaries and magnitude of disturbances that can alter the system or reconfigure the domain of attraction (Carpenter et al, 2001). The study also showed that socio-ecological systems are capable of self organisation. The self organisation of a system is the process through which the system rearranges itself around a new underlying order and structure. The self organised system may resemble the prior system, however a fundamental change will have occurred (Murphy, 1996). The ability of a socio-ecological system to self organise is related to the extent to which self organisation is driven by internal factors rather than forced by external drivers. As such, the system should be allowed to self organise within the management regime and the process is enhanced by ‘coevolved’ system components and the presence of social networks. These factors influence and facilitate the development of innovative problem solving within the system (Carpenter et al, 2001).
Finally the study of the two socio-ecological systems draws attention to how a system functions when there are changes in the systems resilience. A system’s robustness to alterations and changes in resilience is termed a systems ‘adaptive capacity’ (Gunderson, 2000). The adaptive capacity of a system is partly determined by the diversity within a system and the networks that create flexibility and balance power. Through this the adaptive capacity of a system is related to the mechanisms that create novelty and learning within socio-ecological systems (Carpenter et al, 2001).

### 2.7.4. Social System (Community) Resilience

Fundamentally, the concept of resilience is closely related with the capability and ability of an element to return to a pre-disturbance state after a disruption. When the notion of resilience is applied to communities and the wider context of organisations, this broad definition does not change. Resilience is related to both the individual and organisational responses to turbulence and discontinuities. This involves both the ability to withstand systematic discontinuities as well as the capability to adapt to new risk environments (Starr et al, 2003).

Comfort (2001) presents a theoretical framework for self organisation in complex adaptive systems. A central concept within this framework is that of a disaster acting as a mechanism for change. Without change, the community, once restored, would be open to the reoccurrence of a similar disaster at a later point. As a result of this the concept of community resilience is composed of two elements, that of anticipation and of resilience (Comfort, 2001). A community based strategy for anticipation identifies the community’s vulnerabilities to risk and also the areas of strength and safety. The strategy for resilience identifies the community’s capacity to mobilise and respond to a disruption or threat. Through this a community is able to respond, adapt and learn from disruptive events.

Within community level resilience studies, the notion that crises, or disruptive events, can introduce opportunities for growth and development is also outlined by Norris et al (2008). This idea correlates to that of the ‘adaptive cycle’ developed by Holling (2001). An adaptive cycle involves the cyclic accumulation and rapid release of a systems capital to ensure an ecological system survival. Following this, Norris et al
(2008) identify that resilience should be conceptualised as an ability or process; rather than as an outcome following a disruptive event. Instead of a post hoc judgement on the successful adaption of a system to a disruption, resilience should be considered the ability to adjust and overcome a disturbance. Through this, it is the resilient capabilities of a community or system that seek to gain advantage through disruptive events.

Norris et al (2008) also begin to conceptualise the capabilities and resources that develop resilience within communities. Based on an extensive literature review the conceptual paper postulates that the resilience of a system is largely determined by a set of dynamic capabilities or resources that form a community’s adaptive capacity (Norris et al, 2008). Dynamic capabilities relate to a community’s or organisations competencies to integrate, develop and reconfigure resource positions in rapidly changing and turbulent environments (Pettus et al, 2009). The capacities become adaptive capacities when they have one of three dynamic properties to create resilience (Norris et al, 2008). These dynamic properties include robustness, redundancy and rapidity (How quickly a resource can be mobilised).

As such, a rational strategy is required to develop the dynamic capacities of resiliency within communities. This involves understanding the interplay and relationship between systems and the environment and how various investments and policy choices can affect the stability of a community (Allenby and Fink, 2005). A common aspect within the conceptualisation of a community’s response strategy is the view that communities are able to draw upon these resources and competencies to effectively manage and mitigate the demands, challenges and changes caused by disruptive events and turbulent environmental conditions (Paton and Johnson, 2001). This echoes the perspective presented by Norris et al (2008) that disasters can act as a source of growth and development.

The social or psychological perspective of resilience can also offer several insights into the management and cultivation of resilience as well as other related subjects. Powley (2009) presents an in depth analysis of the social mechanisms of resilience following the events of a tragic school shooting in the United States. The journal article presents
resilience as a critical resource for both individuals and large social systems facing serve disturbances. Powley (2009) follows a qualitative approach to understand the behaviour of individuals and captures this through developing narrative accounts of affected individual across various organisational levels. This proves the basis to analyse the social connections during the initial response and recovery phases following the tragic events. Powley (2009) aids in the conceptual development of a systems response to disruption or crisis through developing evidence focused on the activation of resilience. The activation of resilience forms a critical period (Powley, 2009) as it is through this that system is able to utilise any accumulated capital (Holling, 2001). The study follows Holling (1973) perspective that communities and organisations as large social systems are resilient systems, and thereby possess the latent capacity to adapt and learn from crisis through social interactions and relationships.

2.7.5. Organisational Resilience

As shown by a variety of authors (Dooley, 1997; Comfort et al, 2001; Dalziell and McManus, 2004; Vogus and Sutcliffe, 2007; Pettus et al, 2009) within an ever changing environment capable of significant turbulence, a system is required to change and adapt in response to environmental fluctuations in order to sustain function and retain advantage. Without this change in the face of adversity, systems will follow a primarily recovery based approach which may introduce maladaptive cycles of development. Instead a resilience approach in the face of perturbation is suggested to enable an organisation to adapt to new risk environments and circumstances. The different organisational responses to disruption are shown in a graphical form by Dalziell and Mcmanus (2004), shown in Figure 2-7.

The figure developed by Dalziell and Mcmanus (2004) highlights that, through a resilience focus, organisations are able to advance through seeking new opportunities within an altered environment. With a recovery focus, organisations will focus on returning to a pre-disruption state or configuration, through which the opportunity for development and advancement is limited. The same disruption may also reoccur within a purely recovery based focus as there is no change to the adaptive capacity of
the organisation and there may be an increased vulnerability as a result of the initial
disruption (Dalziell and Mcmanus, 2004). As a result it is necessary to promote a
resilience focus within the development and strategic management (Hamel and
Valikangas, 2003) of organisational systems. Through this organisations should
recover to new equilibrium points and achieve a balance with the external
environment (Dalziell and McManus, 2004).

![Figure 2-7 - Organisational Responses to Disruption](image)

The following sections present pertinent literature in relation to resilience within the
Human Resource, Organisational Processes and Resources, Organisational Strategy,
Organisational Capabilities and Organisational Systems.

**2.7.5.1. Resilience within the Human Resource**

Resilience is a multidisciplinary and multidimensional concept (Ponomarov and
Holcomb, 2009). Resilience is more than an abstract concept for the adaption of an
organisation to an environment. It relates to the positive adaptive capabilities that
enable an organisation to respond to change effectively while enduring minimal stress
(Mallak, 1998). Resilience therefore provides an insight into how particular
organisations are able to continually achieve positive results through turbulent
periods causing otherwise significant barriers to adaption and development (Sutcliffe
and Vogus, 2003).

“Resilience is a fundamental quality of individuals, groups, organizations, and systems as
a whole to respond productively to significant change that disrupts the expected pattern
of events without engaging in an extended period of regressive behaviour.” (Horne and Orr, 1998)

Mallak (1998) states that a resilient organisation is able to design and implement effective actions to advance organisational development and ensure survival. The author proposes that resilience within organisational systems builds on the resilience of its members. This is extended by Horne and Orr (1998) who suggest that at the individual level, individual resilience does not guarantee resilience at the organisational level. However the positive correlation between individual behaviour and organisational resilience is recognised.

Mallak’s (1998) review of resilience concepts identifies the underlying principles in implementing resilience in organisations. Through these an organisation can begin to improve its resilience following the Carpenter et al (2001) definition of resilience as the amount of change an organisation can undergo and still remain within the same domain of attraction, the degree to which the organisation is capable of self organisation and the extent to which the organisation can build the capacity to learn and adapt to uncertainties and disturbances.

Horne and Orr (1998) also focus on the resilience of individuals within organisations and propose, much like Powley (2009), that organisational level resilience is a naturally occurring aspect of living organisational systems. Horne and Orr (1998) identify seven streams of behaviour that contribute to the development of resilience within organisations. These streams of behaviour and interconnected and significantly overlap highlighting the complexity within resilient behaviour. The seven streams (or 7C’s) of resilient behaviour are Community, Competence, Connections, Commitment, Communications, Coordination and Consideration (Horne and Orr, 1998).

As shown by Mallak (1998) and by Horne and Orr (1998), resilience can prove a critical element in human resource development. The resilience of employees is related to their performance under turbulent conditions and highlights that organisations that are able to develop the resilience of their employees are more adaptive to environmental changes (Luthans et al, 2006). As such, in addition to ‘optimism’, ‘efficacy’ and ‘hope’, the psychological capital of ‘resilience’ is a component of positive
organisational behaviour (Youssef and Luthans, 2007). Positive organisational behaviour relates to the development of human resource strengths and psychological capacities (Luthans et al, 2006). It is therefore important to invest in the human and social capital of employees and develop the elements of psychological capital.

Using the evidence from both Mallak (1998) and the seven streams of resilient behaviour identified by Horne and Orr (1998), Riolli and Savicki (2003) review a model for the integration of both individual and organisational levels leading to organisational resilience. The model supports the assertion of Mallak (1998) that organisational resilience depends on resilient individuals. However, it is also noted that resilient individuals alone do not guarantee organisational resilience (Horne and Orr, 1998). The analysis of the model highlights that individual and organisational level responses to resilience therefore reciprocally influence each other (Riolli and Savicki, 2003). As such, elements such as organisational structure and processes can all influence the capability of an organisation to respond productively to change (Riolli and Savicki, 2003).

2.7.5.2. Resilience within Organisational Processes and Resources

Utilising a developmental perspective to recognise the fallibility and probability of successful coping within turbulent conditions, Sutcliffe and Vogus (2003) present a literature review and conceptual model for organisational responses relating to organisational level resilience. Within this it is identified that the dynamics that create and retain organisational resources and competencies in a flexible, storable, convertible and malleable form give rise to resilience. This ability within the cognitive, emotional, relational and structural resources allows organisations and organisational elements (units, teams and individuals) to avoid maladaptive tendencies and positively cope with unexpected complexity and disorder (Sutcliffe and Vogus, 2003).

Through this, within the individual level, resilience is developed from two fundamental properties within organisations (Sutcliffe and Vogus, 2003). Firstly, resilience is more likely when individuals have access to a sufficient amount of resources so that they are able to develop appropriate competencies. Secondly, resilience is more likely when individuals have experiences that allow them to encounter success and develop self
efficacy. The importance to motivate and mobilise individuals also cannot be underestimated. This further supports the assertion of Riolli and Savicki (2003) that individual and organisational level responses to resilience reciprocally influence each other.

Sutcliffe and Vogus (2003) state that organisational level resilience is based on the organisational processes and resources focused on developing the competence and growth of an organisation. Organisational level resilience is thereby based on the capability to restore efficacy and the ability to effectively process environmental feedback and flexibly rearrange and transfer knowledge and resources to overcome a disruptive event (Sutcliffe and Vogus, 2003). This is reflected in the model of resilient and rigid responses to threats presented by the Sutcliffe and Vogus (2003), shown in Figure 2-8.

The model outlines that efficacy facilitates resilience through:

- *Reducing the defensive perception of an organisation* – This reinforces the capability for broad information processing and allows the organisation to address a disruptive event as a possible opportunity for development and growth.

- *Loosening organisational control* – Decision making and problem solving shifts to individuals who have the greatest expertise with a particular problem. As such, control is deferred to areas of local authority (Sheffi, 2007).

The model of organisational responses was developed following the work of organisational behaviour amidst radical environmental change (Staw et al, 1981; Barnett and Pratt, 2000). The work is largely conceptual and has received little empirical support. The deterministic perspective of Staw et al (1981) presents a model of organisational response based on threat rigidities, it is suggested that impending threats or crises invariably lead to maladaptive organisational cycles and rigid organisational responses.
Barnett and Pratt (2000) identify that through emphasizing rigidity as the primary response of an organisation to a threat, organisational opportunities for development and survival are missed or restricted. Instead a flexible response is proposed (Barnett and Pratt, 2000) leading to a resilient perspective on organisation sustainability and strategy through viewing organisations as efficacious entities able to absorb complexity and preserve functioning despite significant discontinuities and able to recover from unexpected events (Sutcliffe and Vogus, 2003).

2.7.5.3. Resilience within Organisational Strategy

Hamel and Valikanagas (2003) begin to develop the notion of resilience as a potential strategy for organisations. The authors note that organisational success is becoming increasing fragile and organisations are no longer purely able to rely on ‘momentum’ to sustain their performance. A similar observation is made by Devanna and Tichy (1990) about competitive organisations during the 1980’s. Significant competitive advantage was gained through an organisation’s speed of adaption not the size or ‘muscle’ of the organisation. The critical variables in a successful organisational design

(Adapted from Sutcliffe and Vogus (2003))

Figure 2-8 - Organisational Response to Threats

Barnett and Pratt (2000) identify that through emphasizing rigidity as the primary response of an organisation to a threat, organisational opportunities for development and survival are missed or restricted. Instead a flexible response is proposed (Barnett and Pratt, 2000) leading to a resilient perspective on organisation sustainability and strategy through viewing organisations as efficacious entities able to absorb complexity and preserve functioning despite significant discontinuities and able to recover from unexpected events (Sutcliffe and Vogus, 2003).

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are therefore control and guidance during periods of turbulence and uncertainty (Devanna and Tichy, 1990).

Instead of relying on ‘momentum’ (Hamel and Valikanagas, 2003) or ‘muscle’ (Devanna and Tichy, 1990), strategic resilience is required to enable an organisation to change and adapt before the need to change is paramount to survival. Certainly organisations operating within different environments will require different strategic initiatives and policies to enhance organisational performance (Hoque, 2004). But through incorporating the concept of resilience into strategic decisions and policy development, organisations can begin to overcome the cognitive, strategic, political and ideological challenges (Hamel and Valikanagas, 2003) of becoming resilient, and realise the potential competitive advantage there within.

As shown by Voss (2005), in order to increase competitiveness it is vital to align organisational capabilities with key success factors. As such, optimising these capabilities is essential in the development towards a positive adjustment (Sutcliffe and Vogus, 2003) from a disruption or threat. Within manufacturing strategy, Voss (2005) identifies three distinct yet related paradigms of strategy. These include competition, strategic choices and best practice (Voss, 2005).

Following the evidence presented by Hamel and Valikangas (2003) and several other authors, the concept of resilience and strategic resilience possibly reside within a combination of these three paradigms. The continuous improvement and development of organisational processes will inevitably lead to developing an organisation’s capability for enhancement (Voss, 2005). Through cultivating resilience, organisations are able to develop robust strategies (Tang, 2006) to withstand systemic discontinuities and adapt to new risk environments (Starr et al, 2003). Voss (2005) suggests that organisations should compete through their capabilities and thereby align their capabilities with success. Through developing dynamic capabilities, as suggested by Norris et al (2008), and following the principles for implementing resilience (Mallak, 1998), an organisation may be able to identify and utilise inherent strengths within organisational systems and elements. The organisation may then also be able to increase the amount of possible responses to
disruptions. As noted by Hamel and Valikangas (2003), the larger the variety of responses available, the larger the variety of perturbations the organisation is able to overcome. The strategic choices strategy paradigm (Voss, 2005) relates to developing both internal and external consistency.

Through this the organisation should adjust to changes in its operating environment and become efficient at organisational renewal (Hamel and Valikangas, 2003). As such, organisations should continuously monitor the environment so that organisational renewal becomes opportunity driven rather than crisis or event driven. The strategy of best practice (Voss, 2005) correlates to an additional fundamental property of resilience. As shown by several authors, resilience relates to learning from previous experiences (Barnett and Pratt, 2000; Carrol et al, 2003; Crichton et al, 2009). This allows organisations to develop procedures and learn from past experience to overcome reoccurring threats, and develop competencies and capabilities to overcome new novel threats. As such the strategy of best practice (Voss, 2005) develops this characteristic of resilience.

An organisation is said to have a ‘competitive’ advantage when the organisation sustains returns that exceed the average for its operating industry (Yolles, 2009). The area of competitive advantage is a paradigm of strategic management. There has been significant amount of work done within the area, including investigating the relationship between competitive advantage and organisational culture (Barney, 1986; Sadri and Lees, 2003), lean production (Lewis, 2000) and organisational configuration (Miller and Whitney, 1999). As such competitive advantage is related to the core competencies of an organisation (Yolles, 2009). Hamel and Valikangas (2003) propose that during periods of chaos and turbulence, resilience will prove a significant competitive advantage for organisations. This is reflected by Sheffi’s three year research project with the Massachusetts Institute of Technology’s Supply Chain Exchange programme relating to resilience within organisations and supply chains. Sheffi (2007) through several case studies outlines that resilience within competitive markets offers organisations the potential for ‘positive’ long-term effects (Such as improved market share and financial gains).
If McDonalds (2006) perspective of resilience being related to an organisation’s capability of adapting to the requirements of an environment and being able to successfully manage environmental turbulence and variability is held, then the possible relationship between resilience and competitive advantage is also reflected in Yolles (2009) study on the conceptual development of strategic management and competitive advantage. Yolles (2009) states that an organisation’s competitive advantage can be made sustainable through making the organisation more responsive to rapidly changing market conditions. This is achieved through maintaining existing resources and capabilities as well as developing new ones. As such, the fundamental properties of resilience are interlinked with the notion of competitive advantage. An organisation’s ability to respond effectively and restore efficacy depends on the structure, management and operational systems of the organisation and the resilience of these elements (Dalziell and McManus, 2004). Through cultivating the elements of resilience an organisation may therefore gain a competitive advantage through being able to adapt and sustain function during periods of environmental turbulence.

2.7.5.4. Resilience within Organisational Capabilities

Sheffi (2005) identifies that organisations develop resilience in three ways. These relate to the definition of supply chain resilience given by Falasca et al (2008). Within this definition resilience is related to the ability of a system to reduce the probabilities of a disruption, reduce the subsequent consequences once a disruption occurs and reduce the time it take the system to recover to a normal performance level. Although strictly this definition relates to supply chains, as stated by Sheffi (2005), supply chain resilience does not merely rely on the ability to manage risk; it relies on the organisational capabilities to gain opportunities through disruptions. As such, through developing organisational level resilience a more robust and resilient supply chain could also be developed. Steffi’s (2005) identified methods for developing resilience include 1) increasing redundancy; 2) building flexibility; and 3) changing corporate cultures.
In addition to this, Seville et al (2006) identify that resilience cannot be achieved by any one organisation acting in isolation. Instead, the development of organisational resilience relies on establishing a network between the organisation, suppliers and customers. Through this organisational resilience becomes a function of the overall vulnerability, environmental awareness and adaptive capacity of an organisation within a complex dynamic system (Seville et al, 2006).

Seville et al (2006) presents evidence from the Resilient Organisations research programmes case study of eleven organisations. The Resilient Organisations research programme aided within providing a platform for hazard planning across industry boundaries, addressing the prioritisation and deployment of physical and human resources during recovery, and investigation of post event reconstruction. The study concluded that a resilient organisation is able to achieve core objectives during turbulent conditions. As such, resilience relies upon organisational processes, structures and practices that promote competencies, restore efficacy and promote growth and development. Through this, resilience provides organisations with the dynamic capabilities to mediate and overcome major disruptions (Vogus and Sutcliffe, 2007).

Subsequently, the concept of resilience has a strong relationship with the notion of stability (Smith and Fischbacher, 2009). The relationship was also identified within Holling (1973) original work within ecological systems. Ponomarov and Holcomb (2009) make the distinction between resilience and stability through stating that resilience determines the ability of a system to absorb changes, while a system’s stability is the capacity of the system to return to an equilibrium state after a temporary disturbance. Through this organisational resilience is defined in terms of the adjustment of capacities and abilities relative to a disturbance. Ponomarov and Holcomb (2009) highlight adaptability, flexibility, maintenance, organisational learning and recovery as important aspects of organisational level resilience.

Organisational resilience depends on the capability of an organisation to restore efficacy after a disruption. Deterministic approaches to organisational disruptions suggest that organisations are only able to do so and respond through positive
adjustment if a threat is relatively small and not especially novel (LIHP events) (Sutcliffe and Vogus, 2003). This suggests that larger disruptions or HILP events can only be mitigated through a rigid organisational response (Staw et al., 1981). This perspective suggests that organisational strategies should be developed to minimise the size of threats and subsequently render threats more controllable. However this response limits organisational opportunities for development and survival (Barnett and Pratt, 2000), due to cognitive narrowing and constriction of control (Vogus and Sutcliffe, 2007). The limitations of the rigid response are further compounded by organisations inability to establish accurate long-term plans due to significant uncertainties as shown by chaos theorists (Thietart and Forgues, 1995; Levy 1994; Cartwright 1991). However, in the presence of certain enabling conditions the probability of positive adjustment is increased (Vogus and Sutcliffe, 2007). If the assumption that organisations operate as chaotic systems is held (Marion, 1999), then the chaotic systems are bounded, meaning that outcome variables only fluctuate within certain bounds that are determined by the structures and parameters of the system (Levy, 1994). As such developing positive organisational bounds, may enable the development of organisational systems capable of resilient responses.

2.7.5.5. Resilience within Organisational Systems

Fundamentally, the underlying objective of an organisation is to learn, expand and ensure sustainability of business practices. Instead of viewing an organisation as a mechanical machine designed to deliver profits, a more compelling perspective it to view organisations as living organisms (Fiksel, 2003). Subsequently, individuals should learn to ‘live’ or ‘operate’ within systems instead of striving to control the system (Walker et al., 2002). Developing the psychological capital of individuals is therefore vital to ensure continued performance during a disruption (Luthans et al., 2006). This is further reinforced through the socio-technical perspective of organisations (Coiera, 2007).

The concept of resilience enables organisational survival and sustainability to be viewed as an inherent system property rather than an abstract goal (Fiksel, 2003, 2006). As shown by Stafford Beer’s Viable System Model (Beer, 1984), the
management of any viable system poses the issues of managing complexity itself, as it is complexity that threatens to overwhelm a systems regulators. Organisational resilience may offer a means to develop organisational systems capable of overcoming complexity and turbulent environmental conditions through positive adjustment. As a result if ‘resilience’ is to be thought of as a system property, then it must be considered as an important aspect within the relationship between a particular socio-technical system and the operating environment of that system. Instead of a ‘post-hoc’ judgement of success after an event, the positive adjustment of an organisation to perturbation should be viewed as a resilient response. It is through this that resilience may become a key factor in a firm achieving a sustainable competitive advantage.

Through being able to effectively mitigate perturbations and disruptions to organisational systems, utilising an embedded intelligence and capability within organisational resources and systems, an organisation may ensure sustainability and continued operation through discontinuities and changing environmental conditions. A competitive advantage rises through an organisation’s rare and valuable resources (Hulland, 2004). Subsequently, a competitive advantage can be made sustainable through making an organisation responsive to rapidly changing conditions (Yolles, 2009). Through maintaining the development of existing resources and capabilities and through creating new resources, an organisation’s attributes may enable a sustained superior performance over that of competitors.

2.8. Components of Resilience

Resilience is both a function of the vulnerability of a system and its adaptive capacity (Dalziell and McManus, 2004). Fiksel (2003) identifies four major system characteristics that contribute to resilience. These include:

- **Diversity** – The existence of multiple forms and behaviours
- **Efficiency** – Performance with modest resource consumption
- **Adaptability** – Flexibility to change in response to new pressures
- **Cohesion** – Existence of unifying relationships and linkages between system variables and elements
To illustrate this, Fiksel (2003) presents simplified graphical representations of thermodynamic systems to characterise the different types of resilience. Each system has a stable state representing the lowest potential energy at which the systems maintain order and function. When the system is subjected to a threat or perturbation, this state will shift along the trajectory of the adjacent states (Fiksel, 2003). The examples of system behaviour are shown in Figure 2-9.

System 1 highlights an engineered system through which the system operates within a narrow band of possible states. Although the system is designed to be resistant to small disturbances from its equilibrium state, the system is unable to cope with larger scale or high impact events. As such the system may be regarded as resistant, but not as resilient. System 2 offers a greater resiliency to disturbances, as the system is able to retain fundamental function across a broad range of possible states and then gradually return to equilibrium. As a result system 2, typical of social and ecological systems, can be characterised as a resilient system. Although system 2 does classify as a resilient system, the characteristics of system 3 offer much greater resilience in the face of significant disturbance. Through the system having multiple equilibrium states, under certain condition the system is able to shift to a different state. This means that the system is able to tolerate larger perturbations. However, the shift to a different equilibrium point represents a fundamental change in the systems structure and function (Fiksel, 2003, 2006).
Resilience expands the concept of vulnerability and can be viewed as the system characteristics that enable an individual, community or organisation to cope with, adapt to and recover from a threat. To illustrate this Dalziell and McManus (2004) identify the relationship between vulnerability and adaptive capacity as a function of a system potential energy and time. This is shown in Figure 2-10. The graphical representation highlights that lower vulnerability and a high level of adaptive capacity indicate a higher system resilience to disturbances and perturbations.

2.8.1. Principles of Resilience

Gibson and Tarrant (2010) identify six governing principles for resilience. These principles were developed to support the investigation of resilience following a synthesis of various literature streams across different disciplines. The principles are outlined within Table 2-3.

Table 2-3 - Principles of Resilience

<table>
<thead>
<tr>
<th>Resilience Principle</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resilience is an outcome</td>
<td>Resilience is not a process, management system, strategy or predictive measurement. Instead, resilience is a trait that can be observed within the response of a system or element to a significant change event.</td>
</tr>
<tr>
<td>Resilience is not a static trait</td>
<td>Resilience is dynamic. Subsequently, it will change (increase or decrease) in response to volatility in the external environment and as system capabilities change and develop over time. As such, it is</td>
</tr>
</tbody>
</table>
Resilience is not a single trait

Resilience results from the complex interplay and exchange between multiple factors. As circumstances change, possible through the influence of an event, the presence, importance and contribution of each influencing factor will change.

Resilience is multidimensional

There is no single model that describes resilience. It is important to recognise limitations of existing models.

Resilience exists over a range of conditions

Resilience can be observed through a spectrum ranging from vulnerable system to highly resilient systems.

Resilience is founded on effective risk management

A systems approach to developing resilience should be based on an effective understanding, assessment, management, communication and monitoring of risk.

2.8.2. Vulnerability

The term ‘vulnerability’ carries with it several connotations, often connected to the susceptibility of a system to harm (Adger, 2006). This view is reflected by McCarthy (2001) within the context of climate change. Here vulnerability is defined as the degree to which a system is susceptible to the effects of climate change. Within a broader context, the concept of vulnerability is most often defined as being composed of several different elements. These include exposure to perturbations, external stresses, sensitivity to perturbation (the degree to which the system is affected or altered due to perturbation) and the system’s capacity of response (Gallopin, 2006). Subsequently the concept of vulnerability is inherently complex, impinging of several variables and can therefore be thought of as a dynamic entity (Dalziell and McManus, 2004).

Gallopin (2006) identify the conceptual linkages between vulnerability, resilience and adaptive capacity. This is shown in Figure 2-11. Within this diagrammatic representation resilience is considered a subset or component of a system capacity of response. A systems capacity of response relates to the ability of the system to adjust to a disturbance, moderate the effects, take advantage of any available opportunities and cope with the consequences of any system transformations (Gallopin, 2006).
Within Gallopins (2006) model of the components of vulnerability it is clear that vulnerability is the overreaching concept, and that resilience and adaptive capacity are considered a conceptual subset. Through this, Gallopin (2006) refers to the vulnerability as the capacity to preserve the structure of a system, while resilience refers to the capacity to recover from disturbances. The same relationship between vulnerability and resilience is reflected by Turner et al (2003) within the development of vulnerability analysis models within the concept of sustainability. Here, vulnerability is defined as the degree to which a system is likely to experience harm due to exposure to a threat or perturbation. As such, resilience is identified as a subset element of vulnerability.

2.8.3. Adaptive Capacity

As shown by the examples of socio-ecological systems within Carpenter et al (2001) study into resilience, the adaptive capacity of a system is related to the mechanisms for the creation of novelty and learning. Adaptive capacity is described by Gunderson (2000) in regards to ecological resilience as a system’s robustness to alterations and changes in resilience. Within Gallopins (2006) model of the components of vulnerability, a system adaptive capacity is linked to a system capacity of response.
and is defined as the ability of a system to evolve in order to accommodate environmental threats or changes and the ability to expand the range of variability.

“Adaptive capacity reflects the ability of the system to respond to changes in its external environment, and to recover from damage to internal structures within the system that affect the ability to achieve its purpose.” (Dalziell and McManus, 2004)

Predominately, literature has referred to or emphasised resilience as a means to recover from disturbances, however, the concept of adaptive capacity may also lead to establishing new system equilibriums or stability domains, allowing a system to adapt to new environments (Fiksel, 2006). Through this resilience is established from a system adaptive capacities, through this resilience can be regarded as the process of linking of resources to outcomes (Norris et al, 2007). As such the adaptive capacity of a system can be regarded as the mechanism for resilience.

Carpenter et al (2001) identify that the adaptive capacity of a system also reflects the learning aspect of system behaviour in response to a disruption. Within organisations, adaptive capacity refers to the ability to cope with unknown future circumstances (Staber and Sydow, 2002). As such, this view reflects the definition set by Carpenter et al (2001). As a result organisations that focus on adaptive capacity will not experience environments passively, instead the organisation will continuously develop and apply new knowledge in relation to the operating environment. Rather than identifying the existing demands and then exploiting the available resources, adaptive organisations will reconfigure quickly in changing environments (Staber and Sydow, 2002). Through this, the adaptive capacity of an organisation aids in better preparedness for turbulent environments.

2.8.4. Adaptive Cycle

Dynamic system trajectories do not tend towards stable points or an equilibrium condition (Carpenter et al, 2001). Instead the system will pass through four phases termed an ‘adaptive cycle’ (Gunderson, 2000). The adaptive cycle was developed by Holling (2001) following a comparative study of ecosystem dynamics. The four phase adaptive cycle identifies how patterns and processes change and interact within ecosystems. As stated by Walker et al (2002), managed systems tend to repeat
specific behavioural characteristics or phases. Through identifying the specific phases of these behavioural responses it is possible to identify different management and policy processes within each phase (Walker et al, 2002). Through this it is possible to understand the system properties that affect response during crisis. Holling (2001) states that there are three properties that influence the adaptive cycle and subsequent future states of a system, these include:

- The ‘wealth’ of a system, or the systems capability for change.
- The ‘controllability’ of the system. Such as the connectedness between a system’s controlling variables and processes.
- The ‘adaptive capacity’ of the system, or the resilience of the system.

The adaptive cycle is composed of four phases (Walker et al, 2004), these include:

- Growth and Exploitation Phase ($r$)
- Conservation Phase ($K$)
- Release Phase ($\Omega$)
- Reorganisation Phase ($\alpha$)

A system following the adaptive cycle will alternate between long periods of slow accumulation and transformation of resources (phases $r$ to $K$), with shorter periods that generate opportunities for the systems innovation and development (phases $\Omega$ and $\alpha$) (Holling, 2001). As such, the adaptive cycle can be characterised through two transitional loops, termed the ‘forward loop’ and the ‘back loop’ (Walker et al, 2004). The forward loop (phases $r$ to $K$) exhibits a slow, incremental phase of growth and accumulation, while the back loop (phases $\Omega$ and $\alpha$) exhibits a rapid phase of reorganisation leading to renewal. During the progression of the system through the growth and exploitation phase towards the conservation phase, the connectedness and stability of the system increases as ‘capital’ is accumulated (Holling, 2001). Within the ecological context this capital may relate to the accumulation of nutrients and biomass, while within economic or social systems the accumulated capital may relate to the development of skills, relationships and mutual trust (Holling, 2001). As the conservation phase ($K$) continues, the existing resources and accumulated capital become increasingly bound interlinked within the system. As such the system
becomes progressively less flexible and responsive to external disruptions (Walker et al, 2004). The rigidity is caused as the system becomes overly connected (Holling, 2001), this is typically characterised through a decline in resilience (Walker et al, 2002).

At this stage of the systems progression through the adaptive cycle the system is in a vulnerable position between the forward loop and back loop. When a disruption is introduced, the system will experience a chaotic collapse and breakdown (Walker et al, 2004), this is termed ‘creative destruction’ (Gunderson et al, 2000).

The back loop is a rapid phase of reorganisation within the systems trajectory, leading to the systems renewal. The disruption or disturbance to the systems causes the release of the accumulated system capital (Gunderson, 2000). The release phase (Ω) then quickly gives way to the reorganisation phase (α). During this period the system may remain within the same domain or configuration or may change, however regardless of this the system has gained resilience (Walker et al, 2002). If the system retains some of the accumulated capital, it may be possible to reorganise to same system configuration. The system may also introduce innovation through reconfiguring the accumulated capital into novel combinations to realise new opportunities (Holling, 2001). Similar behaviour can be found in organisational systems, were organisational rigidities are accumulated and increase to a point of

![Adaptive Cycle](Presented within Walker et al (2004))

Figure 2-12 - Adaptive Cycle
crisis. At which point the organisation will attempt to restructure the organisational systems (Holling, 2001).

An interesting correlation can be drawn between the adaptive capacity of ecological systems shown by Holling (2001) and the stages of disaster response (Harrald, 2006). Harrald (2006) reviews some of the challenges presented by extreme events and outlines the critical success factors for response and recovery. The research was developed following a study of the responses to extreme events and drills by the United States of America and other international response and relief agencies. The research identifies how organisational size and complexity increases after a crisis event. Much like the accumulation of resources within the adaptive cycle, the system or organisation increases in connectedness and size as capital is accumulated. This continues until the resources are released through the transition or back loop phase. As such the organisation will follow through four phases of disaster response (Harrald, 2006), these include:

- Reaction and Mobilisation Phase
- Organisational Integration Phase
- Production Phase
- Transition and Demobilisation Phase

During the initial phase of ‘reaction and mobilisation’, existing resources react to the event while external resources are mobilised. The available capital thereby increases as external resources are mobilised. The organisational integration phase follows a similar path to that of the conservation phase (K), the existing resources and accumulated capital become bound within the system (Holling, 2001). The organisational integration phase structures the accumulated resources into a functioning organisation with the capability and capacity to provide services beyond that of the initial response (Harrald, 2006). It is during the production phase of the organisation’s response that the accumulated resources are released. Within the context of a response organisation to an extreme event the organisation is able to deliver the necessary services to the affected area. The organisation then moves into the phase of transition and demobilisation, where external resources are demobilised.
and emphasis is placed on recovery. The reorganisation phase \((\alpha)\) of the adaptability cycle can be either a rapid or slow, allows for innovation and new system opportunities (Walker et al., 2004). Much in the same way, the final disaster recovery phase allows for organisational learning.

2.9. Conclusions and Implications

Following the evidence of the literature review several theoretical propositions relating to organisational resilience can be raised. These epistemological propositions represent the underlying mechanics and dynamics of resilience identified within the literature base.

**Proposition 1** – Resilience is a multidisciplinary and multifaceted concept. Organisational resilience follows the ecological perspective outlined by Holling (1973).

1a. The concept of organisational resilience has developed following resilience studies based in ecological systems, socio-ecological systems, communities, supply chains and individuals.
1b. Resilience is a dynamic property of systems and is linked to a systems capacity of response (Gallopin, 2006).
1c. The resilience of a system is determined by a set of dynamic capabilities and resources that form a systems adaptive capacity (Norris et al., 2008).
1d. The trajectory of an organisation follows the adaptive cycle leading to adaption and learning from disruptive events (Holling, 2001).
1e. Organisational level resilience is an emergent property that resides in the individuals, systems, structures, infrastructure, procedures and parameters of the organisation.

**Proposition 2** – An organisation is capable of a variety of responses to disruptions and discontinuities.

2a. The occurrence of a major disruption that threatens an organisation’s profit making capability can dramatically increase complexity and environmental uncertainty (Comfort et al., 2001).
2b. Organisational resilience offers the potential for positive adjustment (Vogus and Sutcliffe, 2007).
2c. An organisational system is capable of self organisation (Thietart and Forgues, 1995).
2d. Organisations have a diverse stability landscape composed of multiple stability domains (Walker et al., 2004).
**Proposition 3** – It is possible to create bounds for organisational systems. Outcome variables only fluctuate within certain bounds that are determined by the structure and parameters of a system (Levy, 1994).

3a. Resilience results from processes and dynamics that create and retain resources (Vogus and Sutcliffe, 2007).

3b. Positive organisational bounds enable the activation of a resilient response to a disruption. The organisational system can be in a number of different states or forms and still meet a set of criteria (Gunderson, 2000; Walker et al, 2002).

3c. The dynamics of a resilient response enable a system to reconfigure to mitigate a threat.

3d. However, the system may not be in a desirable configuration. Subsequently a resilient system is able to rebound.

3e. Through a resilient response, organisations are able to learn and develop appropriate capabilities which improve future preparedness.

**Proposition 4** – Due to changing circumstances, organisational success has become fragile and subjective (Hamel and Valikanagas, 2003). A higher level of thinking is required to develop adaptive systems capable of a resilient response.

4a. In order for an organisation to remain a viable system it must foster the features of resilience and become capable of achieving a positive adjustment.

4b. The potential for developing a sustainable competitive advantage may reside in an organisation’s ability to develop strategic resilience.

4c. To enable a positive response, organisational systems should enhance the factors of individual psychological capital (Youssef and Luthans, 2007).

4d. The organisational system must overcome the challenges of becoming resilient.

4e. The organisational system should be able to adapt and cope with the consequences of an organisational transformation.

4f. It is through individuals that an organisation will be able to achieve the benefits of resilience.

In addition to these research propositions a working definition of organisational level resilience is proposed. Following the evidence of the literature review, organisational resilience is defined as follows:

*Resilience is the emergent property of organisational systems that relates to the inherent and adaptive qualities and capabilities that enable an organisation’s adaptive capacity*
during turbulent periods. The mechanisms of organisational resilience thereby strive to improve an organisation’s situational awareness, reduce organisational vulnerabilities to systemic risk environments and restore efficacy following the events of a disruption. (Burnard and Bhamra, 2011)

2.10. Summary

The chapter presents a synthesis of literature across multiple disciplines and sources. The literature review outlines the dramatic implications presented by disruptive and crisis events and the developed strategies towards their mitigation and management. A focused review of literature related to resilience is then presented. From the evidence of this review, resilience presents a diverse construct composed of several elements and concepts; these include robustness, adaption, vulnerability, adaptive capacity and the adaptive cycle. Following the evidence of the literature review, four epistemological propositions are raised towards supporting the intended research design presented within subsequent chapters.
Chapter 3 - Research Design and Methodology

3.1. Introduction

This Chapter outlines the research methodology and the surrounding concepts utilised within the research. The chapter details the merits of both qualitative and quantitative approaches to research and discusses various aspects associated with the development of a research design and methodology.

3.2. Research

Research is based on a certain view of the world and its function. Understanding and recognising the features of research is vital in order to control a research approach, increase validity of results and produce cumulative knowledge. As such, research deploys a methodology and proposes results aimed at predicting, prescribing, and understanding the world around us (Girod-Seville and Perret, 2001). Through this research can be thought of as the generation of knowledge or the investigation to establish facts. Sekaran (2003) defines the term ‘research’ as the process that is used to find solutions to a problem through a thorough study and analysis of variables and situational factors. Research can be conducted at the individual level, group level or at the organisational level of analysis (Scandura and Williams, 2000). Following a traditional view, scientific research seeks address causation and trace or establish cause and effect relationships (Punch, 2009). However, the objectives for research and the subsequent approaches can broadly be divided into two subgroups. It can either be ‘theory-building’ research or ‘fact-finding’ research (Wacker, 1998).

Within the context of theory building research the objective is to develop a clear explanation of how and why specific relationships lead to specific events (Wacker, 1998). The development or formulation of a theory is achieved through the logical and systematic integration of information and data, so that factors responsible for a problem or situation can be conceptualised and tested (Sekaran, 2003). The development of ‘theory’ is important as it provides a potential framework for analysis (Wacker, 1998). Theories also provide an efficient method for the research within a field to develop. The development of a good quality theory also provides clear
Research Design and Methodology

explanations for the ‘pragmatic’ world and is composed of four components. These include:

- The definition of terms and variables
- The definition of the domain where the theory applies
- The definition of the relationship of variables
- Specific predictions or factual claims

The purpose of theory-building research is to build an integrated body of knowledge that can be used to explain a certain phenomenon, while fact-finding research aims to build facts gathered under specific conditions. As such there is a fine line between the two research approaches (Wacker, 1998). Walker (1998) outlines that both approaches carefully define concepts and the research domain. The initial stages of both approaches involve the definition of the problem, initial data gathering through a literature review and then developing a conceptual or theoretical framework through which variables are identified and defined (Bennett, 1991; Sekaran, 2003).

The deviation between the two methods occurs after this point. The theory-building approach then goes on to explain the relationship between variables and makes predictions. While within fact-finding research, evidence is gathered and analysed to discover if relationships exist and then explain how and why specific phenomena occurred (Wacker, 1998). However, the two subgroups are not mutually exclusive as good quality fact-finding research can establish a foundation for future theory-building research.

3.3. Paradigms and Philosophies in Research

A well structured scientific approach to research can be characterised through a set of ‘philosophical’ and ‘meta-theoretical’ assumptions concerning the nature of reality (ontology), knowledge (epistemology), principles pertaining to governing scientific investigation (methodology) and issues related to practical implementation of a study (research methods) (Gelo et al, 2008). As identified by Creswell (2009), although philosophical ideas can remain largely hidden within research, it is important that they are identified as they directly influence the practice of research. Table 3-1 presents the features of both ‘hard’ and ‘soft’ research dichotomies.
Ontological assumptions address the relationship of individuals with the world around us and relate to the view or nature of reality (Guba and Lincoln, 1994). Epistemological positions relate to the various views in how best to structure enquiries and investigations of that reality (Easterby-Smith et al., 2002). As such, epistemological assumptions shape the relationship between the researcher and the research context (Collis and Hussey, 2003). Easterby-Smith et al. (2002) identify three reasons that outline the importance of understanding philosophical issues within research. A clear understanding of research philosophies will firstly help to clarify different research designs and aid in establishing an approach based on the requirements of the research. Being able to recognise suitable research designs is important as this will limit the researcher from following an inappropriate research design and prevent unnecessary work. Finally, knowledge and understanding of research philosophy will aid a researcher to identify, adapt and even create designs that may have previously been outside of the experience of the researcher. As such, an appreciation and understanding of research philosophy is required in order for research to achieve the desired outcomes.

“The term paradigm refers to the progress of scientific practice based on people philosophies and assumptions about the world and the nature of knowledge; in this context, about how research should be conducted.” (Collis and Hussey, 2003)

Scientific paradigms relate to a basic set of beliefs and assumptions that aid in guiding scientific inquiries and investigations (Lincoln and Guba, 1985). As such, paradigms relate to the worldview held within research. Varying worldviews or paradigms within different research approaches (i.e. quantitative or qualitative) are reflected in the different conceptions about the nature of reality and of knowledge itself (Gelo et al., 2008). These conceptions influence the ontological, epistemological, methodological and axiological position of a research design. Fitzgerald and Howcroft (1998) present a simplified model of ‘soft’ versus ‘hard’ research dichotomies, which provides a useful means for classification across the different levels and dichotomies.
Table 3.1 - Summary of ‘Soft’ Versus ‘Hard’ Research Dichotomies

<table>
<thead>
<tr>
<th>SOFT</th>
<th>HARD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ONTOLOGICAL LEVEL</strong></td>
<td></td>
</tr>
<tr>
<td>Relativist</td>
<td>Realist</td>
</tr>
<tr>
<td>Belief that multiple realities exist as subjective constructions of the mind.</td>
<td>Belief that external world consists of pre-existing hard, tangible structures which exist independently of an individual’s cognition.</td>
</tr>
<tr>
<td><strong>EPISTEMOLOGICAL LEVEL</strong></td>
<td></td>
</tr>
<tr>
<td>Interpretivist</td>
<td>Positivist</td>
</tr>
<tr>
<td>No universal truth. Understand &amp; interpret from researcher’s own frame of reference.</td>
<td>Belief that world conforms to fixed laws of causation. Complexity can be addressed by reductionism.</td>
</tr>
<tr>
<td>Subjectivist</td>
<td>Objectivist</td>
</tr>
<tr>
<td>Distinction between the researcher and research situation is collapsed. Research findings emerge from the interaction between researcher and research situation.</td>
<td>Both possible and essential that the researcher remain detached from the research situation. Neutral observation of reality.</td>
</tr>
<tr>
<td><strong>EMERODLOGICAL LEVEL</strong></td>
<td></td>
</tr>
<tr>
<td>Qualitative</td>
<td>Quantitative</td>
</tr>
<tr>
<td>Determining what things exist rather than how many there are through description</td>
<td>Use of mathematical &amp; statistical techniques to identify facts and causal relationships.</td>
</tr>
<tr>
<td>Exploratory</td>
<td>Confirmatory</td>
</tr>
<tr>
<td>Concerned with discovering patterns in research data, &amp; to explain/understand them.</td>
<td>Concerned with hypothesis testing &amp; theory verification.</td>
</tr>
<tr>
<td>Induction</td>
<td>Deduction</td>
</tr>
<tr>
<td>Begins with specific instances which are used to arrive at overall generalisations which can be expected on the balance of probability.</td>
<td>Uses general results to ascribe properties to specific instances. Associated with theory verification/falsification &amp; hypothesis testing</td>
</tr>
<tr>
<td>Field</td>
<td>Laboratory</td>
</tr>
<tr>
<td>Emphasis on realism of context in natural situation, but precision in control of variables &amp; behaviour measurement cannot be achieved</td>
<td>Precise measurement &amp; control of variables, but at expense of naturalness of situation.</td>
</tr>
<tr>
<td>Idiographic</td>
<td>Nomothetic</td>
</tr>
<tr>
<td>Individual-centred perspective which uses naturalistic contexts &amp; qualitative methods to recognise unique experience of the subject</td>
<td>Group-centred perspective using controlled environments &amp; quantitative methods to establish general laws</td>
</tr>
<tr>
<td><strong>AXIOLOGICAL LEVEL</strong></td>
<td></td>
</tr>
<tr>
<td>Relevance</td>
<td>Rigour</td>
</tr>
<tr>
<td>External validity of actual research question &amp; its relevance to practice is emphasised.</td>
<td>Research characterised by hypothetic-deductive testing with emphasis on internal validity</td>
</tr>
</tbody>
</table>
3.4. Approaches to Research

Walker (1997) states that the major issue within research is whether research should be qualitative or quantitative or have elements of both. The features that characterise both qualitative and quantitative research relate to their philosophical foundations, assumptions and research methodologies (Gelo et al, 2008). Within qualitative research, data is typically collected in a non-numerical form, while within quantitative research phenomena and variables are equated to a numerical value to support a statistical analysis. In relation to this, the quantitative research perspective views reality as singular and tangible. While the qualitative research perspective views reality as a socially and psychologically developed construct, in which a systems variables are inextricably connected (Gelo et al, 2008). As a result qualitative research is typically exploratory in nature (Walker, 1997).

Gelo et al (2008) present a useful table that outlines the attributes and paradigmatic foundations of both quantitative and qualitative approaches.

Table 3-2 - Quantitative and Qualitative Approaches

<table>
<thead>
<tr>
<th>Quantitative Approach</th>
<th>Qualitative Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nomothetic</strong></td>
<td><strong>Idiographic</strong></td>
</tr>
<tr>
<td>Extensive</td>
<td>Intensive</td>
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<tr>
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<td>Individualising</td>
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<tr>
<td><strong>Explanation</strong></td>
<td><strong>Comprehensive</strong></td>
</tr>
<tr>
<td>Prediction</td>
<td>Interpretation</td>
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<tr>
<td>Generalization</td>
<td>Contextualisation</td>
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<tr>
<td><strong>Deduction</strong></td>
<td><strong>Induction</strong></td>
</tr>
<tr>
<td>Theory-driven</td>
<td>Data-driven</td>
</tr>
<tr>
<td>Hypotheses-testing</td>
<td>Hypothesis-generating</td>
</tr>
<tr>
<td>Verification-orientated (confirmatory)</td>
<td>Discovery-orientated (exploratory)</td>
</tr>
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<td><strong>Naturalistic</strong></td>
</tr>
<tr>
<td>True-experiments</td>
<td>Case Study (narrative)</td>
</tr>
<tr>
<td>Quasi-experiments</td>
<td>Discourse Analysis</td>
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<tr>
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<td>Conversation Analysis</td>
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<td>Focus Group</td>
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<td>Grounded Theory</td>
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<td>Correlation-causal-comparative</td>
<td>Ethnographic</td>
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<td>Explanatory Validity</td>
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<td>Causal Validity</td>
<td><strong>Generalisability</strong></td>
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<td><strong>Generalisability</strong></td>
<td>Transferability</td>
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<td>External Validity</td>
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</tbody>
</table>
3.4.1. Deductive and Inductive Approaches

Fundamentally, research can be classified through either a ‘deductive’ or ‘inductive’ approach. Within ‘deductive’ research particular instances are deduced from more general inferences. In relation to a research design, a deductive approach would result in a conceptual and theoretical structure being developed and then tested through gathering empirical evidence. The ‘inductive’ approach is effectively the reverse of ‘deductive’ research through which general inferences are induced from particular instances (Collis and Hussey, 2003). While the qualitative paradigm follows an inductive approach, the quantitative paradigm typically takes a deductive position.

![Inductive Research Process](image1)

**Figure 3-1 - Inductive Research Process**

![Deductive Research Process](image2)

**Figure 3-2 - Deductive Research Process**

While the quantitative approach typically views reality as single and tangible, the qualitative approach views reality from the perspective that the ‘knower’ and the ‘known’ are mutually interactive and bound together (Sales et al, 2002; Gelo et al, 2008). Qualitative approaches therefore are typically based on the comprehension, interpretation and contextualisation of phenomena forming an ‘inductive’ approach. Quantitative approaches focus on the explanation, prediction and generalisation of
phenomena and thereby form a ‘deductive’ approach (Gelo et al, 2008). The elements of both deductive and inductive approaches are shown in Figure 3-2 and Figure 3-1.

Deduction is the process through which conclusions are achieved through the logical generalisation of a known fact. Meaning that if the initial hypotheses are true, then any conclusions that are derived logically from these hypotheses must be true (Charreire and Durieux, 2001). Induction relates to the process where observations are made pertaining to a certain phenomena and are then used as the basis to arrive at conclusions (Sekaran, 2003). The deductive approach then creates specific conclusions from a general perspective (Wacker, 1998), while the inductive approach develops broader generalisations and theories from specific observations forming an empirical classification of research (Wacker, 1998). A positivist epistemological perspective follows an objective view of reality. Following this approach, researchers’ will typically follow a deductive approach. While a constructivist or interpretivist perspective lends itself towards an inductive approach as the ‘knower’ and the ‘known’ are inseparably linked (Fitzgerald and Howcroft, 1998). As such, the objective is the develop understanding of a particular phenomenon within its social context (Rocco et al, 2003).

3.4.2. Qualitative Research

Developing from phenomenological assumptions, qualitative research provides a structured approach for exploring and understanding the meaning individuals ascribe to certain phenomena (Creswell, 2009). Through this, qualitative approaches strive to comprehend and develop understanding of personal perspectives, experiences and phenomena in a context specific setting (Golafshani, 2003). The approach follows a naturalistic perspective, without imposing preconceptions or prior judgments on the research. Qualitative research is based within the phenomenological positioning (spanning both interpretivism and constructivism positioning) and primarily follows an inductive approach (Sale et al, 2002). Qualitative research typically involves collecting data in a non-numerical form within the participant’s setting. The data is then analysed through developing themes from the data and then the researcher developing interpretations of the meaning of the data (Creswell, 2009). As such,
qualitative data provides a rich source of grounded descriptions and explanations of processes and phenomena in identifiable contexts (Miles and Huberman, 1994; Gelo et al, 2008).

Qualitative research is typically explorative in nature given the paradigms inductive approach. A qualitative approach can be used to explore a topic or research area when the variables and theoretical base is relatively unknown (Creswell, 2009). Subsequently, rigour within qualitative research is ensured through systematic, self conscious research design development, data collection, interpretation and effective communication (Mays and Pope, 2000).

3.4.3. Quantitative Research

Quantitative research provides a means for testing objective theories through examining the relationship between particular variables (Creswell, 2009). This is achieved through the reduction of phenomena to numerical values in order to carry out some form of statistical analysis. Through this quantitative approaches explain and verify if observed variables and phenomena and their relationships confirm or reject predications and hypotheses made by a theory (Gelo et al, 2008).

“Quantitative research attempts to fragment and delimit phenomena into measureable or ‘common’ categories that can be applied to all subjects or wider and similar situations” (Winters, 2000)

The quantitative approach to research is based on positivist epistemological assumptions in which it is regarded that all phenomena and variables under consideration can be reduced to empirical indicators which represent the truth (Sale et al, 2002). There are several features of the quantitative paradigm, these include (Golafshani, 2003):

1. The emphasis within the research is placed on facts and causes of behaviour
2. The information is typically presented in a numeric form
3. The numeric data is analysed through a mathematical and statistical process
4. The final result is expressed in statistical terminologies
3.4.4. Mixed Method Approach

Many research methodologies also employ a mixed approach, incorporating both qualitative and quantitative perspectives. The mixed method approach to research employs a ‘pragmatic’ worldview and integrates the approaches of both qualitative and quantitative research and is termed ‘mixed method research’ (Gelo et al, 2008; Creswell, 2009). As both qualitative and quantitative approach share the same unified goal of understanding the world, the two seemingly conflicting paradigms can be considered compatible (Sales et al, 2002).

Mixed method research allows researchers to address and investigate more complex research questions and collect a richer array of evidence than could be achieved through following any single method (Yin, 2009). The underlying rational behind the mixed method approach is to develop better understanding, generate deeper and broader insights and develop knowledge that involves a wider range of interests and perspectives (Rocco et al, 2003). The mixed method approach involves the use of induction (through the discovery of patterns), deduction (through the testing of theories and hypotheses) and abduction (through uncovering and relying on the best explanations for understanding results) (Johnson and Onwuegbuzie, 2004). Through the use multiple methods and approaches, researchers are able to address a broader and more complete range of research questions and lines of enquiry. Researchers are not restricted by a single method and as such are able to utilise additional methods where necessary (Johnson and Onwuegbuzie, 2004).

3.5. Research Methods

Different research methods can be implemented through different research designs. The research method is defined by the procedures and techniques involved within the research’s data collection, analysis and interpretation (Gelo et al, 2008). This research project takes the position that both qualitative and quantitative approaches are part of a continuum in which the most appropriate research method should selected and based on the merit of the research’s specific objectives (Sales et al, 2002).

“Research methods are the various procedures, schemes, algorithms, etc. used in research. All the methods used by a researcher during a research study are termed as
research methods. They are essentially planned, scientific and value-neutral. They include theoretical procedures, experimental studies, numerical schemes, statistical approaches, etc." (Rajasekar et al, 2006)

There are several research methods, both qualitative or quantitative, that can be used towards addressing the specific objectives of a research project. The following section details several research methods.

3.5.1. Experiment Based Research

Experiments follow a systematic approach and are typically conducted in a laboratory or in a natural setting (Field experiments). Fundamentally the objective within experimental research design methodologies is to identify casual relationships. This is achieved through the manipulation of an independent variable and observing the effect on a dependent variable (Collis and Hussey, 2003).

“The empirical experimental research uses experimental design to verify the causality of a specific theory while elevating relationships from a testable hypothesis to an empirically verified theory.” (Wacker, 1998)

Organisational and human orientated experiments tend towards forms of quasi-experiments. The difficulty in experimental research lies in that the environment in which the experiment are conducted must be closed to contamination effects (Wacker, 1998). The experiment should also address issues such as compounding variables, which constrain and obscure the effects of other variables (Collis and Hussey, 2003). Without the control of these issues, the research may lead to inaccurate conclusion about causality. As such, rigorous control of ‘extraneous’ variables is required (Gelo et al, 2008).

3.5.2. Survey Research

Research that employs a survey design provides quantitative descriptions of trends, attitudes and opinions of a population by conducting the study within a sample of that population (Creswell, 2009). Through this survey research can establish relationships between variables, as well as provide specific information about a defined set of people or make inferences about a wider population (Pinsonneault and Kraemer,
As a result, surveys can be characterised as being factual, attitudinal, social psychological and explanatory (May, 1997). Surveys provide a standardised measurement and sampling procedure within a research design. This enhances the reliability of observations, provides a means of statistical analysis, facilitates replication and allows for the development of generalisations for a larger population. As such, the use of surveys has increased dramatically within the field of operations management (Rungtusanatham et al, 2003). Survey research is most appropriate when (Pinsonneault and Kraemer, 1993):

1. Survey research is especially well-suited for answering questions about how, why, what, how much and how many
2. Control of the independent and dependent variables is not possible or not desirable
3. The phenomena of interest must be studied in its natural setting
4. The phenomena of interest occur in current time or the recent past

3.5.3. Action Research

Action research, sometimes referred to as ‘action science’, forms a participatory research methodology in which there is close collaboration between the researcher and the research participants, in which theory and practice are combined. The research forms an iterative process through which improvement and involvement are the central issues of concern (Robson, 2011). The focus of action research is to study the resolution of issues and problems through a systematic approach together with the participants involved. As such, action research is an applied form of research developed in order to bring about a conscious change within a partially controlled environment (Coughlan and Coghlan, 2002; Collis and Hussey, 2003).

As outlined by Collis and Hussey (2003), action research involves two objectives: solve the problem under consideration and contribute to science. Through this the researcher and the research participants should learn and develop from each other. There is a close cooperation and collaboration between the researcher and participants; continuous feedback and adjustment to new information and events is
made. As a result, action research is primarily applicable to the understanding and planning of change within social systems, such as organisations.

3.5.4. Case Study Based Research

Within case study research, the term ‘case’ refers to a situation, individual, group, organisation or the phenomena under consideration (Robson, 2011). The case study methodology and research design provides a systematic approach to study a given phenomena (Merriam, 1988). Unlike other research methods, there are no specific methods for data collection and analysis, instead any appropriate methods can be utilised. Case studies may combine various methods within data collection towards achieving the desired research outcomes, this includes the use of archival data, interviews, questionnaire and observations (Eisenhardt, 1989).

“...The methodology, then, is characterized by design flexibility and reliance on the researcher’s ability to discern cause-and-effect relationships in complex organizational contexts. Case researchers frequently confront new concepts or situations; the researcher is often forced to rely on imaginative means to gather data about them.” (McCutcheon and Meredith, 1993)

Initially within case studies, there may or may not be any clearly defined independent and dependent variables (Pinsonneault and Kraemer, 1993). However, the case study research methodology provides a comprehensive strategy for the empirical investigation of the ‘case’ under consideration. Through this case study research provides an in-depth investigation which seeks to holistically explain and understand the dynamics of a phenomenon (Yin, 2009).

3.5.5. Grounded Theory Research

Grounded theory research seeks to develop a theory which relates directly to the particular situation forming the focus of a study. The approach allows for the development of ‘robust theoretical’ explanations of a phenomena (McGhee et al, 2007) and challenges the divisions between theory and research. The theory emerges from the systematic examination of the phenomenon under investigation (Shannak
Grounded theory follows an iterative approach, in which the researcher continually transition between concepts and collected data. Fundamentally, the approach is based upon the constant comparison of data across types of evidence in order to control the conceptual development and scope of the developing theory (Rowlands, 2005). The approach was developed through the work of Glaser and Strauss (1967) who developed the notion that the research approach should allow for concepts and hypotheses to develop directly from field work instead of priori theoretical orientations or pre-existing theories (Robson, 2011). Through this a robust set of research procedures has emerged towards the development of conceptual categories within theory building.

3.6. Developing a Research Design

The research design provides a guide for how researchers approach and structure their investigations (Neuman, 2003). As such, several research methods could be used in order to achieve the intended research outcome. The use of a particular research design is not completely reliant on the selection of a certain research methodology. Instead, the research design is largely dependent on the logic of the research and the preferred approach of the researcher (Yin, 2009). As such, the research design is the logic that links the data to be collected within a study to the conclusions of the research (Rowley, 2002).

As outlined by Creswell (2009), an effective research design will not only yield valid data and causal inferences but will ensure that findings are accepted, dependable and consistent. The determinants for the section of a research design is based on three fundamental criteria; 1) the research problem and question; 2) the personal experiences of the researcher; and 3) the audiences for the research (Creswell, 2009). As such, the research design creates the foundation for the entire research project (Rajasekar et al, 2006).

The research design provides a framework for planning and structuring research activities, establishing a protocol for data collection and providing a means of analysis.
towards achieving the objectives of the research study. Selecting an appropriate methodology is paramount to ensure that the objectives of a research project are met and the research is conducted in a structured manner. As identified by Yin (2009), the purpose of an effective research design and methodology is to ensure that the evidence gathered from the research address the initial research questions. The research design thereby involves a series of rational decisions between development, data collection and eventual analysis (Sekaran, 2003). These decision points include identifying the purpose of research, identifying the type of investigation, establishing the extent of the researcher’s intervention and direct involvement (researcher’s inference), identifying the location or context of the research (the research setting), selecting appropriate measures, outlining data collection methods, deciding on the research timeframe, developing a suitable sampling design, identifying the unit of analysis and how the collected data will be analysed. An appropriate research design therefore ensures coherence between data collection and the final conclusion drawn (Rowley, 2002).

3.6.1. Research Questions

Marshall and Rossman (2006) advocate that the intended research purpose should be matched to specific research questions, and vice versa. As such, good research questions are required to meet several criterions (Punch, 2009). Research questions should be 1) unambiguous; 2) easily understood; and 3) easily interpreted. However, the concepts involved should be at a specific enough level in order to establish connections to data indicators. Additionally, the research questions must be substantively relevant in order to support investment within the research as well as outline the specific research objectives. Research questions should also be related to each other and interconnect in a meaningful way. This aids in establishing a logical structure within the research from the onset. Arguably, the most important criterion for a research question is that the question should be answerable within the constraints of the research project. Identifying what data is required to address the question and how this data can be collected.
3.6.2. Research Propositions

Focus and direction is further enhanced within a study through the development of research propositions (Stuart et al, 2002). Propositions identify functional relationships between two or more concepts (Meredith, 1993). These then form testable or measurable arguments that are developed from an extant theory, body of literature or from the preliminary research (Creswell, 2003). The development of these propositions provides a guide or structure for data collection and analysis (Yin, 2009). As such, propositions form theoretical statements which indicate the direction and scope of a research project (Walliman, 2002) and may be considered working hypotheses.

3.6.3. Theoretical and Conceptual Frameworks

A framework or model provides a simplified representation of a situation or phenomena under consideration. This representation or ‘abstraction’ of reality can then be used to describe, reflect or replicate events, objects or processes. However, there is an important distinction between a framework and a model. Any conceptual model which does not meet the criterion for a theory, yet includes epistemic propositions, is considered a framework (Meredith, 1993). While a model allows for prediction or increased understanding and includes attributes or variables and their interactions (including Boundary criteria).

The development of a theoretical or conceptual framework consists of grouping and outlining the relationships between certain concepts towards enhancing the interoperability of structures and linkages between concepts (Rowlands, 2005). The development of a conceptual framework can thereby be used to link relationships between concepts, constructs and theories (Fox-Wolfgramm, 1997). However the developed framework does not explain these relationships and may be developed with or without the support of prior propositions. As such, any propositions within a framework form logical statements rather than epistemological statements (Meredith, 1993). These propositions thereby support the development of the framework and provide an understanding of its function.
3.6.4. Unit of Analysis

The unit of analysis within a research study identifies the constituents of a case (Darke et al, 1998, Yin, 2009). This may be an individual, a group of individuals, an organisation or a particular event or phenomena. The selection of the unit of analysis used within a study is dependent on the research’s specific research questions and subsequent hypotheses (Flynn et al, 1990). As such, the unit of analysis is determined by setting research boundaries (Miles and Huberman, 1994). Within selection, the unit of analysis should ensure an adequate depth and breadth within the data to be collected in order to appropriately address the intended research questions (Darke et al, 1998).

3.6.5. Sampling

The purpose of sampling is to select participants that are representative of a wider population so that extracted results can be generalised towards that population (Gelo et al, 2008). This is broadly achieved through either probabilistic or non-probability (or purposive) sampling. Within probabilistic sampling each member of the population has the same probability of being selected within the research sample. While within non-probability sampling, the sampling is based on non-random selection and the research utilises specific selection criteria (Devers and Frankel, 2000).

Quantitative research frequently utilises both probability and non-probability methods towards the specific objectives of a given research project; however qualitative research by contrast, almost exclusively follows non-probability sampling (Gelo et al, 2008). Probability sampling, such as random, systematic, stratified and cluster sampling, is based on random selection and therefore provides the most reliable representation of a population. Non-probability sampling techniques, such as convenience, theoretical and purposive sampling, are fundamentally based upon the judgments and criteria set by a researcher (Walliman, 2002).

3.6.6. Data Collection

Data collection forms a critical junction within research; data can be collected directly (primary data) from participants within the sample population or indirectly (secondary
data) through utilising alternative information sources such as publications, documentation, databases or research archives (Gelo et al, 2008). Data collection methods are used in conjunction with the research design to document the situation and phenomenon being observed and investigated. There are several possible data collection methods that are appropriate within operation management (Flynn et al, 1990; Gelo et al, 2008). These include:

- Historical Archive Analysis
- Participant Observation
- Outside Observation
- Interviews
- Questionnaires

3.6.7. Logic Linking Data to Propositions and Interpreting Findings

Regardless of the specific objectives within a potential project, fundamentally research requires that collected data be linked to concepts or establishing a connection between a concept and its empirical indicators (Punch, 2009). As such, it is essential that the developed research design should create a solid foundation for future data analysis. Dependent on the structure and choices made within a developed research design, the criteria for interpreting findings may differ. There are several analytic techniques towards linking data to propositions; these typically involve matching collected data to patterns that can be derived directly from the research propositions (Yin, 2009). Techniques include pattern matching, rival explanations, time series analysis, development of logic models, explanation building and cross-case analysis (Miles and Huberman, 1994; Yin, 2009).

3.6.8. Validity and Reliability

Elements of a research design and subsequently the conclusion drawn from it are broadly evaluated against four quality criteria. These include construct validity, internal validity, external validity and reliability (Pandit, 1996). The quality of the research design is dependent on addressing these criteria and successfully overcoming issues of validity and reliability within the research. As shown by Winter (2000), the definition of ‘validity’ is most commonly associated with ‘accuracy’ or ‘credibility’; while ‘reliability’ is more commonly associated with ‘replicatability’. Construct validity is improved within a research design through clearly establishing
specific operational procedures. Internal validity is addressed through identifying causal relationships between variables and the influencing conditions. External validity establishes the domain to which the research's findings can be inferred or generalised. Reliability relates to the research designs capability to demonstrate that the operations and procedures used can be repeated towards achieving the same results (Pandit, 1996).

### 3.6.8.1. Validity

A valid measurement or assessment is achieved when results are able to account and establish the ideas contained within a concept (Adcock and Collier, 2001). As such, the validity of a piece of research is concerned with the extent that the research findings accurately represent the measured phenomena or situation and whether the means of measurement is measuring what is intended (Winter, 2000; Collis and Hussey, 2003). Validity is one of the strengths of qualitative research and as such provides a solid base for the development of new theories (Creswell, 2009).

However, issues of validity often revolve around construct and content validity. Issues with construct validity arise when researchers use inadequate definitions and measurements of variables (Creswell, 2009). As such, construct validity reflects issues in establishing the ‘theoretical territory’ associated with a defined construct and ensuring there is consistency between it and other constructs (McCutcheon and Meredith, 1993). Content validity relates to how a construct is directly measured (McCutcheon and Meredith, 1993).

Construct validity is thereby determined by 1) the extent to which the operational measures for a construct reflect a constructs observable effects; 2) extent to which the operational measures for a construct appear to describe a single construct; and 3) the correlation between operational measures of related constructs (McCutcheon and Meredith, 1993). Content validity is determined by the degree to which a measure accurately reflects a construct (McCutcheon and Meredith, 1993).

In addition to construct and content validity it is also necessary to address issues of internal and external validity. Within case study research, Yin (2009) identifies that it important to clearly establish the internal validity within the proposed
relationships between variables. As such internal validity ensures that accurate cause and effect relationships are established (Stuart et al, 2002). While, external validity relates to the wider context of the research and addresses the extent that the research findings and outcomes are applicable to other groups or settings (McCutcheon and Meredith, 1993). As such the issue of external validity concerns issues of ‘generalisability’. As noted by Winter (2000), while the generalisation of findings to wider groups is a well established test for validity within quantitative data; within qualitative it is considered to be of little importance. As such, qualitative findings are most readily generalisable to the development of theories and not towards the wider context of groups or populations.

3.6.8.2. Reliability

The issue of reliability is concerned with the findings of a piece of research. The reliability of a piece of research relates to the extent to which the researches operations can be repeated and achieve the same results (Stuart et al, 2002). Creswell (2009) suggests several procedures that can be utilised to ensure reliability. These include 1) checking transcripts to ensure they do not contain any obvious errors; 2) making sure that there is consistency during the coding process; and 3) cross-check codes developed by different researchers. In addition to these procedures outlined, it is noted by Stuart et al (2002) that the reliability of a piece of research can be enhanced through the development of a case study protocol and through maintaining a case study database.

3.6.8.3. Test Procedures

In order to address the issues of validity and reliability the following test procedures can be applied to research designs.

Table 3-3 - Test Procedures

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Test Procedure</th>
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<tbody>
<tr>
<td>Construct Validity</td>
<td>Multiple data sources (Eisenhardt, 1989; Yin, 2009; Stuart et al, 2002)</td>
</tr>
<tr>
<td></td>
<td>Explanation of data analysis (Gibbert et al, 2008)</td>
</tr>
<tr>
<td></td>
<td>Create chain of evidence (Yin, 2009)</td>
</tr>
<tr>
<td></td>
<td>Indication of data collection circumstances (Gibbert et al, 2008)</td>
</tr>
<tr>
<td></td>
<td>Member/ participate checking (Creswell, 2009)</td>
</tr>
</tbody>
</table>
Clearly outline and clarify the bias within the research (Creswell, 2009)
Triangulation (Miles and Huberman, 1994; Collis and Hussey, 2003; Gibbert et al, 2008)
Cross-case comparison
Pattern matching (Yin, 2009; Gibbert et al, 2008)
Explanation building (Yin, 2009)
Research Framework derived from literature (Gibbert et al, 2008)
Address rival explanations (Yin, 2009)
Use Logic models (Yin, 2009)

Replication Logic (Yin, 2009)
Outline rationale for case study selection (Gibbert et al, 2008)
Outline details of case study context (Gibbert et al, 2008)
Cross-case comparison (Yin, 2009)
Use of theory within single case study designs (Yin, 2009)
Use an external auditor to review the research findings in their entirety (Creswell, 2009)
Utilisation of peer debriefing in order to enhance the accuracy of a case study (Creswell, 2009)

Case Study Protocol (Yin, 2009; Sturat et al, 2002)
Case study database (Yin, 2009; Sturat et al, 2002)

3.6.8.4. Triangulation

Triangulation compares the results from either two or more different methodologies of data collection or two or more data sources (Mays and Pope, 2000). Through this, triangulation strives to improve consistency within research rather than simply trying to achieve the same result using different data sources and approaches (Rocco et al, 2003). As identified by Neuman (2011), triangulation allows the researcher to learn more and gain an improved understanding through utilising multiple perspectives within research. Through utilising multiple methods and approaches within data collection, triangulation provides a higher level of validation or substantiation of constructs and hypotheses (Eisenhardt, 1989).

The researcher looks for patterns of convergence to develop an interpretation of the collected data. Through merging different methods and data sources, including qualitative and quantitative, triangulation allows for a wider range of inferences and
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perspectives from the research to develop (Gelo et al, 2008). As such, it offers a more reflexive analysis of data (Mays and Pope, 2000).

Triangulation could be considered a controversial test for validity within research as it assumes that any weakness in one methodology or data source is compensated by the strengths or another (Mays and Pope, 2000). However, through developing a rigorous triangulation strategy it is possible to utilise two or more approaches simultaneously to take advantage of their respective qualities and strengths. Through this, triangulation offers a practical means of combining both qualitative and quantitative approaches (Thietart et al, 2001). Triangulation could therefore be considered a test for the validity of a potential research design as triangulation ensures that the findings and conclusion generated from a study are not just a direct reflection of the methodology utilised within the research, but instead captures a more complete, holistic and contextual account of the phenomena under study (Jick, 1979).

3.7. Research Design Adopted

The following section details the research design followed within the research. This design is linked to the achievement of the research aim and objectives presented within Chapter 1. An overview of the research design and analyses is presented within Table 3-4. This table outlines the various phases within the research design and the associated analyses used.

Table 3-4 - Research Design and Analysis

<table>
<thead>
<tr>
<th>Phase 1</th>
<th>Description</th>
<th>Data Set</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Theoretical and Conceptual Foundation</td>
<td>- Extant literature</td>
<td>- Literature review</td>
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<td></td>
<td></td>
<td></td>
<td>- Content analysis</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- Thematic analysis</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- Conceptual framework</td>
</tr>
</tbody>
</table>
### Research Design and Methodology

<table>
<thead>
<tr>
<th>Phase 2</th>
<th>Establish Research Design</th>
<th>- Establish literature protocols</th>
<th>- Develop organisational survey protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 3</td>
<td>Organisational Survey</td>
<td>- Survey across Engineering and Technology Organisations - Respondents within Strategic Management roles</td>
<td>- Descriptive statistics and analysis - Factor analysis - Factor score analysis - Bivariate analysis</td>
</tr>
<tr>
<td>Phase 4</td>
<td>Organisational Case Studies</td>
<td>- Four organisational case studies - Participants within Senior Management roles</td>
<td>- Grounded Theory coding - Within-Case analysis - Cross-Case analysis - Causal network development</td>
</tr>
<tr>
<td>Phase 5</td>
<td>Research Output and Discussion</td>
<td>- Literature review - Organisational survey - Organisational case studies</td>
<td>- Causal network development - Discussion of findings - Literature review</td>
</tr>
</tbody>
</table>

#### 3.7.1. Research Paradigm and Philosophy

Based on a grounded theory approach, the research design utilised for this research follows a theory building approach. Although the concept of organisational resilience is of increasing interest and a growing area of research within academia, systematic and structured approaches towards the development of a more complete understanding of the concept are lacking (Bhamra et al, 2011). Theory building provides a structured framework for data analysis towards developing an integrated body of knowledge which may then be applied in order to address who, what, when, where, how and why certain phenomenon may occur (Wacker, 1998). Within a broader context, good theory building also supports the development of the
Operations Management field, through establishing a connection to practical real world problems (Wacker, 1998).

At an ontological level the research will fundamentally follow a realist perspective, contending that research is a systematic process of enquiry and investigation (Collis and Hussey, 2003) that seeks to understand an independent and pre-existent reality and not the constructions of the human mind (Blismas, 2001). As such, the research will follow the ontological position of ‘critical realism’, where it is assumed that an individual’s ability to interpret reality is imperfect and must subsequently be subject to critical examination (Fitzgerald and Howcroft, 1998).

3.7.2. Research Method Followed

The research follows a primarily qualitative approach. This approach presents a much more open perspective within the research through utilising a wide variety of data and evidence as well as uncovering new issues (Neuman, 2011). While quantitative research seeks causal determination, prediction and generalisation of findings (Golafshani, 2003); qualitative research is based on the research participants’ own categories of meaning (Johnson and Onwuegbuzie, 2004). As a result, qualitative research allows for the description of complex phenomena and situations through providing a rich detail within the explanation of the research participants’ personal experiences. This allows the research to address dynamic processes within the constraints of the research project (Johnson and Onwuegbuzie, 2004). Through following a naturalistic approach, it is also possible to identify contextual and situational factors that relate to the area or phenomena under investigation. As such, qualitative research allows researchers to develop an understanding of a given phenomena in context specific settings, allowing researchers to seek illumination, understanding and extrapolation of research findings to similar contexts or situations (Golafshani, 2003).

Given the context of the research and the research objectives, a case study research methodology offers the most suitable platform for the study of resilience within organisations. Case studies involve the examination and study of a phenomenon in its natural setting. The researcher has no control over the phenomenon under study but
instead strives to develop holistic descriptive accounts and explanations of the phenomena. Through this case study research is able to provide a detailed understanding of a phenomenon under study. Survey data will also be used as a form of triangulation to support case study findings.

Case study research is most applicable when the research objectives aim to explore and understand the relationship between context of the research area and the phenomena of interest (Pinsonneault and Kraemer, 1993). Through this case study research develops an intensive investigation of single or multiple cases, focussing on several details within each case. Through this, the research is able to develop and examine details of the internal features of each case and the wider context of the cases surrounding situations (Neuman, 2011). As such, case studies are typically selective in nature, focusing on a few issues that are fundamental to understanding the system under investigation (Tellis, 1997). This is reflected by Merriam (1988) who states:

“...a case study is an examination of a specific phenomena such as a program, an event, a person, a process, an institution, or a social group. The bounded system, or case, might be selected because it is an instance of some concern, issue or hypothesis.” (Merriam, 1988)

The research design follows a multiple case study design. This approach is adapted from Yin (2009), and follows Eisenhardt’s (1989) replication approach. This approach is composed of eight stages which can be broadly characterised through three phases: phase one defines the protocols used within data collection, phase three involves a within-case analysis and finally, phase three involves a cross-case analysis. This approach is illustrated within Figure 3-3.

Multiple case study designs are suitable when the research objectives focus largely on descriptions, theory building or theory testing. The multiple case study design allows for cross-case comparison and the extension of theory (Gable, 1994). A multiple case approach within a research investigation is widely considered more robust than a single case study approach (Yin, 2009). Multiple cases strengthen the results and
robustness of a study through replication and offers a greater opportunity to identify features through case comparison techniques (Bryman, 1989; Tellis, 1997).

A major concern within case study research relates to the difficulty in developing generalisations from the research that are applicable to the wider population as well as issues related to rigour and validity (Yin, 2009). Yin (2009) addresses these
concerns through stating that generalisations based from the results of either single or multiple case study designs are made to theories and not to populations. This form of generalisation is termed ‘analytical generalisation’ and is separate from statistical generalisation which makes inferences to a larger population (Gibbert et al, 2008).

### 3.7.3. Data Collection

The primary source of data within each case study is collected through conducting focused interviews (Yin, 2009) with appropriate individuals, as well as analysing relevant organisational documentation and published material. The interviews follow a semi-structured approach and are supported by the case study protocol, presented within Chapter 4 Section 4.4. Semi-structured interviews are considered the most appropriate means of providing primary data within the research as they provide flexibility within data collection whilst still providing a structure and ensuring rigour. To ensure validity and reliability within each case study, triangulation will be achieved through the use of multiple data sources, multiple interviews, any relevant supporting organisational documentation and the use of an organisational survey.

The organisational survey will be used to provide initial data related to organisational resilience. Survey based research is a prominent methodology used extensively within the study of organisations (Malhotra and Grover, 1998). Conducting a survey is comprised of three stages (Thietart et al, 2001). The first stage involves developing the initial survey and selecting appropriate scales; the survey is then tested through a ‘pilot study’ or ‘pre-test’. This stage is then used to check the validity and reliability of the developed survey scales. Once the survey is reviewed and validated, the final survey can be administered to the selected population sample.

### 3.7.4. Research Design and Approach

The research design is supported by a grounded theory approach in order to develop a more complete theory and understanding of organisational resilience. The research asserts that the grounded theory approach offers a structured method towards the exploration of organisational resilience and the response of organisations to disruptive events. Fundamentally, the grounded theory approach is composed of five analytic phases (Pandit, 1996). These include the development of the research design,
data collection, data ordering, data analysis and a final literature review and comparison. However, these phases are not sequential given the nature of the approach and the use of the constant comparison method.

Although the merits and potential contributions of alternative research methodologies, such as action research, are recognised, given the demands and constraints of the project, this methodology was not considered suitable. The close integration and collaboration required from the participant organisations could not be achieved within the research timeframe. However, the grounded theory approach offers a concurrent, iterative and integrative methodology, in which data collection, analysis and conceptual development all occur in parallel. This allows for every variation within the data collected to be considered (McGhee et al, 2007).

Grounded theory therefore offers flexible guidelines rather than rigid prescriptions towards developing a theory. The approach allows for researchers to capture the interpretive experiences of research participants and develop theoretical proposition directly linked to the collected data (Strauss and Corbin, 1990). The researcher is then able to conceptualise latent patterns and structures through a process of constant comparison and theoretical development.

As such, grounded theory offers a flexible method for exploring the dynamics of resilience within organisations and establishing the features of organisational responses. The grounded theory approach provides a robust methodology and research structure towards developing theoretical propositions from collected data (Shannak and Aldhmour, 2009). Following Glaser and Strauss (1967) original methodology there are several defining features of grounded theory as outlined by Charmaz (2006). These include:

- Simultaneous data collection and data analysis
- Instead of following preconceived hypotheses, grounded theory develops analytic codes and categories
- Utilising a constant comparative method, which involves making comparisons during each phase of data analysis
• Advancing theory development through each phase of data collection and analysis
• Utilising memo writing to elaborate categories, specifying their properties, relationships and identifying gaps within the data collected
• Sampling aimed toward theory construction and development
• Conducting the literature review after developing an independent analysis

3.7.5. Theoretical Foundation and Prior Knowledge

The use of the grounded theory approach within research is evolving and subsequently does not offer a single or static reference point (McGhee et al, 2007). A key debate within the use of grounded theory this that of the positioning of the literature review. As identified by Charmaz (2006) the positioning of the literature review is both widely disputed and misunderstood. Following the original research process, Glaser and Strauss (1967) advocate delaying the literature review phase until after completing the stages of data analysis. This is to prevent preconceived ideas influencing the study. However, as shown by McGhee et al (2007) the issue of conducting a literature review within grounded theory is complex and is subject to several considerations. These include:

• The researcher’s ontological perspective
• Previous background and knowledge
• The researcher’s experience
• Institutional requirements of the research project

Although grounded theory does emphasise conducting research from a minimal theoretical foundation, as stated by Binder and Edwards (2008) this does limit researchers to conducting grounded theory studies without any prior knowledge and awareness. Instead, researchers following a grounded theory approach should clearly state and outline the theoretical basis of the research prior to conducting the empirical research. As such, the review of technical literature may be included within the initial stages of the grounded theory research design development (Pandit, 1996). This allows researchers to reflect on existing theories and knowledge and avoid imposing it directly on the data. Reviewing the theoretical foundation of a research
area, possibility through a structured literature review, also allows for the identification of current gaps in knowledge (Binder and Edwards, 2008). As such, researchers are able to focus efforts within the development and definition of the research questions and priori constructs (Pandit, 1996).

Following these considerations the decision to follow the grounded theory approach rests with the circumstances of the researcher and the research area. Although the concept of organisational resilience has gained increasing recognition and support within academia; fundamental variables are still yet to be fully understood (Bhamra et al., 2011). As such, a literature review was conducted during the initial stages of the research design in order to constrain irrelevant variation and enhance external validity, this review is presented within Chapter 2. The literature review also focuses attention on theoretically relevant and useful cases within the development of the research design.

3.7.6. Selection of Cases

Within a case study design the selection of cases is of vital importance. Eisenhardt (1989) identifies that within a case study design, there is no ideal number of cases, but outlines that typically between four to ten case studies are appropriate. If fewer cases are used, it can often be difficult to generate a complete theory with the necessary detail required as the empirical grounding of the study is likely to be ‘unconvincing’. The selection of cases defines the sample population for the research and subsequently helps control variation and to an extent, defines the limits of the research findings eventual generalisability (Eisenhardt, 1989). Cases are selected based on a specific criteria or logic (Yin, 2009). Case selection is determined by the research purpose, research questions, propositions and theoretical context (Rowley, 2002). Whereas single case studies will follow sampling logic, a multiple case study design will follow replication logic (Tellis, 1997). Through the investigation of multiple cases with comparable results, a robust multiple case study approach allows for results to be tested and extended through replication towards increasing the confidence and robustness within the development of a theory (McCutcheon and Meredith, 1993; Yin, 2009). Additionally, a multiple case study approach allows for a
cross-case comparison within the research analysis. As identified by Yin (2009) there are two forms of replication logic, that of literal and theoretical replication. Within the selection of cases, multiple case studies must select cases that will either predict similar results, forming a literal replication, or cases that will outline contrasting results but for predictable reasons forming a theoretical replication logic.

If collected data within a case study can be matched with propositions or proposed patterns, through pattern matching, the internal validity within causal relationships can be established (Stuart et al, 2002). If these results can be replicated within similar cases through literal replication, the high level of confidence within the results can be established. If these patterns can then be shown or disproven for predictable reasons across dissimilar cases through theoretical replication, the confirmation becomes even stronger. Following the previously outlined research objectives, the research does not seek to infer the findings from the individual cases to a wider population but instead seeks to establish patterns and linkages of theoretical and conceptual importance. As such, the generalisation of results is made to theory and not to populations (Yin, 2009). Subsequently, the selection of cases within the research design follows theoretical replication logic. The selection of cases will be based on cases where the theory points to different yet predictable results (McCutcheon and Meredith, 1993).

Figure 3.4 - Case Study Structure
The structure of research design is outlined within Figure 3-4. Cases are selected on the merit of four main criteria. These included: 1) a willingness to participate within the research and provide access to relevant individuals and information; 2) large scale organisation with substantial operations within the UK; 3) operations related to critical infrastructure within the UK; and 4) experience and exposure to significant threats or disruptions.

3.7.7. Unit of Analysis and Measurement

The unit of analysis is the actual source of information and data utilised within research, and refers to the level of data aggregation during subsequent analysis. This could include individuals, dyads, groups, plants, divisions, companies, projects and systems for example (Flynn et al., 1990). Within the research project, the unit of analysis will be that of an organisation.

“It is necessary to determine the unit of analysis when formulating the research questions. Data collection methods, sample size and even the operationalisation of constructs may sometimes be determined or guided by the level at which data will be aggregated at the time of analysis.” (Forza, 2002)

Case studies are considered to be ‘multi-perspectival’, in which not only the perspectives of direct actors are considered, but also the perspectives of the relevant groups of actors and the interaction between them (Tellis, 1997). As such, case study designs can be divided into either holistic or embedded case study designs (Rowley, 2002; Yin, 2009). Holistic designs follow a single unit of analysis and aim to address the global nature of a particular phenomenon or address a broad issue. Conversely, embedded designs include multiple units of analysis. The case study includes various units of analysis possibly across different levels, each of which are addressed individually and then brought together.

Subsequently, the research follows a holistic case study design. Within each case this is achieved through the use of semi-structured interviews with individuals within Senior Management roles primarily related to Strategic Planning and Management or equivalent positions. As such, the selection of respondents follows purposive sampling. However, where appropriate, in order to achieve a holistic representation of
resilience, interviews were conducted with a variety of participants from across the organisations involved within resilience related activities. Secondary sources of data included organisational publications, financial reports, corporate presentations and relevant documents.

3.8. Conclusions and Implications

In order to achieve the intended research aims and objectives, Presented within Chapter 1 Section 1.3, the developed research design follows a grounded theory approach. An overview of the research design is presented within Figure 3-5. The research follows a multiple case study design, incorporating both qualitative and quantitative elements. In order to support this approach, an initial organisational survey is conducted to provide initial information in regards to the perception of organisational resilience within industry. This survey also provides an element of triangulation and supports the generalisation of the research findings. Following this, four organisational case studies are then developed to explore the research aims and objectives. Within these case studies, semi-structured interviews provide the primary data source. Through the transcription and coding of these interviews, thematic matrices and causal networks are developed to support the analysis of the case studies. Both a within-case and cross-case analysis of the organisational case studies is then conducted.

3.9. Summary

This chapter outlines the methodology and research design followed within the research project. The chapter outlines the paradigms within research including ontological, epistemological, methodological and axiological levels. Identifying the features of both qualitative and quantitative research, the merits of each approach is then discussed. The various available research methods are then outlined, paying specific attention to the features of case study research. The features of the chosen research design are then discussed.
Research Design and Methodology

Initial Research Position
- Aims
- Objectives

Literature Review

Research Design

Organisational Case Studies
- Case 1
- Case 2
- Case 3
- Case 4

Data Analysis

Within-Case Data Analysis

Cross-Case Data Analysis

Research Output and Discussion

Case Study Protocol
GT Coding Protocol
Conceptual Framework

Organisational Survey

Figure 3-5 - Overview of Research Approach
Chapter 4 - Conceptual Framework and Research Protocol

4.1. Introduction

Following the research design and methodology detailed within Chapter 3, this chapter presents the development of a supportive conceptual framework and research protocol. Utilising the evidence from the literature review and the developed epistemological propositions, the conceptual framework outlines the key features and concepts within the response of an organisation to disruptive events. The conceptual framework develops from previous trends within literature and extends to address the phases of detection and activation within the response of an organisation. As such, this chapter begins to address the research objective RO3 (presented within Chapter 1, section 1.3). In addition, in order to support the researches aims and objectives, the development of a case study protocol and grounded theory coding protocol are also detailed.

4.2. Conceptual Framework

As outlined within previous chapters, this research follows a theory building approach within exploring and developing a comprehensive understanding of the dynamics of organisational resilience. This approach is based on drawing conclusions (Meredith, 1998) through establishing and developing definitions, domains, relationships and predictions (Wacker, 1998). Theory building research thereby forms an iterative process that cycles through phases of description, explanation and testing (Meredith, 1993). The development of conceptual models and frameworks thereby supports the phases of description and explanation within research. In relation to this theory building approach, the developed conceptual framework strives to characterise the key features of organisational responses to high impact events. As such, key concepts and variables are introduced and the theoretical relationships between variables established. Through this, the framework draws specific attention to the previously neglected areas of detection and activation within organisational response frameworks.
An important aspect of theory building research is comparing emergent concepts, constructs and theories with extant literature (Eisenhardt, 1989). To address this, the development of this conceptual framework will follow the work of Flynn et al (1990), Meredith (1993, 1998), Lynman (2002) and Stuart et al (2002) in relation to a theory building approach. A conceptual framework provides a representation of the main concepts and variables under investigation and the presumed relationship between them (Punch, 2009). The development of the conceptual model follows a largely exploratory perspective, where the objective is to establish an understanding of the fundamental variables involved within organisational level resilience (Malhotra and Grover, 1998).

Conceptual frameworks are an important aspect of Operations Management research as they can increase the external validity of the field and are readily adaptable for organisations through providing guidelines for managers (Meredith, 1993). Whereas a conceptual model could be used to describe an event, a conceptual framework can be used to provide an understanding of the underlying dynamics of a concept. The resulting conceptual framework aids in not only providing construct validity but also provide an outline for future research activities (Flynn et al, 1990).

4.2.1. Resilient Response Framework

Following the evidence of the literature review and following the rationale of Miles and Huberman (1994), a conceptual framework was developed to illustrate and explain graphically the main factors, constructs and variables in relation to the response of an organisation to a major disruption. The developed framework, shown in Figure 4-1, includes the previously neglected features of detection and activation, and aims to conceptualise organisational adaption and resilience during disruptive periods. The framework aims to provide an improved understanding of organisational behaviour during turbulent conditions and begins to explore the linkages between organisational resilience and other business strategy concepts such as competitive advantage and risk management.

The framework of organisational responses presented within Figure 4-1 was developed following the work on organisational behaviour amidst radical
environmental change (Staw et al, 1981; Barnett and Pratt, 2000). This area is largely conceptual and has received little empirical support. Staw et al (1981) present a model of organisational response based on threat rigidities; through the model it is suggested that impending threats or crises invariably lead to maladaptive organisational cycles and rigid organisational responses. As such the authors propose that only through a rigid organisational response will an organisation be able to effectively mitigate a major disruption or threat.

This was then extended by Barnett and Pratt (2000) who identified that through emphasizing rigidity as the primary response of an organisation to a threat, organisational opportunities for development and survival could be restricted. Instead a flexible response was proposed (Barnett and Pratt, 2000) leading to the resilient perspective on organisation sustainability and strategy through viewing organisations as efficacious entities able to absorb complexity and preserve function despite significant discontinuities. Through this organisations are able to recover from unexpected events (Weick and Sutcliffe, 2001) and major disruptions (Sutcliffe and Vogus, 2003). As such two different characterisations of organisational response are recognised. Following the early work of Staw et al (1981) the rigid response is outlined, this has later been classified as a ‘negative adjustment’. Where, during a disruptive event, control is restricted to a central authority and the organisation functions through its traditional channels. While through the work of Barnett and Pratt (2000) and the recognition of the flexible response has lead to the development of the ‘resilient response’ and the subsequent ‘positive adjustment’ to turbulence. This is reflected in the proposed working definition of organisational resilience, presented within Chapter 2 Section 2.9, and the linkages within the developed conceptual framework, presented within Figure 4-1. The positive adjustment of an organisation thereby represents the ability of organisational systems to cope, adapt, recover and advance from disruptive events.

Within the conceptual framework, each node represents an identified concept or construct within the response of an organisation. The connection between two nodes is then represented by a connecting arrow. Following the evidence of the literature review, solid arrows indicate an established causal connection between two concepts.
or 'nodes'. The dotted arrows indicate an ‘unestablished’ exchange between two or more nodes. As such, this linkage represents an inferred connection. Two-way arrows indicate a reciprocating exchange between two nodes.

Utilising a developmental perspective to recognise the fallibility and probability of successful coping and adaption within turbulent conditions, Sutcliffe and Vogus (2003) present a literature review and conceptual framework for organisational responses relating to organisational level resilience. Within this framework it is identified that the dynamics that create and retain organisational resources and competencies in a flexible, storable, convertible and malleable form give rise to resilience. This ability within an organisation’s cognitive, emotional, relational and structural resources allow organisational systems to avoid maladaptive tendencies and positively cope and adjust to unexpected complexity and disorder (Sutcliffe and Vogus, 2003).

Sutcliffe and Vogus (2003) state that organisational level resilience is based on the organisational processes and resources focused on developing the competence and growth of an organisation. Organisational level resilience is thereby based on the capability to restore efficacy, the ability to effectively process environmental feedback and flexibly rearrange and transfer knowledge and resources to overcome a given disruptive event (Sutcliffe and Vogus, 2003). Although the framework presented by the authors does provide an improved perspective on the complexities and intricacies
of organisational responses, the framework neglects several features of resilience identified within a wider context of literature. As such, the conceptual framework of organisational responses developed within this research acts to not only unify several trends of literature but also provide a solid conceptual base for empirical study.

Within the conceptual model, Figure 4-1, the capability of an organisation for both positive and negative adjustment is recognised. The resilient response of an organisation relates to the fundamental properties of resilience identified within the epistemological propositions and the proposed working definition of organisational resilience. Through this, concepts such as the adaptive cycle (Holling, 2001; Walker et al., 2002; Fiksel, 2003; Cumming et al., 2005) can be conceptualised within organisations. As such, within the framework the resilience response phase represents the culmination of a proactive approach to threat mitigation through an organisation cultivating the elements of resilience. The phases of detection and activation are interlinked within the organisational response framework; this interconnection reflects the relationship between cause-and-effect through the causality between the impending threat and the adjustment of an organisation.

4.2.1.1. Critical Phases: Detection and Activation

The period of detection and activation is recognised as a critical junction in an organisation’s ability to adjust positively to a disruption. However, an organisation’s ability to take a proactive approach to threat mitigation is partially governed by the organisation’s ability to recognise potential discontinuities. Within the presented conceptual framework this notion of proactive behaviour draws influence from the notion of ‘mindfulness’ presented by Weick and Sutcliffe (2001; 2006). The ability of the organisation to recognise potential threats is then interlinked with the organisation’s capability to feedback critical information to the appropriate system or authority. Recognising and interpreting threats effectively is therefore an important stage in the positive adjustment of system to a potentially severe event. The positive adjustment of an organisation to turbulence can therefore be defined as the organisation taking a proactive approach during the phases of detection and activation.
Within the organisational response framework the linkages between detection and activation (shown in Figure 4-2) could be conceptualised as the fundamental components of a system’s ‘adaptive capacity’. As shown by the study of Carpenter et al (2001) into resilience, the adaptive capacity of a system is related to the mechanisms for the creation of novelty and learning. In addition to this, the adaptive capacity of a system can be defined as a system’s robustness to alterations or changes in resilience (Gunderson, 2000). Within Gallopins (2006) model of the components of vulnerability, a system’s adaptive capacity is linked with a system’s capacity of response and is defined as the ability of a system to evolve in order to ‘accommodate’ environmental threats or changes. As such the adaptive capacity relates to the ability to expand the range of response variability.

Literature has predominately referred to or emphasised resilience as a means to recover from disturbances, however, the concept of adaptive capacity may also lead to establishing new system equilibriums or stability domains, allowing a system to adapt to new environments (Fiksel, 2006). Through this, resilience is established from a system’s adaptive capacities, and can be regarded as the process of linking resources to outcomes (Norris et al, 2007). As such the adaptive capacity of a system can be viewed as the mechanism of resilience. In relation to the organisational response framework (Figure 4-1), detection and activation are therefore the fundamental mechanisms for eliciting an effective resilient response.

Carpenter et al (2001) identify that the adaptive capacity of a system also reflects the learning aspect of a system’s behaviour in response to a disruption. Within organisations, adaptive capacity refers to the ability to cope with unknown future circumstances (Staber and Sydow, 2002). As a result, organisations that focus on
enhancing a systems adaptive capacity will not experience environments passively; instead the organisation will continuously develop and apply new knowledge in relation to the operating environment. This is reflected within the conceptual framework through the linkage between learning and enhanced monitoring. Rather than identifying the existing demands and then exploiting the available resources, adaptive organisations will reconfigure quickly in changing environments (Staber and Sydow, 2002). Through this, the adaptive capacity of an organisation aids in better preparedness for turbulent environments.

Event perception is also an important facet of an organisation’s ability to respond effectively to altered environmental conditions, this is reflected in Figure 4-2. Milliken (1987) establishes that given the nature of uncertainty it can be difficult to identify threats and opportunities with any degree of confidence. Therefore, as stated by Papadakis et al (1999) the characterisation of an event can directly influence the potential response of an organisation. It is through this characterisation that an event can be seen as either a threat or an opportunity, as such; event perception is closely linked to the activity of environmental scanning and recognising environmental fluctuations. As such, understanding organisational vulnerabilities is essential within the detection of potentially disruptive events. However, when a potentially disruptive event is recognised, unless the organisation has the capacity to take advantage of the opportunity, no real value can be attached to the event characterisation (Harms et al, 2009). It is therefore vital to develop the necessary capabilities to allow the organisation to respond effectively to future events.

4.2.2. Detection

The phase of detection (Figure 4-3) is related to both the environmental feedback controls and the assessment of operating conditions. Through this it is possible to develop an ‘embedded intelligence’ within organisational systems with an awareness of both the internal and external system conditions and intricacies. Without conceptualising the elements of detection within the framework, key factors, such as organisational learning, may be neglected, limiting an organisation’s ability to effectively develop and deploy dynamic responses and elicit a positive adjustment to a
disruption. Understanding not only the requirements of a given organisational system but also the system vulnerability is essential in developing a proactive approach to threat mitigation and enhancing an organisation’s adaptive capacity.

As shown by Sheffi (2007) in regards to supply chain disruption, high impact low probability (HILP) events require planning and response activities outside of traditional work routines and standard operating procedures. The limitations of traditional system responses is highlighted by the difficulty in interpreting low probability events during the decision making process (Camerer and Kunreuther, 1989). This is possibly through uncertainties being large and difficult to characterise (Sheffi, 2007); high-impact events will therefore affect an organisational systems on a much wider scale. The environmental conditions may also change faster than the forecasting model or environmental feedback controls can process information. Subsequently, to enable a proactive positive adjustment a broader range of information processing is required. Through this organisational systems can be developed to be not only adaptive to the requirements of the disruption mitigation process, but also flexible in their ability to return to a pre-disruption structure and performance.

Through an organisation’s self assessment of vulnerabilities, the process of detection within the developed framework (Figure 4-1) enables both an improved internal and external situational awareness. This in turn can aid in the development of an organisation’s adaptive capacity (McManus et al, 2007) and can be viewed as a reciprocating relationship between an organisation’s assessment of vulnerabilities and the analysis of the operating environment. Understanding the demands of the
operating environment and the potential organisational vulnerabilities to it is essential for an organisation to begin to explore and take advantage of the linkages between ‘cause-and-effect’.

4.2.3. Activation

When discontinuity is introduced into an organisational system, the system is plunged into a temporary period in which the organisation must strive to restore order; this is a critical period within the response of an organisation. Figure 4-4 outlines the fundamental characteristics of response activation. Organisations that can intelligently absorb both internal and external system signals and are subsequently able to effectively mobilise their accumulated resources and capital will be more proactive and able to successfully adjust to environmental turbulence and discontinuities (Hatum et al, 2006). Although the morals of a proactive approach are recognised, previous models have not accounted for the activation of organisational responses.

Within the activation phase, an organisation can begin to deploy the available relational and cognitive resources within the organisational system. Through this, the phase of activation is vital within the conceptualisation of an organisation’s ‘adaptive cycle’ (Holling, 2001). As such, the phase of activation forms a critical junction in an organisation’s ability to elicit a positive adjustment to a disruption. The activation phase within the conceptual framework (Figure 4-1) therefore represents the initial
stages of an organisation’s response to threats and discontinuity; this is reflected within the phase of ‘Response Preparations’ within Figure 4.4.

4.3. Research Protocols

Following the development of the Resilient Response Framework, the following sections detail the research protocols employed within this research. The research design follows a grounded theory approach using a multiple case study design. This approach was considered the most appropriate given the researches aims and objectives. As a result, both a case study protocol and grounded theory coding protocol were developed. These protocols were employed to ensure the validity and reliability of the research findings.

4.4. Case Study Protocol

As identified by several authors (Yin, 2009; Sturat et al, 2002; Gibbert et al, 2008) developing a case study protocol aids in developing a reliable case study through developing a report and design framework that specifies and outlines how the entire case study will be conducted. Through this the case study protocol provides a structured guide for data collection (Rowley, 2002). Stuart et al (2002) elaborate this point through stating:

“The protocol encompasses the principal documentation needed to provide the researchers with the necessary focus, organise the visits and ensure that the trail of evidence is thoroughly documented.” (Stuart et al, 2002)

To achieve this, the protocol should include the following sections (Rowley, 2002):

1. An overview of the case study project
2. Field procedures, such as the different sources of information, and access arrangements to these sources
3. Case Study Questions

4.4.1. Outline of Case Study Protocol

The following table (Table 4-1) presents an overview of the case study protocol. A more detailed version is presented within the following sections.
Table 4-1 - Case Study Protocol Features

<table>
<thead>
<tr>
<th>Protocol Phase</th>
<th>Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Contact</td>
<td>Guidelines for contacting the relevant individuals within selected organisations to discuss research participation</td>
</tr>
<tr>
<td>Data Sources</td>
<td>Identifying relevant individuals within participating organisations</td>
</tr>
<tr>
<td>Research Timeframe</td>
<td>Schedule of arranged meetings with targeted individuals and organisations</td>
</tr>
<tr>
<td>Interviews</td>
<td>Outline content of interviews including areas of interest, specific questions and sources of data</td>
</tr>
<tr>
<td>Documentation</td>
<td>Suggested documentation to support data collected</td>
</tr>
<tr>
<td>Data Catalogue</td>
<td>Organised catalogue of case study notes, documents and narratives</td>
</tr>
</tbody>
</table>

4.4.2. Overview of Case Study Project

4.4.2.1. Purpose

From an operations management (OM) perspective, the research will strive to explore the features of organisational resilience in relation to the adaption of an organisation to a disruption. As such the focus will be on establishing the features of an organisation’s resilient response to turbulence and discontinuity.

4.4.2.2. Objectives

In relation to the research aim and objectives presented within Chapter 1 Section 1.2 and Section 1.3, the case study protocol set the following objectives:

1) Explore the response procedure/chain of events during an organisation’s response to a disruption (RO2, RO3)
2) Identify and explore an organisation’s detection of a disruption (RO3)
3) Explore the influence of organisational capabilities on organisational responses (RO3, RO4)
4) Identify the critical success factors of an effective resilient response (RO2, RO3)
5) Explore the strategic implications of organisational resilience (RO4)
4.4.3. Case Study Protocol Field Procedures

The case study protocol is divided into five distinct sections in order to provide a structured approach for data collection and analysis. Appendix B presents a Template for Case Study Protocol. The sections within this template were developed following the fundamental properties of resilience as outlined by Ponomarov and Holcomb (2009). These sections include:

1) Introduction
2) Readiness and Preparation
3) Response and Adaption
4) Recovery and Adjustment
5) Dynamics of Resilience

The developed case study protocol sections address several aspects of resilience through a structured approach. An organisation’s readiness and preparedness for potentially disruptive events builds on the organisation’s experience before, during and after an event. This section of the protocol addresses an organisation’s strategy, planning, actual experience (both individual and organisational) and elements of organisational performance.

The following section addresses the response and adaption of an organisation to a disruption. This section of the protocol aims to develop understanding of how organisations are able to mitigate the impact of the threat and produce effective and efficient performance in the face of adversity. The recovery and adjustment section addresses the process through which organisational elements readjust and recuperate from a disruptive event.

4.4.3.1. Readiness and Preparation

An organisation’s readiness and preparedness for potentially disruptive events builds on an organisation’s experience before, during and after an event. It addresses an organisation’s strategy, planning, actual experience (both individual and organisational) and elements of organisational performance.
4.4.3.2. Response and Adaption

The response of an organisation to a disruption aims to mitigate the impact of the threat and produce effective and efficient performance in the face of adversity. This includes factors such as threat detection, the activation of the organisation’s response procedures and the active response of the organisation to the event.

4.4.3.3. Recovery and Adjustment

Organisational recovery is the process through which organisational elements readjust and recuperate from a disruptive event. Factors influencing the operation of the organisation following a disruptive event will be explored, as well as the outcomes of a successful response.

4.5. Grounded Theory Coding Protocol

At the foundation of the grounded theory approach, as developed by Glaser and Strauss (1967), is the procedure through which data is analysed. Although there have been several derivations of the original methodology and grounded theory procedure, the grounded theory approach developed as a hybrid method that combines two distinct data analysis methods (Walker and Myrick, 2006). Within the first method, the data collected during the study is systematically coded. These codes are then analysed to support a given hypotheses or propositions of the research. The second method does not specifically involve coding the data, but instead develops categories for the data. These categories are then used to develop the theoretical ideas within the data. The grounded theory approach, strives to combine both of these analysis methods to provide a systematic framework and procedure for the development of theory through the constant comparison of data.

Within Grounded theory, data analysis has a distinct process which begins with a basic description and develops into conceptual ordering and theorising (Walker and Myrick, 2006). Coding forms the basic analytic process (Corbin and Strauss, 1990). Coding involves an analytic interpretation of the data collected. The process involves defining segments of data with a label that simultaneously categorises, summarises and accounts for each feature of the data collected (Charmaz, 2006). There are three
fundamental types of coding within grounded theory studies: open coding, axial coding and selective coding.

Within open coding the researcher begin to develop initial categories about the phenomenon from the initial data gathered within the study (Robson, 2011). Axial coding involves assembling the data in new and novel ways following the initial phase of open coding. This process allows for the development of a ‘coding paradigm’ which supports several features of data analysis within grounded theory (Robson, 2011). These include:

- Identifying the central phenomenon under study
- Exploring causal conditions
- Specifies strategies, actions and interactions that emerge from the phenomenon under study
- Identifies the context and intervening conditions
- Delineates the consequences and outcomes for the phenomenon

The final phase of the coding process is termed ‘selective coding’. This phase involves the integration of the categories within the developed axial coding paradigm. During this process, conditional propositions or hypotheses can be developed (Robson, 2011). The below figure (Figure 4-5) presents the major phases involved within the coding and analysis of grounded theory data as identified by Eaves (2001).
The coding procedure within the grounded theory approach is at the core of the data analysis process (Walker and Myrick, 2006) and consists of defining and categorising the data collected during the case studies. As such, the coding procedure is defined as an analytic process in which data is ‘fractured, conceptualised, and integrated’ in order to form a theory (Strauss and Corbin, 1998, p.3). As identified by Salinger et al (2008), the core of the grounded theory approach consists of three fundamental elements. These are:

- **Theoretical coding**: Within the grounded theory approach, the codes that are developed from the data are theoretical and not just descriptive. As such, the codes reflect the concepts within the data and provide the potential explanation of the phenomena under consideration.
- **Theoretical sampling**: During the course of the data analysis, the selection and analysis of material is made incrementally based on what is most relevant for the development of a theory.
• Constant comparison: In order to develop accurate and consistent codes, the observed phenomena is continually compared between the sources of data collected.

This is reflected in the grounded theory approach as outlined by Eaves (2001). This is represented within the Figure 4-6. The figure identifies the major stages and sub-stages involved within the synthesis of grounded theory data.

4.5.1. Sampling and Constant Comparison

The grounded theory approach provides an iterative process towards the development of a theory ‘grounded’ within the data collected. The fundamental features of the approach are that of ‘theoretical sampling’ and ‘constant comparison’. During the development of the theory the researcher constantly undertakes data collection, coding and interpretation until theoretical saturation is reached (Binder et al., 2008). The constant comparison method followed within the grounded theory approach means that the derived themes and concepts are grounded in the data rather than being preconceived. The method also provides guidelines for the collection of additional data in order to develop a more complete theory of the phenomena under consideration (Moghaddam, 2006).

"The grounded theory approach is not linear but concurrent, iterative and integrative, with data collection, analysis and conceptual theorizing occurring in parallel and from the outset of the research process. This process continues until the theory generated explains every variation in the data. The resulting theory is a robust theoretical explanation of the social phenomenon under investigation." (McGhee et al, 2007)
The constant comparison method involves comparing aspects within the collected data in order to identify emerging patterns and themes (Moghaddam, 2006). The comparison explores and analyses incidents and events within the data that appear to belong to the same category. The method identifies differences and similarities within the data, as concepts are established and the theory begins to develop, further data may be required in order to strength the validity of the developing theory. This process is referred to as ‘theoretical sampling’. Once no new properties, dimensions or
relationships emerge from the data during analysis, theoretical saturation is said to have been reached.

### 4.5.2. Grounded Theory Coding Process

One of the principle techniques within the grounded theory approach is the use of an inductive analysis process (Bowen, 2006). This process allows for the development of categories or nodes directly from the collected data through the grounded theory coding process. The coding process involves both a descriptive and interpretative approach within the analysis of data (Miles and Huberman, 1994). The resulting nodes have several key features (Thomas, 2006). These include:

- A node label – This label identifies the category
- Node description – This description outlines the meaning, features key characteristics and scope of the node.
- Data associated with a category – Use of extracted data to illustrate meanings, associations and perspectives within nodes
- Linkages – There may be links or relationships between nodes and sub-nodes within the collected data. Linkages may be based upon commonalities in meanings between nodes or assumed causal relationships.
- Nodes may be embedded into a model – The development of categories can be used towards the development of models, frameworks or an eventual theory.

As detailed within Section 4.5, the grounded theory coding process follows three phases: Open Coding, Axial Coding, and Selective Coding. The coding process for each of the organisational case studies is then captured within the development of a coding database. The resulting database outlines the extracted nodes from the transcribed interviews in relation to the coding and analysis process outlined by Eaves (2001). The components within the coding database are detailed within Table 4-2.

**Table 4-2 - Grounded Theory Coding Database**

<table>
<thead>
<tr>
<th>Component</th>
<th>Coding Phase</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concepts</td>
<td>Open Coding</td>
<td>Extracted coding from line-by-line analysis</td>
</tr>
<tr>
<td>Initial Group</td>
<td>Open Coding</td>
<td>Grouping of extracted concepts towards establishing context</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------</td>
<td>------------------------------------------------------------</td>
</tr>
<tr>
<td>Theme</td>
<td>Open Coding</td>
<td>Establishes the dimensional range for extracted concepts. Provides grouping and categories for analysis.</td>
</tr>
<tr>
<td>Node Group</td>
<td>Axial Coding</td>
<td>Identifies subcategories and causal conditions for extracted concepts. Identified linkages and commonalities between nodes.</td>
</tr>
<tr>
<td>Node</td>
<td>Axial Coding</td>
<td>Outlines the central phenomenon represented by the extracted concept</td>
</tr>
<tr>
<td>Sub-node</td>
<td>Axial Coding</td>
<td>Outlines intervening condition related to the identified node</td>
</tr>
</tbody>
</table>

Following the development of the coding database, the developed nodes are then extracted and refined; identifying characteristics, properties and dimensional ranges. Linkages and connections between nodes are then outlined in relation to the identified themes and node groups; a network of nodes is then created. The refined nodes are then translated into causal networks following the inductive approach outlined by Miles and Huberman (1994). The resulting networks are refined and rearranged to reflect the relationships within the data. The developed causal networks thereby provide an extension of the Selective Coding process as outlined by Eaves (2001). Through this the extracted nodes are unified around a central core category within the grounded theory approach (Corbin and Strauss, 1990). The resulting networks relate extracted nodes at a dimensional level; reflecting linkages and relationships between nodes. As such, the developed causal networks provide a diagrammatic representation of the connections and interactions between extracted nodes. A detailed summary of the coding process is provided within Appendix B.

4.6. Conclusions and Implications

The developed Resilient Response Framework develops from previously published literature related to the response of an organisation to change and disruptive events. The conceptual framework addresses the features of both positive and negative
adjustments within response activities. Through this the framework draws specific attention to the phases of detection and activation. Within the framework, the resilient response to a perceived threat or disruptive event is considered a positive adjustment. Allowing an organisation to effectively utilise its developed and accumulated resources and capabilities.

In order to support the achievement of the researches aims and objectives, both a case study protocol and grounded theory coding protocol were developed. These protocols support the intended research design; providing a structured approach within the collection, analysis and discussion of research data and findings. The case study protocol is developed around the identified features presented within the Resilient Response Framework. While the grounded theory coding protocol is based on the work of Glaser and Strauss (1967).

4.7. Summary

This chapter details the development of conceptual framework based of the evidence presented within Chapter 2. The developed Resilient Response Framework provides a graphical representation of the key features and concepts under investigation and the perceived relationship between them. Following this, the development of both a case study protocol and grounded theory coding protocol is detailed. These research protocols support the intended research design (presented within Chapter 3) and support the researches theory building approach.
Chapter 5 - Organisational Resilience Survey

5.1. Introduction

This chapter details the development and analysis the Organisational Resilience Survey. Following a review of literature related to organisational resilience and other associated concepts, an organisational survey was conducted as a means of gathering feedback and information about the understanding of resilience within UK industry. The Organisational Resilience Survey provides a means of understanding practitioner perception of issues related to resilience and the subsequent response of an organisation to a threat or disruption. As such, the survey begins to address the research objectives RO2 and RO4 (presented within Chapter 1, section 1.3).

5.2. Survey Aim and Objectives

The aim of the survey was to gauge the perceptions of UK industry practitioners in issues related to resilience and the influence of an organisation’s capabilities in the response to disruptions. The survey formed an exploratory tool used within the early stages of the research, in order to gain a preliminary understanding of the concept of organisational resilience prior to more in-depth qualitative research activities.

The objectives of the Organisational Resilience Survey include:

- Initial perception of resilience
- Provide an indication of the influence of organisational capabilities
- Provide an understanding of the impact of a disruption across organisational levels
- Address factors related to the response of an organisation to a disruption

For the Organisational Resilience Survey, an initial pilot study was conducted to aid in the development of the survey. Following the pilot testing of this survey, an introductory covering letter offering an overview of current research activities was sent out to potential respondents through post and electronically via email. An online link to the survey was also included. Following a non-response, the organisations were
Organisational Resilience Survey

contacted and follow up correspondence sent. Data from the completed surveys was then collected and analysed.

5.3. Survey Development

The Organisational Resilience Survey was developed through an extensive literature review, and previously outlined theoretical work presented within Chapter 2 (Epistemological Propositions) and Chapter 4 (Conceptual Frameworks). The survey was composed of three scales: the Organisational Resilience Scale, the Organisational Response Scale and the Organisational Capabilities Scale. Each scale was composed of independent items related to the objectives of the survey. The completed survey is shown within Appendix C. The development process for the Organisational Resilience Survey is shown within Figure 5-1.

![Survey Development Process](image)

**Figure 5-1 - Survey Development Process**

The Organisational Resilience Scale provides an initial assessment of items related to resilience prior to the onset of an event. Respondents were asked to rate items linked to resilience following the resilience audit developed by Weick and Sutcliffe (2001). This allowed for the identification of resilience constructs within the routine or ‘day to day’ operations of an organisation. Organisational Response Scale was developed following the evidence of the literature review related to resilience and organisational responses. Based largely on the work of Staw et al (1981), Branett and Pratt (2000) and Sutcliffe and Vogus (2003), this section provides an understanding of the features
of an organisational response. Finally, the Organisational Capabilities Scale provides an assessment of the influence of identified organisational capabilities within the response of an organisation. Pertinent organisational capabilities were identified through Horne and Orr (1998), Mallak (1998), Ulrich and Lake (1991) and Ulrich and Smallwood (2004).

Within each of the survey scales, items were assessed through the use of a five point Likert scale. The Likert scale allows researchers to identify the ‘position’ of respondents on certain issues represented by items within the survey (Flynn et al., 1990). This means that it is possible to gauge respondents’ perceptions of their own experiences with a higher degree of confidence. Responses ranged from (1) Strongly Disagree to (5) Strongly Agree; with (3) forming a neutral position. Although the response categories for items have a ranked order, the intervals between categories are not equal. As such, the Likert scale provides an ordinal measurement of items (Jamieson, 2004). The five point scale was considered appropriate as reliability within scale items increases as the number of scale points increases. After a five point Likert scale, the rate of increase within reliability is much lower (Hensely, 1999). Additionally, the Likert scale allows for items for be more easily interpreted and analysed than open ended attitude questions. The results can then be summated in order to measure a more general construct (Flynn et al., 1990). Where open ended questions were asked, multiple choice and pre-coded answers were provided through the use of tick boxes. Following a largely explorative approach, the survey was also kept relatively short. The length of a survey has a direct impact on the eventual response rate, with longer survey’s achieving a lower response rate (Hensely, 1999).

5.3.1. Survey Sample

Sampling is an important issue within the development of a survey as the process of sampling refers to the selection of units of analysis for a particular study (Seale, 2004). The process determines particular information about larger populations with a known level of accuracy, the researcher is then able to generalise characteristics and features to the population (Forza, 2002). There are two distinct groups of sampling methods, that of Probability and Non-probability samples. Within probability methods, each
potential respondent within a population has a known chance of being selected for the sample. While within non-probability methods do not allow for an estimate of the extent to which sample statics may differ from population parameters (Walliman, 2002).

Within the Organisational Resilience Survey, respondents from across UK industry were selected through purposive sampling; a form of non-probability sampling. The study was focused on organisations based within engineering and technology sectors. This sampling method is typically characterised by the use of the researchers' judgement to establish a representative sample by including typical areas or groups within the sample (Walliman, 2002; Gelo et al., 2008), meaning that the use of purposive sampling intentionally seeks out individuals or situations that are likely to yield new instances or greater understanding of the concept under consideration. This is achieved through the researcher selecting ‘information rich’ cases, such as individuals, groups, organisations or behaviours that provide the greatest insight into the research question (Devers and Frankel, 2000).

Following the evidence of the literature review individuals involved within strategic management appeared the most appropriate potential respondents. Individuals within strategic management are typically involved within issues related to resilience such as business continuity management, recovery planning and risk management.

5.3.2. Pre-testing and Pilot Survey

In order to determine whether the developed survey would achieve the desired aim and objectives, pre-testing and a pilot study was conducted to ensure the suitability and appropriateness of the survey. This was achieved through the use of convenience sampling in order to provide feedback towards the development of the survey (Flynn et al., 1990). Within this phase of the research, the survey pre-testing allowed for feedback and comments to aid in the development of the survey prior to distribution. The pre-testing of the survey was done through the review of the survey by ten academics from Loughborough University. Following the feedback and comments received, the Organisational Resilience Survey was amended and refined. Following the pre-testing and refinement of the survey, a pilot study was conducted. As the
Organisational Resilience Survey

Survey would be self completed by respondents, pilot testing prior to survey distribution and administration can prove crucial in identifying potential areas of confusion and misinterpretation within the survey. The pilot test involved the completion of the survey by ten industry practitioners that were know to the researcher prior to conducting the research activities. In addition to the industry practitioners, the survey was completed by ten Masters (Msc) students from Loughborough University. There were no issues identified through the pilot testing phase and it was assumed that the survey design was satisfactory.

A summary of the feedback and comments is shown in Table 5-1.

Table 5-1 - Pre-Testing Comments

<table>
<thead>
<tr>
<th>Comment</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>The structure of the survey was unclear</td>
<td>The survey was divided into three clear sections with associated headings</td>
</tr>
<tr>
<td>The length of the survey was too long</td>
<td>The number of items within the survey was reduced to those with established importance from the literature base</td>
</tr>
<tr>
<td>The survey used complex academic language</td>
<td>The questions and instructions within the survey were refined and where appropriate addition descriptions added</td>
</tr>
<tr>
<td>Several of the items relating to organisational capabilities were considered too broad</td>
<td>The items relating to these particular capabilities were refined and where necessary additional items added</td>
</tr>
<tr>
<td>The use of open ended questions was deemed to be 'too involved'</td>
<td>Open ended questions were removed, and an additional comments section added</td>
</tr>
<tr>
<td>Disagreement over the definition of certain capabilities</td>
<td>The definitions for all of the identified capabilities were reviewed and where appropriate in conjunction with literature refined and adjusted</td>
</tr>
<tr>
<td>Possible mixed interpretation of certain items</td>
<td>Questions and instruction were clarified</td>
</tr>
</tbody>
</table>

5.3.3. Response Rate

Following the deployment of the web based survey; a final response of 117 participants across 39 organisations was achieved. Data was collected across three rounds of sampling within Engineering and Technology organisations. Multiple responses were collected across each of the participating organisations. A total of 250 organisations were contacted within the sample; round one: 100 organisations; round two: 100 organisations; round three: 50 organisations. This gave a response rate of
15.6%. Although the response rate was below a desired level of 20% (Flynn et al., 1990), given the explorative nature of the survey, the response rate was considered suitable.

5.4. Survey Results

The following sections detail the results of the Organisational Resilience Survey.

5.4.1. Descriptive Statistics

Prior to an in-depth statistical analysis of the survey results a descriptive statistical analysis was conducted. This analysis contains measures of the mean, standard deviation, median and range for each of the survey items across each scale and identifies the quantities and frequencies of each variable. The analysis provides an initial assessment of the importance associated with a particular variable in relation to the constructs under investigation. As such, descriptive statistics outline the characteristics of the sample. The descriptive statistics for each of the survey scales are shown within Appendix D.

Within the Organisational Resilience Survey, respondents were asked to outline any organisational disruptions they may have experienced during their time at their respective organisations. The results are shown within Figure 5-2. The largest proportion of respondents indicated ‘no disruption’ during their time within the organisation (38 respondents). Financial, Supply Chain and Damage or failure of Products/Services were the most commonly experienced disruptions.

Given the time of the survey’s deployment, January 2011 to February 2012, the high ranking of financial disruptions is unsurprising. The causes of the Global Financial Crisis (2007 – present) are complex. During the mid 2000s, global markets experienced a relatively strong economic performance, characterised by robust economic growth, expansion of international trade and financial flows and development across emerging and developing nations and economies. However, this period of growth and expansion was underpinned by increasingly unstable factors. Real estate values were rising at a high rate across many countries. Economic markets were running high and rising current account deficits and a significant leverage had developed in many
sectors across the globe (Obstfeld and Rogoff, 2010). These factors contributed greatly to the collapse of mortgage backed securities held within many countries, causing the worst global recession since the 1930’s. The resulting crisis has had dramatic implications for banks, organisations, investors and governments across the world.

The second most pertinent disruption was that of ‘supply chain disruptions’; accounting for almost 19% of the responses. Supply chains create a complex set of interdependencies between organisations, often characterised through nonlinear and complex interactions. Additionally, as a result of significant operational and environmental changes, supply chains are becoming increasing vital to the success of an organisation and subsequently more complex and vulnerable (Pettit et al, 2010).
Broadly characterised, potential supply chain disruptions and risks include delays (delivery disruptions), failure of single source suppliers, forecast inaccuracies, system breakdowns, intellectual property breaches, procurement failures, inventory problems, capacity issues, accidents, national incidents, supply quality standards and contract breaches (Chopra and Sodhi, 2004). Contributing factors towards disruptions within supply chains include (Pettit et al, 2010):

- Increasingly globalised supply chains
- Development of specialised factories and facilities
- Centralised distribution centres
- Increased outsourcing
- Reduced supplier base
- Increased volatility of demand
- Technological innovations

Table 5.2 - Impact of Disruptions

<table>
<thead>
<tr>
<th>Disruptions</th>
<th>Individual and Personal</th>
<th>Departmental</th>
<th>Managerial</th>
<th>Senior Management</th>
<th>Organisational</th>
<th>Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.74</td>
<td>1.90</td>
<td>1.91</td>
<td>1.82</td>
<td>2.13</td>
<td>1.18</td>
</tr>
<tr>
<td>2</td>
<td>3.45</td>
<td>3.70</td>
<td>2.95</td>
<td>3.50</td>
<td>3.50</td>
<td>2.75</td>
</tr>
<tr>
<td>3</td>
<td>3.70</td>
<td>5.30</td>
<td>5.30</td>
<td>5.70</td>
<td>5.70</td>
<td>5.00</td>
</tr>
<tr>
<td>4</td>
<td>0.00</td>
<td>2.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>0.00</td>
</tr>
<tr>
<td>5</td>
<td>3.57</td>
<td>4.86</td>
<td>4.86</td>
<td>4.86</td>
<td>5.14</td>
<td>6.14</td>
</tr>
<tr>
<td>6</td>
<td>8.00</td>
<td>6.00</td>
<td>1.00</td>
<td>1.00</td>
<td>4.00</td>
<td>5.00</td>
</tr>
<tr>
<td>7</td>
<td>6.50</td>
<td>7.50</td>
<td>7.50</td>
<td>5.50</td>
<td>5.00</td>
<td>3.50</td>
</tr>
</tbody>
</table>

In addition to the type of disruption which has impacted an organisation, respondents were also asked to rate the severity of that disruption. This was achieved on a 9 point Likert scale ranging from ‘none’ to ‘severe’ impact. The results are shown within Table 5.2 and displayed within Figure 5.3. The graph plots the average severity of an event
across various organisational levels. Although the greatest proportion of events occurred across a single disruptive event category (69 respondents), the remaining responses indicated events across multiple disruption categories.

![Impact of Disruptions](image)

**Figure 5.3 - Graph of the Impact of Disruptions**

As shown within Figure 5-3, as the complexity of a disruptive event increases through events being characterised through multiple categories, the impact across all organisational levels increases. Complex events also had a greater impact across the industry level, indicating that larger scale events do not effect an organisation in isolation. Instead the events carry greater consequences for the entire organisational network.

**5.5. Factor Analysis**

The following section details the primary statistical analysis method followed within the analysis of the Organisational Resilience Survey. An Exploratory Factor Analysis was used within each of the three survey scales.
The objective of factor analysis is to reduce a number of observed variables to a smaller amount of unobserved factors in order to enhance general interpretability and to detect ‘hidden’ structures within a data set (Treiblmaier and Filzmose, 2010). As identified by Field (2009), factor analysis forms a statistical technique for identifying groups or clusters of variables. The technique can be used to aid in understanding the structure and composition of a set of variables as it allows for the development of an assessment tool capable of measuring the underlying variable under consideration. As such, factor analysis can be utilised to reduce a data set to a more manageable size while still retaining much of the original information as possible (Field, 2009).

Factor analysis can be either confirmatory or exploratory. As Segars and Grover (1993) note, exploratory factor analysis is a useful statistical technique in discovering potential latent sources of variation and covariation in observed measurements. As such, exploratory factor analysis is a suitable validation technique in order to establish construct validity. Confirmatory factor analysis looks to establish if the number of factors and the loadings of measured variables conform to what is expected. Measures thereby are often subject to prior exploratory factor analysis. Confirmatory factor analysis cannot be conducted unless there are specific expectation or hypotheses in regards to the number of factors, which variables will reflect given factors and the degree to which the factors are correlated. As such, confirmatory factor analysis depends largely on whether there is a specific theory regarding the data structure (Thompson, 2004).

As Schmitt and Sass (2011) identify, the main purpose of exploratory factor analysis is to simplify a factor rather than a particular variable. The focus is in learning and exploring the factors rather than the specific variables. In addition, confirmatory factor analysis can prove problematic when it is used to ‘re-specify’ models in an exploratory context (Schmitt and Sass, 2011). As such, the use of exploratory factor analysis is the most appropriate method given the focus and objectives of the Organisational Resilience Survey. Within the analysis of the survey an exploratory factor analysis was used to identify the distinguishing characteristics and factors that influence an organisation’s resilience. Specifically, the organisation’s ability to
respond and recover from disruptive events, and the organisational capabilities (latent variables) that contribute to a successful response.

5.5.1. Statistical Software

The factor analysis was conducted using the statistical computer package SPSS 19; the analysis used is termed ‘principle component analysis’ rather than ‘factor analysis’. However, the two procedures often yield very similar results with both approaches identifying the underlying dimensions of a data set. The difference between the two approaches is within the estimates of communality. While factor analysis derives a mathematical model, principle component analysis decomposes the data into a set of linear variants (Field, 2009).

5.5.2. Rotation

In order to interpret the output from the analysis a rotation method is applied to the data output. This maximizes the loading of each of the analysed variables in relation to the extracted factors while minimizing the loading on the remaining factors (Field, 2009). As such, a method of rotation is applied to the data to clarify the data structure within the analysis (Costello and Osborne, 2005). There are several methods of data rotation available through SPSS (Varimax, Quartimax, Equamax, Direct Oblimin and Promax), these are defined as being either orthogonal or oblique rotations (Field, 2009).

Orthogonal rotation is typically the most common form of rotation applied to data sets as orthogonal rotations produce stable results and allow for easily interpreted results. However the use of an oblique rotation method allows for the correlation between factors to be taken into consideration creating a more accurate representation of the factors (Costello and Osborne, 2005). Additionally, oblique rotation methods do not require that factors be correlated meaning that if the data structure of the data set is orthogonal, valid results are still generated (Treiblmaier and Filzmose, 2010). However, oblique rotation methods are subject to considerable controversy and can produce a slightly more complex output (Costello and Osborne, 2005). As such as suggested by Field (2009), the selection of orthogonal or oblique rotation methods should be done based on the theoretical merit of the items. Field
(2009) suggests that a comparison between the methods should be run and the output compared. If an oblique rotation is used and the difference is negligible, then it is possible to assume that an orthogonal rotation may also be appropriate.

5.5.3. Reliability Analysis

Prior to analysing the survey item scales, the reliability of the scales for Organisational Resilience (RES), Organisational Response (ORS) and Organisational Capabilities (OCS) were evaluated. The reliability measure provides a measure of the consistency and the extent to which an item measures an intended construct (Flynn et al, 1990; Sekeran, 2003). As such, the reliability measure assesses the extent to which an item may be considered suitable. Within the analysis of the Organisational Resilience Survey scales, this was achieved through the use of the Cronbach’s Alpha test (α) (Ward et al, 1995; Hensley, 1999; Hoque, 2004). This test provides an estimate between 0 and 1 for the reliability of an item. The Cronbach’s Alpha test (α) is the most commonly used statistical test for scale reliability (McCutcheon and Meredith, 1993). Values of coefficient alpha (α) over 0.6 are considered acceptable (Nunally et al, 1967). With values greater than 0.9 considered excellent.

The results are shown in Table 5-3. Each of the survey scales was well above 0.8 indicating a high level of reliability. This suggests that the scale items within the Organisational Resilience Survey are internally consistent and comparatively reliable.

Table 5-3 - Survey Scale Reliability Analysis

<table>
<thead>
<tr>
<th>Scale Item</th>
<th>Cronbach’s α</th>
<th>Standardised Item α</th>
<th>Number of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organisational Resilience</td>
<td>0.929</td>
<td>0.932</td>
<td>20</td>
</tr>
<tr>
<td>Organisational Response</td>
<td>0.891</td>
<td>0.902</td>
<td>28</td>
</tr>
<tr>
<td>Organisational Capabilities</td>
<td>0.946</td>
<td>0.946</td>
<td>29</td>
</tr>
</tbody>
</table>

5.6. Data Analysis

The following section details the analysis of each of the three survey scales. An exploratory factor analysis (EFA) using an orthogonal rotation method was used to explore the common characteristics of the three survey scales (Organisational Resilience, Organisational Response, Organisational Capabilities). The objective was
to identify and produce a smaller and more manageable set of factors to represent the relationships among variables.

Prior to the factor analysis a Bartlett's test of sphericity was conducted in order to identify whether the variables within the data set were significantly correlated. A Kaiser-Meyer-Olkin (KMO) measure was also used in order to validate the sampling adequacy. Following these tests, a principle component analysis was then conducted in order to determine the number of factors required within the data set to explain the correlation between the variables. This was achieved through the use of K1 test (eigenvalue>1) and a scree plot diagram.

In addition to the overall KMO value, the individual KMO values for each variable are shown in the anti-image correlation matrix within SPSS. These results are shown on a diagonal line within the correlation table and should ideally all be over the 0.5 threshold (Field, 2009). Principal component analysis also requires that the probability associated with Bartlett's Test of Sphericity be less than the level of significance. Within the variables analysed the probability associated with the Bartlett test should be less than 0.001 (sig. 0.000), in order to satisfy this requirement. The Bartlett’s Test of Sphericity tests the null hypothesis that the original correlation matrix is an identity matrix (Field, 2009). As the probability is less than 0.001, the Barlett’s test is highly significant meaning that the correlation matrix is not an identity matrix and that there are relationships between the analysed variables. Meaning that principle component analysis is appropriate.

Given the relative small size of the sample, 117 participants, the factor loading must be at least ±0.30, with loading of ±0.40 considered significant and loading greater than ± 0.50 considered very significant in the interpretation of the Pattern Matrix (Child, 1990; Field, 2009). Each of the extracted factor components has a factor loading above 0.4. Items with high factor loadings that converge on latent factors within the data set indicate scales with good measurement properties giving an accurate measure of an unobservable phenomena (Segars and Grover, 1993).
5.6.1. Organisational Resilience Scale

A Principle Component Analysis was conducted utilising an orthogonal rotation method (Varimax). From the initial analysis of the data, the Kaiser-Meyer-Olkin (KMO) measure identifies the adequacy of the sample size for the analysed data. It is recommended that the (KMO) be greater than a value of 0.5 as a minimum. The initial analysis of the data for the Organisational Resilience Scale reveals a KMO value of 0.689, indicating that the sample size of the data is adequate for factor analysis or principle component analysis. In addition to the overall KMO value, the individual KMO values for each variable are shown in the anti-image correlation matrix within SPSS. These results are shown on a diagonal line within the correlation table and should ideally all be over the 0.5 threshold. Following a review of the matrix all of the variables were over this threshold.

Table 5-4 - Organisational Resilience Scale Communalities

<table>
<thead>
<tr>
<th></th>
<th>Initial</th>
<th>Extraction</th>
<th></th>
<th>Initial</th>
<th>Extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>1.000</td>
<td>0.614</td>
<td>Q11</td>
<td>1.000</td>
<td>0.667</td>
</tr>
<tr>
<td>Q2</td>
<td>1.000</td>
<td>0.658</td>
<td>Q12</td>
<td>1.000</td>
<td>0.870</td>
</tr>
<tr>
<td>Q3</td>
<td>1.000</td>
<td>0.596</td>
<td>Q13</td>
<td>1.000</td>
<td>0.702</td>
</tr>
<tr>
<td>Q4</td>
<td>1.000</td>
<td>0.591</td>
<td>Q14</td>
<td>1.000</td>
<td>0.787</td>
</tr>
<tr>
<td>Q5</td>
<td>1.000</td>
<td>0.781</td>
<td>Q15</td>
<td>1.000</td>
<td>0.697</td>
</tr>
<tr>
<td>Q6</td>
<td>1.000</td>
<td>0.765</td>
<td>Q16</td>
<td>1.000</td>
<td>0.763</td>
</tr>
<tr>
<td>Q7</td>
<td>1.000</td>
<td>0.800</td>
<td>Q17</td>
<td>1.000</td>
<td>0.619</td>
</tr>
<tr>
<td>Q8</td>
<td>1.000</td>
<td>0.830</td>
<td>Q18</td>
<td>1.000</td>
<td>0.748</td>
</tr>
<tr>
<td>Q9</td>
<td>1.000</td>
<td>0.820</td>
<td>Q19</td>
<td>1.000</td>
<td>0.712</td>
</tr>
<tr>
<td>Q10</td>
<td>1.000</td>
<td>0.754</td>
<td>Q20</td>
<td>1.000</td>
<td>0.661</td>
</tr>
</tbody>
</table>

Communalities represent the amount of variance explained by the extracted factors. As shown within the Communalities table, Table 5-4, all of the variables have a communality greater than 0.59. This indicates that the extracted factors account for most of the variance in the variables being analysed and that the sample size (117) is adequate for the factor analysis (Field, 2009). Communalities represent the percentage of variance explained by the extracted components.
Following the evidence of the scree plot, shown in Figure 5-4, from 20 components included within the analysis, five factors were extracted with eigenvalues greater than 1 (K1 method) accounting for a total of 72.182% of the total variance for the entire set of variables. The five extracted factors and the associated components are shown in Table 5-5. Each of the extracted factor components has a factor loading above 0.4 (Field, 2009). Items with high factor loadings that converge on latent factors within the data set indicate scales with good measurement properties giving an accurate measure of an unobservable phenomena (Segars and Grover, 1993).

Table 5-5 - Organisational Resilience Scale (RES) EFA

<table>
<thead>
<tr>
<th>Factor</th>
<th>α</th>
<th>% of Variance</th>
<th>Scale Items</th>
<th>Factor Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>RES1 Employee Development</td>
<td>0.892</td>
<td>44.21</td>
<td>- Resources for training</td>
<td>0.783</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Developing employee knowledge</td>
<td>0.782</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Opportunities for employee development</td>
<td>0.761</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Develop employee competencies</td>
<td>0.661</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Organisation is resilient</td>
<td>0.401</td>
</tr>
<tr>
<td>RES 2 Situational Awareness (Firm)</td>
<td>0.909</td>
<td>8.59</td>
<td>- Agreement about how things could go wrong</td>
<td>0.739</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Effectively use forecasting</td>
<td>0.694</td>
</tr>
</tbody>
</table>
5.6.2. Organisational Response Scale

A principal component analysis was conducted on 28 items within the Organisational Response Scale using an orthogonal rotation (Varimax). The Kaiser-Meyer-Olkin (KMO) measure of 0.530 was found indicating a sampling adequacy slightly above the acceptable limit (0.5). A review of the Anti-Image Correlation matrix relieved several items had individual KMO values well below the recommended 0.5 threshold. These items were systematically removed and the test rerun. Following the removal of the items, the analysis was conducted across the 20 remaining items resulting in a KMO measure of 0.742.

Table 5.6 - Organisational Response Scale Communalities

<table>
<thead>
<tr>
<th>Communalities</th>
<th>Initial</th>
<th>Extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>1.000</td>
<td>0.866</td>
</tr>
<tr>
<td>Q2</td>
<td>1.000</td>
<td>0.904</td>
</tr>
<tr>
<td>Q11</td>
<td>1.000</td>
<td>0.533</td>
</tr>
<tr>
<td>Q12</td>
<td>1.000</td>
<td>0.707</td>
</tr>
</tbody>
</table>
The communalities within Table 5-6 are all above 0.4, with the exception of Q20 (0.339). This low communality indicates that the variable has little in common with the extracted components. As a result, the variable will be removed from the analysis.

Through the principle component analysis, four factors were extracted with eigenvalues greater than 1, accounting for 67.74% of the total variance within the dataset. The results on the analysis are shown within Table 5-7.
### Table 5.7 - Organisational Response Scale (ORS) EFA

<table>
<thead>
<tr>
<th>Factor</th>
<th>α</th>
<th>% of Variance</th>
<th>Scale Items</th>
<th>Factor Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORS1 Decision Supported by Expertise and Strengths</td>
<td>0.885</td>
<td>41</td>
<td>- Decisions made quickly                                                   0.820</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Employee expertise utilised                                             0.768</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Utilise organisational strengths                                        0.765</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Effective at seeking information                                         0.732</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Employees given decision authority                                       0.662</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Utilise available resources                                              0.597</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Utilise information from a variety of sources                            0.547</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Identify opportunities                                                   0.539</td>
<td></td>
</tr>
<tr>
<td>ORS2 Interpret Demands and Information</td>
<td>0.872</td>
<td>10.84</td>
<td>- Create favourable working conditions                                      0.875</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Effective decisions made                                                 0.712</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Effectively interpret demands                                            0.702</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Challenge existing standards                                             0.696</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Understand organisational vulnerabilities                                0.678</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Employees given decision authority                                       0.407</td>
<td></td>
</tr>
<tr>
<td>ORS3 Develop Effective Solutions</td>
<td>0.891</td>
<td>8.47</td>
<td>- Create alternative ideas                                                 0.879</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Unique solutions to problems                                             0.763</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Effective risk management                                                0.622</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Effectively interpret demands                                            0.535</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Develop knowledge and understanding                                      0.528</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Effective decisions made                                                 0.512</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Utilise available resources                                              0.471</td>
<td></td>
</tr>
<tr>
<td>ORS4 Established Prior Preparations</td>
<td>0.796</td>
<td>7.35</td>
<td>- Emergency planning used effectively                                     0.903</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Adequate emergency planning                                              0.897</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Develop knowledge and understanding                                      0.400</td>
<td></td>
</tr>
</tbody>
</table>

#### 5.6.3. Organisational Capability Scale

A principal component analysis was conducted on 29 items within the Organisational Capability Scale using a Varimax rotation. The Kaiser-Meyer-Olkin (KMO) measure of 0.524 was found, although acceptable this KMO value is only marginally over an acceptable level of sampling adequacy (0.5). Following a review of individual items it was found that 3 of the items within the data set had individual KMO values well below the acceptable limit of 0.5. As a result, these items removed from the data set and the analysis was rerun. Following the removal of the items the KMO value increased dramatically to 0.7, well above the acceptable limit of sampling adequacy.
The communalities for the remaining 26 items are shown within Table 5-8. With the exception of Q11 all of the values are above 0.4. As such this item will be excluded from the analysis.
A total of three factors were extracted with eigenvalues greater than 1, which accounted for a total of 59.78% of the total variance within the data set. The use of three factors for analysis was supported by the Scree plot which indicated a break point at component 4. The factors are shown in Table 5-9.

Table 5-9 - Organisational Capability Scale (OCS) EFA

<table>
<thead>
<tr>
<th>Factor</th>
<th>α</th>
<th>% of Variance</th>
<th>Scale Items</th>
<th>Factor Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCS1</td>
<td>0.935</td>
<td>43</td>
<td>- Communication</td>
<td>0.820</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Planning</td>
<td>0.795</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Prediction</td>
<td>0.768</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Strategic Unity</td>
<td>0.735</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Connection</td>
<td>0.728</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Collaboration</td>
<td>0.711</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Community</td>
<td>0.692</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Coordination</td>
<td>0.688</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Support</td>
<td>0.618</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Proactive</td>
<td>0.604</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Leadership</td>
<td>0.542</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Financial</td>
<td>0.514</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Focus</td>
<td>0.513</td>
</tr>
<tr>
<td>OCS2</td>
<td>0.907</td>
<td>10.45</td>
<td>- Flexibility</td>
<td>0.782</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Awareness</td>
<td>0.753</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Empowerment</td>
<td>0.721</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Adaption</td>
<td>0.709</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Creating Ideas</td>
<td>0.676</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Speed</td>
<td>0.661</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Performance Accountability</td>
<td>0.566</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Customer Connectivity</td>
<td>0.495</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Efficiency</td>
<td>0.423</td>
</tr>
<tr>
<td>OCS3</td>
<td>0.887</td>
<td>6.28</td>
<td>- Innovation</td>
<td>0.791</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Change</td>
<td>0.696</td>
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<td></td>
<td>- Learning</td>
<td>0.636</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Talent</td>
<td>0.516</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Efficiency</td>
<td>0.479</td>
</tr>
</tbody>
</table>

5.7. Extracted Factors

The following sections detail the extracted factors across each of the three survey scales.

5.7.1. Organisational Resilience Scale

The first extracted factor (RES1) seemed to strongly correlate with items relating to the development of employee skills and competencies, either through training or through providing opportunities for the development of competencies. For RES1 the
overall α score was 0.892 which is over the threshold of a 0.7 α value indicating a high level of reliability within the extracted factor. Within the Item-Total Statistics table, each of the factor components has a value greater than 0.3 under the Corrected Item-Total Correlation (all above 0.453) indicating that all of the data correlate well with the overall scale used.

The second extracted factor (RES2) was termed ‘Situational Awareness’. Items related to the monitoring and assessment of an organisation’s operating environment loaded highly onto this factor. For RES2 the overall α score was 0.909. All of the Corrected Item-Total Correlations were over 0.509 (Above 0.3 threshold). Items included an understanding about how organisational element could fail or be impacted by events, the effective use of forecasting, identifying potential implications within environmental fluctuations and disruptive events, and a sense of susceptibility.

RES3 was termed ‘Adaptability’. Items relating to the ability to change and adapt in the face of a perturbation loaded significantly onto this factor. For RES3 the overall α score was 0.872. All of the Corrected Item-Total Correlations were over 0.517 (Above 0.3 threshold). Items with significant loadings included an organisation’s ability to change and adapt in the face of adversity, as well as items related to reliability.

For RES4 the overall α score was 0.839. All of the Corrected Item-Total Correlations were over 0.507 (Above 0.3 threshold). Items relating to the development of a ‘shared understanding’ loaded onto this item.

Following an incident or through the management of unexpected events, the organisation is able to able to seek opportunities for development. RES5 was termed ‘organisational learning and development’ and related to items such as employees learn from past experiences. For RES5 the overall α score was 0.850. All of the Corrected Item-Total Correlations were over 0.484 (Above 0.3 threshold).

### 5.7.2. Organisational Response Scale

For ORS1 the overall α score was 0.885. All of the Corrected Item-Total Correlations were over 0.364 (Above 0.3 threshold). Items relating to decision making loaded significantly onto this factor. The item loading suggest that effective decision making
is predicated on expertise and organisational strengths. The factor was termed ‘decisions supported by expertise and strengths’. Items that loaded significantly included decision speed, employee expertise used, utilisation of organisational strengths and available resources and effectively seeking information within response activities.

Within the response of the organisation to discontinuities and opportunities, organisations are required to effectively interpret environmental fluctuations (both internal and external). ORS2 relates to this ability and was termed ‘interpret demands and information’. For ORS2 the overall α score was 0.872. All of the Corrected Item-Total Correlations were over 0.414 (Above 0.3 threshold). Items included the ability to create favourable working conditions, effective decision making, understanding organisational elements (including vulnerabilities) and challenging existing standards.

ORS3 was termed ‘develop effective solutions’. For ORS3 the overall α score was 0.891. All of the Corrected Item-Total Correlations were over 0.422 (Above 0.3 threshold). Items related to an organisation’s ability to effectively create alternative ideas and develop unique solutions to problems during periods of adversity loaded highly onto this factor. Additional items included the ability to effectively interpret demands and develop knowledge and understanding.

For ORS4 the overall α score was 0.796. All of the Corrected Item-Total Correlations were over 0.458 (Above 0.3 threshold). Items related to the development of ‘established prior preparations’ loaded significantly onto this factor. Items included sufficient development of prior emergency planning and the effective use of emergency planning during disruptive events.

5.7.3. Organisational Capability Scale

For OCS1 the overall α score was 0.935. All of the Corrected Item-Total Correlations were over 0.490 (Above 0.3 threshold). Capabilities related to the development of a ‘strategic approach’ loaded significantly onto OCS1. OCS1 included items such as communication, planning, the ability to utilise forecasting and sharing a common understanding and strategic perspective across an organisation.
For OCS2 the overall $\alpha$ score was 0.907. All of the Corrected Item-Total Correlations were over 0.339 (Above 0.3 threshold). Items related to the ability to adapt and change when required, awareness (recognising demands and opportunities) and supporting individuals within decision making, loaded significantly onto OCS2. The factor was therefore termed ‘flexible response’.

For OCS3 the overall $\alpha$ score was 0.887. All of the Corrected Item-Total Correlations were over 0.430 (Above 0.3 threshold). Items related to capabilities towards the ‘development’ of an organisation loaded significantly onto OCS3. These items included the ability to do something novel in both content and process (innovation), the ability to recognise the need to change or alter function and learning from experiences.

A description of the scale items related to each of the extracted factors is shown within Table 5-10.

**Table 5-10 - Organisational Capability Scale Items**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Scale Items</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCS1</td>
<td>- Communication</td>
<td>Effectively exchanging information</td>
</tr>
<tr>
<td></td>
<td>- Planning</td>
<td>Developing effective plans</td>
</tr>
<tr>
<td></td>
<td>- Prediction</td>
<td>Effectively utilise forecasting</td>
</tr>
<tr>
<td></td>
<td>- Strategic Unity</td>
<td>Communicating and sharing a strategic point of view</td>
</tr>
<tr>
<td></td>
<td>- Connection</td>
<td>Establishing and maintaining linkages and alignment throughout the organisation</td>
</tr>
<tr>
<td></td>
<td>- Collaboration</td>
<td>Working across boundaries to ensure efficiency and leverage</td>
</tr>
<tr>
<td></td>
<td>- Community</td>
<td>Shared vision of the organisations purpose and values</td>
</tr>
<tr>
<td></td>
<td>- Coordination</td>
<td>Linking our efforts together to achieve effective results</td>
</tr>
<tr>
<td></td>
<td>- Support</td>
<td>Adequate external resources</td>
</tr>
<tr>
<td></td>
<td>- Proactive</td>
<td>Active approach towards problem solving</td>
</tr>
<tr>
<td></td>
<td>- Leadership</td>
<td>Placing effective leaders in the right positions</td>
</tr>
<tr>
<td></td>
<td>- Performance Accountability</td>
<td>Obtaining high performance from employees</td>
</tr>
<tr>
<td></td>
<td>- Financial</td>
<td>Managing costs</td>
</tr>
</tbody>
</table>
### Organisational Resilience Survey

<table>
<thead>
<tr>
<th>OCS2</th>
<th>Flexible Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Focus</td>
<td>Shared mindset and coherent brand identity</td>
</tr>
<tr>
<td>- Flexibility</td>
<td>Able to alter operations when required</td>
</tr>
<tr>
<td>- Awareness</td>
<td>Recognising demands and opportunities</td>
</tr>
<tr>
<td>- Empowerment</td>
<td>Give individuals the ability and support to make decisions</td>
</tr>
<tr>
<td>- Adaption</td>
<td>Adapt and change when required</td>
</tr>
<tr>
<td>- Creating Ideas</td>
<td>Generating ideas with impact</td>
</tr>
<tr>
<td>- Speed</td>
<td>Effective at making important changes rapidly</td>
</tr>
<tr>
<td>- Performance Accountability</td>
<td>Good at obtaining high performance from employees</td>
</tr>
<tr>
<td>- Customer Connectivity</td>
<td>Good at building enduring relationships of trust with targeted customers</td>
</tr>
<tr>
<td>- Efficiency</td>
<td>Ability to accomplish a job effectively</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OCS3</th>
<th>Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Innovation</td>
<td>Good at doing something new in both content and process</td>
</tr>
<tr>
<td>- Change</td>
<td>Good at recognising the need to change</td>
</tr>
<tr>
<td>- Learning</td>
<td>Developing from our experiences</td>
</tr>
<tr>
<td>- Leadership</td>
<td>Good at placing effective leaders in the right positions</td>
</tr>
<tr>
<td>- Talent</td>
<td>Competencies and commitment to meet the demands of a situation</td>
</tr>
<tr>
<td>- Efficiency</td>
<td>Ability to accomplish a job effectively</td>
</tr>
<tr>
<td>- Creating Ideas</td>
<td>Effective at generating ideas with impact</td>
</tr>
<tr>
<td>- Financial</td>
<td>Effective at managing costs</td>
</tr>
</tbody>
</table>

### 5.8. Bivariate Correlation Analysis

Bivariate correlation analysis was used to study the relationships between the latent variables (extracted factors). A correlation coefficient gives a numerical summary of the degree of association between two variables. These coefficients can vary from +1 to -1, with positive values indicating an increasing relationship and negative values indicating a decreasing relationship. From the 66 correlations, 20 were found to be statistically significant at the 0.01 level (2-tail). All of the identified coefficients were positively correlated, suggesting that an increase in one variable would result in a
Organisational Resilience Survey

The positive coefficients suggest that the relationship between the extracted constructs or factors are interactive and mutually beneficial. Implementing or developing one construct will not negatively influence another. As such, the analysis indicates that factors related to resilience within organisations cannot be addressed in isolation. Meaning that the development of resilience within organisations requires an holistic approach. The results of the analysis are shown within Table 5-11.

Table 5-11 - Bivariate Correlation Analysis

<table>
<thead>
<tr>
<th></th>
<th>RES1</th>
<th>RES2</th>
<th>RES3</th>
<th>RES4</th>
<th>RES5</th>
<th>ORS1</th>
<th>ORS2</th>
<th>ORS3</th>
<th>ORS4</th>
<th>OCS1</th>
<th>OCS2</th>
<th>OCS3</th>
</tr>
</thead>
<tbody>
<tr>
<td>RES1</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
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<td></td>
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<tr>
<td>RES2</td>
<td>.000</td>
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<tr>
<td>RES3</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td></td>
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<td></td>
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<tr>
<td>RES4</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.082</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RES5</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td>ORS1</td>
<td></td>
<td></td>
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<tr>
<td>ORS2</td>
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<tr>
<td>ORS3</td>
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</tr>
<tr>
<td>ORS4</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>OCS1</td>
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<td></td>
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<td></td>
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<tr>
<td>OCS2</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OCS3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Organisational capabilities related towards a strategic approach within the response of an organisation, were closely associated with an increased situational awareness, \( r(117) = 0.602, p < .001 \). The Pearson Correlation indicated a strong relationship between the factors. To a much lesser extent the Pearson Correlation indicated a relationship between the factors of strategic approach and developing a shared understanding within an organisation, \( r(117) = 0.290, p < .001 \). A moderate relationship between the ability to effectively interpret demands and information and an organisation’s strategic approach was also reflected within the analysis, \( r(117) = 0.408, p < .001 \). Those organisations with a higher strategic approach also tended to have a greater emphasis placed on employee development, \( r(117) = 0.381, p < .001 \). In addition, employee development also indicated a moderate relationship with both the ability to interpret demands and information, \( r(117) = 0.392, p < .001 \, and the organisation having established prior preparations, \( r(117) = 0.345, p < .001 \).
Organisational capabilities related to a flexible response, associated with the factor of adaptability within organisations. The Pearson Correlation indicated a strong relationship between the factors, $r(117) = 0.519$, $p < .001$. The flexible response of an organisation was also associated with the development of a shared understanding within an organisation, $r(117) = 0.414$, $p < .001$. Although the correlations were less significant, all of the factors related to the response of the organisation were associated with the organisational capability related to a flexible response. The Pearson Correlation indicated a moderate relationship between the factor related to decision making and the flexible response of the organisation ($r(117) = 0.405$, $p < .001$). Interpreting demands and information ($r(117) = 0.270$, $p < .001$), developing effective solutions ($r(117) = 0.251$, $p < .001$) and established prior preparations ($r(117) = 0.266$, $p < .001$) all indicated a fair relationship with the factor flexible response.

The Pearson Correlation indicated a strong relationship between the ability to develop effective solutions within the response of an organisation and the organisational capability for development, $r(117) = 0.513$, $p < .001$. The capability of development was also associated, although less significantly, with an organisation’s ability to effectively interpret demands and information, $r(117) = 0.342$, $p < .001$. The ability to develop effective solutions was also associated within an increased situational awareness, $r(117) = 0.376$, $p < .001$. Decision making supported by expertise and strengths was also associated with situational awareness, $r(117) = 0.261$, $p < .001$.

Tuominen et al (2002) identify a close association between adaptability and innovativeness. This association is reflected within the relationship between the extracted factors of Adaptability (RES3) and Development (OCS3) within the Bivariate correlation analysis. Within the extracted factor of Development, innovation has a strong item loading of 0.791. The Pearson Correlation indicated a significant relationship between the variables, $r(117) = 0.381$, $p < .001$.

The extracted factors of development ($r(117) = 0.381$, $p < .001$.) , an organisation’s ability to interpret demands and information ($r(117) = 0.370$, $p < .001$), the ability to develop effective solutions ($r(117) = 0.334$, $p < .001$) and an organisation established
prior preparations \( r(117)= 0.362, p < .001 \), all tended towards a higher association with the factor of adaptability.

5.9. Conclusions and Implications

Following the development of the Organisational Resilience Survey, an Exploratory Factor Analysis and Bivariate Correlation Analysis was conducted. Twelve factors were extracted across the three survey scales (RES, ORS, OCS). These factors highlight key elements within the response of an organisation to disruptive events. The identified factors will be further explored and developed within the individual case study organisations presented within subsequent chapters.

Following the analysis of the Organisational Resilience Survey, three key conclusions and implications can be drawn. These are:

1) As the complexity of an event increases, the potential impact across organisational levels also increases.
2) There is a positive correlation between the extracted factors, meaning that the improvement of one factor will not negatively influence another.
3) Organisations are required to develop the necessary attributes and adaptive capabilities for an effective response prior to the onset of the event.

Following the evidence of the Organisational Resilience Survey, in relation to the response of an organisation to an event, an effective response involves several elements. These include the ability to anticipate and understand risks and emerging threats as well as the ability to adapt creatively and constructively to change. In addition, organisational actors must understand the structure and operation of the organisation and its associated organisational networks (supply chain), understand both the direct and indirect impacts of an event on the organisation and its associated infrastructures and networks, and support effective decision making.

In addition to these findings, the Organisational Resilience Survey identifies several wider implications related to the development of organisational resilience. These identified features are further elaborated within subsequent chapters. The wider implications of the survey findings are as follows:
1) The need to develop adaptive capabilities within organisational elements. These adaptive capabilities relate to the capabilities required to effectively adapt and overcome possible discontinuities within disruptive events.

2) The need to respond flexibly to disruptions and change events. Providing clear strategic direction within response and recovery activities.

3) Developing a willingness to change and actively seeking opportunities for development and improvement

4) Developing an understanding of organisational interdependencies, linkages, vulnerabilities and constraints. As well as establishing risk thresholds and tolerances within organisational elements

5.10. Summary

Chapter 5 details the development and deployment of the Organisational Resilience Survey. Based on the evidence of the literature review, presented within Chapter 2, the survey is composed of three primary sections: Organisational Resilience Scale, Organisational Response Scale, Organisational Capability Scale. Each section represents an independent aspect of resilience and the response of an organisation. Following the deployment of the survey, the results of the statistical analysis are presented. The analyses include an initial descriptive analysis, an exploratory factor analysis and a bivariate correlation analysis.
Chapter 6 - Organisational Case Studies

6.1. Introduction

Following the developed research design, as outlined within Chapter 3, the following chapter presents evidence from four organisational case studies. Following the developed Case Study Protocol and Grounded Theory Coding Protocol presented within Chapter 4, interviews were conducted and coded towards the development of causal networks. These causal networks present graphically the identified features and influencing factors within an organisation’s response to disruptive events; where appropriate additional causal networks and figures are also presented. The analysis and discussion presented within this chapter is a specific ‘within-case’ analysis. Through this analysis the chapter addresses the research objective RO2 (presented within Chapter 1, section 1.3). A ‘cross-case’ analysis and discussion is presented within subsequent chapters. Each case includes a profile, overview of the organisational structure and the identified features of response.

6.1.1. Case Study Organisations Overview

The below table provides a brief overview of each of the participating organisations and an outline of the number of interviews conducted.

<table>
<thead>
<tr>
<th>Case Company</th>
<th>Company 1</th>
<th>Company 2</th>
<th>Company 3</th>
<th>Company 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company</td>
<td>ABB</td>
<td>E.ON</td>
<td>UAM</td>
<td>3M</td>
</tr>
<tr>
<td>Sector</td>
<td>Engineering and Technology</td>
<td>Energy</td>
<td>Nuclear</td>
<td>Healthcare</td>
</tr>
<tr>
<td>Market</td>
<td>Global</td>
<td>Global</td>
<td>European/Global*</td>
<td>Global</td>
</tr>
<tr>
<td>Section</td>
<td>6.2</td>
<td>6.3</td>
<td>6.4</td>
<td>6.5</td>
</tr>
<tr>
<td>Number of Interviews</td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Average Interview length</td>
<td>55 minutes</td>
<td>65 minutes</td>
<td>60 minutes</td>
<td>55 minutes</td>
</tr>
<tr>
<td>Average Transcript Length</td>
<td>5977 words</td>
<td>6184 words</td>
<td>6561 words</td>
<td>5344</td>
</tr>
</tbody>
</table>
*The company’s primary operations are within Europe; however several international supply contracts are also in place.

6.1.2. Coding

Following the initial coding of the interviews across each of the organisational case studies, thematic matrices were developed. Within these thematic matrices, cumulatively 155 unique initial codes were identified. This initial coding can be characterised through 22 thematic groups.

Following a refinement of the initial groups, 17 distinct themes emerged across the extracted codes. From the themes, 22 node groups were identified. These are shown within Table 6-2.

**Table 6-2 - Identified Theme and Node Groups**

<table>
<thead>
<tr>
<th>Theme</th>
<th>Node Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activation</td>
<td>Activation</td>
</tr>
<tr>
<td>Capabilities</td>
<td>Detection</td>
</tr>
<tr>
<td>Detection</td>
<td>Disruptive Event</td>
</tr>
<tr>
<td>Learning</td>
<td>Identifying Opportunities</td>
</tr>
<tr>
<td>Operating Environment</td>
<td>Knowledge and Experience</td>
</tr>
<tr>
<td>Operations</td>
<td>Knowledge and Expertise</td>
</tr>
<tr>
<td>Opportunities</td>
<td>Limitations and Constraints</td>
</tr>
<tr>
<td>Organisational Capabilities</td>
<td>Operating Environment/Market</td>
</tr>
<tr>
<td>Organisational Development and Growth</td>
<td>Operations</td>
</tr>
<tr>
<td>Organisational Dynamics/Behaviour</td>
<td>Organisational Development and Growth</td>
</tr>
<tr>
<td>Organisational Strategy</td>
<td>Organisational Dynamics/Behaviour</td>
</tr>
<tr>
<td>Organisational Structure and Processes</td>
<td>Organisational Structure and Processes</td>
</tr>
<tr>
<td>Resilience</td>
<td>Organisational Functions</td>
</tr>
<tr>
<td>Response</td>
<td>Organisational Learning</td>
</tr>
<tr>
<td>Stakeholders</td>
<td>Organisational Strategy</td>
</tr>
<tr>
<td>Sustainability</td>
<td>Preparation</td>
</tr>
<tr>
<td>Threat and Risks</td>
<td>Recovery</td>
</tr>
<tr>
<td></td>
<td>Resilience</td>
</tr>
<tr>
<td></td>
<td>Response</td>
</tr>
<tr>
<td></td>
<td>Review</td>
</tr>
<tr>
<td></td>
<td>Risk Management</td>
</tr>
<tr>
<td></td>
<td>Stakeholders</td>
</tr>
</tbody>
</table>
6.1.3. Causal Networks

The development of a model or framework provides an illustrative means of providing explanation through summarising data and identifying key themes and processes (Miles and Huberman, 1994; Sousa, 2003; Nash, 2006; Thomas, 2006). The development of initial conceptual frameworks, as outlined previously within Chapter 4, aides within the structuring of data collection and analysis within each individual case as well as supporting cross-case analysis. Following the coding process during phases of data analysis, causal networks were developed within each of the case study organisations. A causal network forms a “display of the most important independent and dependent variables in a field study and of the relationships among them” (Miles and Huberman, 1994). The identified relationships describe the ways in which components and variables interact or link together (Cumming, 2005). However, it is important to note that within causal networks these relationships are directional rather than correlational.

Following the grounded theory coding process, thematic matrices were developed for each case study organisation. These formed the foundation for the causal networks. The development of causal networks utilises pattern matching, and involves the coding and segmentation of data through the development of labels, names, codes or nodes (Nash, 2006). The networks were then developed through identifying the linkages and associations between variables. As such, the development of the causal networks follows a largely inductive approach (Miles and Huberman, 1994).

Through identifying the relationships and linkages between variables, causal networks form textual and illustrative representations of both independent (cause) and dependent (effect) variables within each of the case study organisations. Independent variables refer to variables that have an affect or influence on dependent variables (Meredith, 1998). The dependent variable therefore refers to the resulting consequence. Within experimental research it is the independent variables that are manipulated. It is therefore the independent variables that affect dependent variables. Within the developed causal networks, where possible causality between variables is identified and outlined. However where this is limited, the linkages
between variables suggest an association or connection (Nash, 2006). As such, a cause and effect relationship may be replaced by a ‘functional relationship’. Subsequently a variety of terms can be used to describe the relationship of cause and effect (Punch, 2009). These are shown in Table 6-3.

**Table 6-3 - Cause and Effect Terms**

<table>
<thead>
<tr>
<th>Cause</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent variable</td>
<td>Dependent variable</td>
</tr>
<tr>
<td>Treatment variable</td>
<td>Outcome variable</td>
</tr>
<tr>
<td>Predictor variable</td>
<td>Criterion variable</td>
</tr>
<tr>
<td>Antecedents</td>
<td>Process</td>
</tr>
<tr>
<td>Determinants</td>
<td>Consequence</td>
</tr>
</tbody>
</table>

Causal networks provide an effective means of developing and communicating a theory in relation to empirical research, as well as providing a diagnostic and control tool (Scavarda et al, 2004). Following the grounded theory coding process, as detailed within Chapter 4 Section 4.5.2 and Appendix B, the developed causal networks provide a diagrammatic representation of extracted nodes. The networks also illustrate the linkages and relationships between nodes. The causal networks were developed in order to provide an understanding and theoretical explanation of 1) the key organisation features related to resilience; 2) of antecedent and process variables (factors); 3) the interaction between organisational variables; 4) the critical stages within the response to disruptive events; 5) how the mechanisms’ of resilience facilitate the response of an organisation; and 6) identify the underlying mechanisms within cognitive processes (decision making).

**6.2. Within-Case Analysis Company 1 – ABB**

Following the coding process outlined within Chapter 4 Section 4.5, 304 nodes were identified and approximately 190 were retained for analysis. Following the development of a thematic matrix, the nodes were then mapped onto a causal network.
From the organisational response causal network, four themes emerged that encompass the majority of the identified response factors. These themes include Threats and Risk, Organisational Structures and Processes, Capabilities, and Organisational Dynamics and Behaviour.

6.2.1. Profile

“Power and productivity for a better world.” (Article-ABB-001)

ABB is an engineering organisation that operates globally across more than 100 countries. The organisation specialises within power and automation technology, providing engineering and technological solutions for the generation, transmission and distribution of electricity. The organisation also focuses on developing solutions towards increasing productivity within industrial, commercial and utility operations and organisations. To achieve this, the organisation has a broad portfolio of companies and is managed through a divisional structure.

ABB Ltd underwent a period of rapid acquisitions during the late 1990’s, including the purchase of the Entrelec Group. This allowed ABB to strengthen its position within key North American and European markets. However, despite the group’s restructuring and the acquisition of new businesses, ABB Ltd was dramatically affected by the global economic slowdown in the early 2000’s. The group’s operating earnings were down 21 percent following the economic slowdown. This is reflected within Figure 6-1.

In response to the economic conditions, in 2001 ABB announced it would reduce its workforce by 8 percent over the following 18 months in order save the organisation a reported $500 million in annual expenses. The impact of the economic slowdown within key markets was further compounded by growing concerns about the organisation’s performance and increasing liabilities associated with acquisitions within North America related to asbestos liabilities. This had dramatic implications for the stock price which fell to below $2 a share in 2002.

Following these events, ABB had to undertake major restructuring and seek financial support in order to avoid financial collapse and bankruptcy. This resulted in cutting the five division units down to two core areas; that of Power Technologies and
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Automation. The remaining units were then set for divestment in order to save $800 million annually. Finance packages with credit facilities were also set in place in order to support the capital base of the organisation. In 2003 ABB posted its third straight full year net loss. However, during the first quarter of 2004 the organisation was able to post its first profit in over two years. This marked a return of the organisation to financial stability.

![Adjusted Close Stock Price ($)](image)

Figure 6-1 - ABB Adjusted Close Stock Price (Source: Article-ABB-003)

6.2.2. Organisational Structure

ABB operates across five divisions. These divisions have developed primarily to support the power and automation markets. Within the UK, ABB operates in more than 20 locations and employs over 2,000 personnel. The structure of ABB UK and its associated supply chain are detailed within Figure 6-2 and Figure 6-3 respectively. The individual business divisions include Power Products, Power Systems, Automation and Motion, Low Voltage Products and Process Automation.

Across the ABB group there is a consistent focus on the core values of the organisation. ABB’s focus remains within engineering and technology, focused within power and automation. The organisation strives to create a balance between economic, environmental and social elements within the operations and structure of
the organisation. This is supported by a clear view and understanding of the organisation’s history and operational capabilities. In order to ensure the continued operation of ABB, the organisation must:

- Understand the operations of each business
- Understand the areas of criticality of each business
- Understand the risks of each business and market

6.2.3. Disruptive Events

Organisations face a diverse range of potential risks and threats. Disruptive events are often characterised by unpredictability. The magnitude and severity of an event is dependent on the culmination and accumulation of certain risks. Each event carries the distinct possibility of escalating into potentially high impact organisational crisis if the appropriate mitigation is not followed. The organisation may also be exposed to considerable market risk factors. These include economic risks, political risks and catastrophic events (such as global pandemic, terrorist attacks or a natural disaster).

A causal network of the nature of disruptive events is presented within Figure 6-4. Potential organisational threats include:

- Direct threats from competitors
- Shifting markets
- Legal and regulatory threats
- Threats to group resource
- Dawn Raids
- Threats caused by events outside of the control of the organisation
Figure 6.2 - ABB Organisational Structure Causal Network
Figure 6.3 - ABB Supply Chain Causal Network
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Figure 6.4 - ABB Disruptive Events Causal Network
ABB is continually changing and developing within its markets. This is due to the organisation continually challenging existing standards and seeking increasing opportunities for organisational growth and development. Following the events of 2002 and the dramatic drop in the stock value of ABB, the organisation went through a period of dramatic restructuring and change to the organisational approach and perspective. ABB currently follows a matrix structure and is supported through a regional approach. Following the events surrounding the stock market drop, the organisation went through a process of centralising several functions within the structure of the organisation.

“... you know and initially there was some push back in the organisation when we tried to centralise some of these functions. But again, through the transparency, the openness, the leadership. I undoubtedly think that we are a better organisation, because that is why many of these things have defined who we are today. So I do believe that we are more resilient and we are more robust.” (Interview-ABB-001)

While individual sectors are rarely stable, the overall performance of the organisation has remained relatively stable over recent years. There have also been several opportunities for organisational expansion and growth, linked to economic growth within emerging markets. For example, growth and development within Chinese and Indian markets as well as the emergence of new growth centres within Southeast Asia, Middle East, Latin America and Africa have provided significant opportunities for expansion. Additionally, increased demand for energy efficiency through public opinion, regulatory pressure and changing energy economies has also provided business opportunities.

However, through the operational history of the organisation, globally ABB has been exposed to several high profile disruptions. These include:

- Severe financial events of 2002/2003
- Event involving terrorist attacks in Saudi Arabia
- Events involving an employee shooting in the USA
- Shut down of procurement system (Supply chain disruption)
Disruptive events caused by external sources or events originating outside of the controls of an organisation are typically more severe and often carry dramatic implications for the organisational elements and members involved. This is possibility due to the events occurring outside of the traditional considerations and preparations of the organisation. This has resulted in the development of increasing security protocols related to external events and the close monitoring of external environments.

In addition to the initial impact of an event, there may be considerable future liabilities associated with disruptive events. Within the development of contingencies the potential impact and cost of associated liabilities must be considered. Additionally, disruptive events have far ranging impacts on the structure and operation of an organisation, as well as substantial psychological impacts. Severe events can also have dramatic implications for all associated stakeholders. In regards to ABB, exposure to previous threats and crises have completely changed and altered the approach of the organisation. ABB is now focused on developing robust capabilities and preparations towards addressing exposure to severe threats and events.

“Yes in a very serious way. It is almost a completely unrecognisable company now compared with how it was then. The way the management operates, the controls the processes and the accountability is much different.” (Interview-ABB-003)

The impacts of an event on an organisation may include:

- Altered management structure
- Altered organisational controls
- Altered organisational processes
- Restructured accountability
- Crises can create open ended liabilities

External events can have significant implications on the operation and functioning of an organisation. Events within the Fukushima Nuclear plant in Japan during March 2011, as well as a multitude of other disastrous events, have highlighted the extended impact that an event can have. While events in Japan have only resulted in minor
implications for the ABB group, the events have highlighted the interconnection of organisations globally and the need to develop robust supply chains.

Disruptive or crisis events provide a means of validation of prior preparations and crisis management procedures, as well as identifying areas of vulnerability. Past experiences of threats and disruptions aid in the development of a more robust organisation. Following the response to previous events, several organisational learnings were identified. These include:

- Need to clearly establish responsibilities within preparations
- Need to develop robust communication system/network
- Need to establish visibility of event

6.2.4. Preparations

In order to validate and develop the response and preparations of the organisation, scenario planning is utilised. A causal network of organisational preparations is shown within Figure 6-5. Preparations relate to developing a proactive approach towards overcoming a disruptive event. Following a scenario session, in which a hypothetical disruption is addressed, a complete review of the organisation’s crisis plan is undertaken. The scenario planning sessions thereby aid in evaluating the strength of the procedures in place as well as highlighting potential inadequacies and areas of improvement. Scenario planning sessions therefore provide a robust means of learning and capturing improvement within the response of the organisation.
Organisational Case Studies

Continuous Improvement

Crisis Planning

Established Communication Network

Scenario Planning as Validation

Crisis Team Functions

Development of Specific Crisis Planning

Appropriate Training

Proactive Behaviour

Established Prior Preparations

Established Procedure for Legal Threats

Flexibility in Planning

Scenario Planning

Assess Preparations and Planning

Business Continuity Planning

Crisis Planning

Current Plan Inadequate

Challenge Existing Standards

Develop Risk Profile

Figure 6.5 - ABB Preparations Causal Network
Within the routine operation of the organisation, proactive behaviour relates to communication within and across the organisation. In relation to the response of the organisation to an event or a potential threat, the proactive response of the organisation to discontinuities relates to established prior preparations and the development of the organisation’s response capabilities. Proactive preparations include:

- Established planning – Crisis and Disaster Planning and Emergency Procedure, Continuity Planning
- Established systems – Management System, Crisis Management, Risk Management
- Established employee responsibilities and duties
- Established communication hierarchy
- Established authority hierarchy – Power Structure

6.2.5. Crisis Planning and Risk Management

Given the nature of disruptive events it is difficult to predict the occurrence and impact of an event with any degree of certainty. However, in order to develop appropriate preparations, ABB invests time in considering both LIHP and HILP\(^1\) events as well as alternative means of conducting business following the occurrence of an event. Through this the organisation not only develops procedures for known threats and risks, but also addresses unique events outside of traditional consideration. This improved front end planning reduces potential future issues.

“I think in the UK we are very good at that. We solve problem. Problem that maybe shouldn’t be there in the first place if we were better at the front end planning we wouldn’t be in that position. I think that is a real strength of the company without a doubt.” (Interview-ABB-004)

Following the organisation’s exposure to risk and disruptive events, ABB has an astute awareness of the importance of developing crisis management capabilities and processes within the organisation. There is a clear business and organisational need to

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\(^1\) LIHP and HILP - low-impact/ high-probability (LIHP) events and high-impact/ low-probability (HILP) events (Sheffi 2005)
develop mechanisms to adapt to unplanned events that could adversely affect the operation and continuity of the organisation. As such, within ABB UK and the wider ABB Group there is a specific focus on developing processes and procedures specific to dealing with disruptive events.

“Again I’m sure that some of this comes down to that you need to have the people, the structures, the flexibility, the frameworks... To make sure that in the event of something we can at least account for them. So I think part of this is the continual learning and having that flexibility and that framework and the recognition that these things are very important and a business critical issue.” (Interview-ABB-001)

In order to ensure compliance and operational performance across ABB divisions, internal and external audits are used. Following the audits, changes and areas of improvement are suggested. Audits are also used to address potential risks within divisions and for insurance purposes for main operational sites. These audits support crisis management activities within the organisation. Within ABB UK there are well established group procedures across all ABB divisions for crisis planning and risk management. ABB Group provides supportive guidelines for the development of procedures related to risk and security, as well as guidance in developing the countries specific crisis plan. Within this approach, commonality and best practice across the ABB group can be established within group procedures, while allowing individual countries and business to develop specific plans pertinent to their region and operating market. Commonality between organisational functions and divisions provides a level of stability and efficiency within the operation of the organisation. ABB businesses are then also audited against group standards to ensure compliance and best practice.

“Group, as in ABB group have a lot of guidance and tools to use for risk but also for security and things like travel, for making sure that we know where our people are and how to handle unwanted events. So it is making sure that all of those are aligned and accessible. We get audited against those.” (Interview-ABB-002)

Following the support and guidance provided by ABB Group, each country is responsible for developing their own unique crisis planning and business continuity
preparations. ABB Group recognises that each country will face specific and varied issues and discontinuities. As such, each plan is specific to the country and may be specific to the particular market that the individual businesses serve. Crisis plans are then further validated through scenario planning and crisis simulations.

Appropriate training for crisis management and planning is also provided by ABB group to key individuals and applied globally. Through a process of continual improvement and development, organisational learnings and guidance from across the group and organisational network are introduced into the training programmes to ensure and improve the standard and quality of risk and crisis preparations. This approach also provides standardisation, compliance and awareness through the alignment of processes and procedures towards the strategic development of the organisation.

“This crisis training that was done in March by ABB group security that was done and will be done in every region all over the world. But on completion of that process there will be learnings and just as they are learnings for the local business he’s got learnings from where his systems haven’t operated sufficiently or could be improved... he will review those changes and put them into place. Then we circulate the group plan. So it is a process of continuous improvement.” (Interview-ABB-002)

Crisis planning within ABB is developed to ensure that the organisation is able to survive and overcome the impact of crises both internal and external to the organisation and its business divisions. The crisis planning provides guidelines and criteria for an impacted business to assess an event in order to determine the appropriate level of response. Severe events are those that pose a significant threat or impact the safety of employees. Other severe threats include:

- Threat to the safety of the wider community or general public
- Events that impact or negatively influence ABB’s operating objectives
- Events associated with Infrastructure
- Terrorist attacks
- Need for better integration of companies (exposure to compliance issues)
- Previously ABB companies were highly autonomous
Within ABB Group there is a dedicated corporate crisis team based within Zurich, focused on addressing severe threats and crises within ABB’s organisational network. If an event is outside of the local capabilities of an ABB business or the event is characterised as severe, the crisis team is available to support and offer assistance to the impacted business. The team is composed of knowledgeable and experienced individuals from a wide range of disciplines.

Within the organisation multiple individuals across varying organisational levels are focused on addressing potential risks within the operation of ABB divisions. This includes reviews within operational activities, projects and contracts. Plans for each major risk scenario are developed through the use of risk registers and associated management systems such as the Health and Safety system.

6.2.6. Detection

In order for the organisation to respond effectively to threats and disruptions, the organisation is required to develop the ability to effectively recognise change. This involves an intuitive approach to monitoring both the internal and external operating environment of the organisation as well as factors or events that may impinge on the performance of business divisions.

“And if you think about some of the things that have happened in the Middle east recently you know, we have people travelling to Nigeria, Columbia, so personal safety becomes an issue. And we do have a team there that is continually monitoring that and pushing that out into the organisation.” (Interview-ABB-001)

“On a regular basis, in terms of figures, orders and performance it’s reviewed at least monthly on a business by business case. So we’re acutely aware of where the risks are and performance wise we keep a close check on that.” (Interview-ABB-002)

In order to effectively interpret operational and environmental fluctuations, it is necessary for the organisation to develop an in-depth operational and organisational understanding. Fluctuations and events affecting performance can thereby be effectively recognised and assessed. Events outside of the operational bounds or
operational capacity/capability of the organisation can then be addressed through a suitable response.

In addition to an operational understanding of the organisation, it is necessary to clearly establish the criticalities and dependencies within the organisation.

“So it is important to understand the operations of each business. As well as their areas of criticality and what their risks are.” (Interview-ABB-002)

Criticalities relate to the importance associated with a particular organisational element. Integral organisational elements through which the organisation’s continued operation and performance are reliant upon, form areas of criticality within the organisation. For example, with the organisational supply chain, ABB is reliant on a number of suppliers in order to ensure products can be delivered on time. The successful integration of acquisitions may also form areas of criticalities within the organisation.

In addition to the level of criticality associated with an organisational element, it is also necessary to address the connectedness between elements and other organisational components. Given the matrix structure and global reach of the organisation, this is of particular importance. Understanding how individual organisational elements operate independently as well as together is essential in order to assess the potential implications of a threat or risk. An event in one area can often have implications in another or cause a cascading effect within the organisation and associated networks.

Dependencies relate to the elements within the wider organisational networks and the external environment that are reliant upon the continued operation of the organisation. For example, customers are reliant on the products and services provided by the organisation. Incidents affecting or impacting areas these areas (criticalities and dependencies) are of vital concern within the organisation, and can carry dramatic and far reaching consequences.

This is further compounded as certain organisational elements will have varying degrees of susceptibility to potentially disruptive events. Achieving a level of
commonality and shared understanding between organisational elements and divisions, stands to partially address susceptibility within the organisation. However, developing an understanding of potential vulnerabilities allows ABB establish the relative risk, susceptibility and resistance to disruptive events and supports the organisation’s ability to effectively interpret the demands of an event. Through this, the organisation is able to develop a response strategy to potential disruptions and events through creating a balance between internal strengths and capabilities and external threats and opportunities. This is supported by an understanding of potential constraints and limitations.

6.2.7. Activation

The response of the organisation is largely predicated on the type of event and the events impact on the organisation. The classification of the event is therefore a critical junction between the detection of a disruptive or crisis event and the activation of the organisation’s response. Within the response of the organisation it is essential that the cause of the event be established. In addition to the type of event, the response of the organisation is heavily influenced by where the necessary expertises lie within the organisation and the wider ABB Group.

"It depends on the topic. And where the expertise is. If we know there are expertise in Zurich then, on that particular example I was giving, we have a full time competition lawyer who is an expert on competition law." (Interview-ABB-003)

Events outside of the traditional expertise or competencies of a business or division, could have greater implications for the organisation. Subsequently, understanding the capabilities of within the organisation is essential in order to elicit and effective response and minimise the potential impact of an event. The response of the organisation is detailed within the causal network presented within Figure 6-6.
Organisational Case Studies

Response
Communicate with Stakeholders
Effective Communication
Transparency
Critical Success Factor
Proactive Response
Communication
External Communication

Levels of Response
Small Events
Locally Managed
Large Events
UK Crisis Team
Severe Events
Zurich Crisis Team
International SOS System

Response Priorities
Operational Priorities
External Resource Available
Established Accountability
Defer to Expertise
Expertise within Organisation
Formalised Communication
Channels
Establish Ownership of Event
Management
Leadership Responsibility
Access to Appropriate Individuals
Knowledge and Expertise
Support of Local Services
First Responders

Transparency in Communication
Information Exchange
Establish Learnings
Culture
Understanding Cause of Event
Effective Response

Figure 6-6 - ABB Organisational Response Causal Network

Figure 6-6 - ABB Organisational Response Causal Network

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6.2.8. Response

Within the response of the organisation, senior management takes ownership of the coordination of response activities. Within ABB, dependent on the severity of the event, different levels of response may be followed. This is linked to the organisation’s ability to successfully interpret demands during periods of disruption and the classification of an event or threat.

“There are different levels of an event which would kick into play at different teams.”
(Interview-ABB-002)

Within the varying levels of response, different organisational elements will become involved dependent on the severity of the event. Smaller events will be managed locally, while events posing a significant threat will involve the ABB UK crisis team or the ABB Group (Zurich) crisis team. The criteria for the classification of events and the responsibility of different organisational elements is outlined within the organisation’s business continuity planning and emergency response procedure.

Severe events are those that:

- Involve serious or multiple loss of life
- Overextend the security of the business
- Impact the image or reputation of ABB
- Impact the share price and value of the organisation

ABB is able to respond to events through the individuals within the organisation. As such, the successful response of the organisation to a disruptive event requires access to individuals with the required experience and expertise related to a particular event. A proactive response to disruption is thereby supported through the effective utilisation of human resource within the organisation. It is the employees that enable ABB to respond effectively and adapt to discontinuity through the employees ability and willingness to adapt to change when required. Depth within the ABB management structure and the global reach of the organisation provide a platform from which the organisation is able to adapt through periods of disruption and
adversity. Ensuring that the right people are in the correct roles and supported within the organisation is crucial in ensuring the flexibility of the organisation.

ABB’s ability to respond to events is largely determined by the event itself. The critical stages within the organisation’s response to disruptive events involve an assessment and characterisation of the event. The organisation must identify and understand what organisational elements have been impacted and affected in order to respond effectively. Following this assessment, the strategic importance of the effected elements must be established in order to develop a suitable response strategy. Dependent on the perceived severity of the event, different levels of response may be appropriate. The central concern is speed within response activities before the event is able to develop into a large scale disruption.

The critical success factors within the response of ABB to a disruptive event include:

- Effective leadership
- Use of alternative supply relationships
- Close connection to regional management structure and ABB Group
- Having specialised expertise within the organisation (E.g. Corporate crisis team)
- Continual access to support network
- Availability of support and advise from knowledgeable source
- Effective tools for managing an event
- Established emergency procedure
- Accessing information database (remote access)
- Effective means of exchanging information and communicating
- Establishing an event timeline

Within the organisation’s response to disruptive events, communication forms the primary mechanism of coordination between organisational elements as well as external networks. Ensuring communication during response operations is achieved through the use of established and formalised communication networks and channels within the organisation. Transparency within communication means that information
is able to transfer across the organisation openly. This creates and promotes awareness across the organisation. Established communication and authority hierarchies allow information to disseminate effectively across the organisation during response operations. Emergency systems, such as support services and international SOS system, mean that immediate support is available during an emergency.

“They [Corporate Crisis Team] manage crisis and prepare for crisis and they also develop systems on maintaining equilibrium but also maintaining having processes in for managing. For instance, the international SOS or the security portal that we have or the travel tracking process to try and manage crisis.” (Interview-ABB-002)

External communication is also essential with response operations, as the organisation may have to coordinate with emergency services and responders. The organisation must also communicate within stakeholders and customers in regards to the nature and impact of the event. Given the size and profile of the organisation, there is a clear need to establish a media interface during the organisation’s response. Negative media associated with a disruptive event or the response of the organisation could cause significant reputational damage to ABB. This was observed through the events associated with the financial crisis the organisation faced during the early 2000’s.

The occurrence of a disruptive event can dramatically alter the functional routine and capability of the effected organisation or operational division. Through this, the organisation may no longer be able to operate through traditional channels or processes. In order to respond to the demands of the situation, the organisation is required to introduce novel solutions to potential issues utilising the inherent and available resources within the organisation. These may form temporary solutions until the disruption is resolved or provide an improvement upon previous processes or procedures.

The potential impact of events can be further compounded by an organisation’s inability to resource effectively. Resources include both tangible and intangible organisational assets. Organisational resources provide the mechanics through which
the organisation is able to function. These resources include: human resources; physical resources; technical resources; financial resources; organisational infrastructure and features related to information technology. In order for an organisation to effectively address the impact of an event, these resources must be accessed and transferred where needed.

Recovery from an event is characterised through establishing the learnings following the mitigation of a disruption or threat. This requires the development of a learning culture within an organisation, and the exchange of information across the organisational group. Developments and improvement within one ABB business are then transferred to other; developing best practice across the organisational group. Within ABB corporate, a senior member is given responsibility for overseeing and facilitating this exchange. An established procedure and protocol has been developed within the organisation to capture learnings and improvement during the course of routine operation. This system is connected to global forums is exchange information. In the event of a serious incident, immediate emergency notices are issued across the group.

6.2.9. Approach to Resilience

Within ABB, resilience is not a direct consideration within the daily operations of the organisation. But is instead the result of the developed processes, procedures and structure within the organisation and the wider organisational group. The organisation is anticipating potential disruptions, risks, and threats, and then developing capabilities to address these disruptions should they occur. Through this ABB is able to develop robust preparations aligned to the organisation’s operational capabilities. This is reflected within:

- Crisis management plans
- Security plans
- Disaster recovery plans
- Employee management
- Travel plans

“Almost without us using that terminology that is what we are doing. We are planning for a disturbance coming in, and what is going to come out the other end.” (Interview-ABB-001)
“I think they plan very early on. I think that is drummed into us. I think resilience is almost built into the way we do business to a certain extent and do I think ABB can mobilise quickly? Yes I do. I think they are very good at that. I think it is a cultural thing a little bit as well in the way we are as a company.” (Interview-ABB-004)

Resilience relates to the strengths and capabilities of the organisation’s operations, and the organisation’s ability to effectively address both small and large scale disruptions. This is possible through the organisation’s established prior preparations and the ability to mobilise quickly and effectively during an event. The global nature of the organisation also creates a diverse pool of experience and expertise upon which the wider organisational network is able to draw upon.

6.3. Within-Case Analysis Company 2 – E.ON

Following the coding process outlined within Chapter 4 Section 4.5, 113 nodes were identified and approximately 100 were retained for analysis. Following the development of a thematic matrix, the nodes were then mapped onto a causal network.

From the organisational response causal network, four themes emerged that encompass the majority of the identified response factors. These themes include Threats and Risk, Organisational Structures and Processes, Organisational Strategy, and Organisational Development and Growth.

6.3.1. Profile

“We have an ambitious objective: to make energy cleaner and better wherever we operate. Going forward, we intend to expand our business outside Europe. Our new strategy, whose motto is cleaner & better energy, will transform E.ON into a global provider of specialized energy solutions.” (Article-EON-001)

E.ON was formed in June 2000 through the merger of two German companies, VEBA and VIAG, and has become one of the world’s largest investor owned power and gas companies, with operations throughout Europe, Russia and North America. In 2010, the E.ON’s attributable power generation capacity increased to over 68 GW, with operations in Germany, the United Kingdom, Sweden, Russia, the USA, Italy, Spain,
France and the Benelux countries. Globally, E.ON has more than 85,000 employees and generated over EUR 93 Billion in sales during 2010.

6.3.2. Organisational Structure

The corporate centre of E.ON AG is based in Dusseldorf, Germany, and oversees and coordinates the operations of the entire E.ON group. As well as providing the strategic and operational direction for the group, E.ON Group Management provides financing, as well managing risk and the groups business portfolio. Within E.ON there are five global units that are responsible for each of the organisation’s primary functions. These include traditional power generation, renewable energy generation, new build and technology, gas and commercial trading.

Within Europe there are 12 regional units that manage the operations, national sales, regional energy networks and distributed-generation businesses within each of the respective countries. The regional units include the United Kingdom, Germany, Sweden, Italy, Spain, France, the Netherlands, Hungary Czechia Slovakia, Romania and Bulgaria. E.ON also has operations within Russia, which operates as a special focus country. These regional units are closely integrated with the global E.ON units which provide a range of functions including HR management, finance and accounting. The global units also provide support in regards to policy deployment, regulatory requirements and market conditions. Of the 68 GW total attributable generation capacity at the end of 2010, almost 28 GW was from gas and oil fired power stations, over 19 GW from coal fired power stations, over 11 GW from Nuclear power, almost 6 GW from Hydroelectricity and almost 5 GW from wind and other renewable energy sources (including solar and bio energy).

6.3.3. Disruptive Events

The E.ON group is subject to a broad range of business and operational risks. Given the nature of the organisation’s operations there are several inherent risks within the production and distribution of energy. Additionally, market uncertainly can also lead to significant risk exposure. Within the operations of the organisation, the main risk categories include market risks, financial risks, strategic risks, operational risks and environmental risks. These are detailed within Table 6-4.
Table 6.4 - Risk Categories

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Risk Factors</th>
</tr>
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<tbody>
<tr>
<td>Market Risk</td>
<td>- Economic instability</td>
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<tr>
<td></td>
<td>- Increased Competition</td>
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<tr>
<td></td>
<td>- Procurement risks linked to price</td>
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<tr>
<td></td>
<td>- Demand fluctuations</td>
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<tr>
<td></td>
<td>- Commodity price risks</td>
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<tr>
<td>Financial Risk</td>
<td>- Currency fluctuations and transactional risks</td>
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<tr>
<td></td>
<td>- Financial liabilities and earnings risk</td>
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<tr>
<td></td>
<td>- Risk related to future obligations</td>
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<tr>
<td></td>
<td>- Changes in trading regulations</td>
</tr>
<tr>
<td>Strategic Risk</td>
<td>- Risks within the acquisition of new companies and investment within core businesses</td>
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<tr>
<td></td>
<td>- Risks involved within the integration of acquisitions</td>
</tr>
<tr>
<td></td>
<td>- Incorrect assessment of profitability within acquisitions</td>
</tr>
<tr>
<td></td>
<td>- Failure to retain key employees</td>
</tr>
<tr>
<td></td>
<td>- Inaccurate forecast of future market trends</td>
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<tr>
<td></td>
<td>- Regulatory and legislative changes</td>
</tr>
<tr>
<td>Operational Risk</td>
<td>- Major power outages</td>
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<tr>
<td></td>
<td>- Inadequate balance between power production and consumption</td>
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<tr>
<td></td>
<td>- Single failures triggering a cascading impact</td>
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<tr>
<td></td>
<td>- Transmission bottlenecks within supply network</td>
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<tr>
<td></td>
<td>- Disruption to offsite activities</td>
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<tr>
<td></td>
<td>- IT risks</td>
</tr>
<tr>
<td>Environmental Risk</td>
<td>- Environmental liabilities</td>
</tr>
<tr>
<td></td>
<td>- Extreme weather and climate change</td>
</tr>
</tbody>
</table>

(Source: Article-EON-002)

Prior plans and preparations form key elements within the organisation's response to disruptive events. These plans are regularly reviewed and adjusted where possible to ensure the development of robust preparations. The developed plans include a variety of general responses to a range of possible scenarios. However, instead of focusing on developing a specific plan for every confineable eventuality, the developed preparations provide an adaptable framework which can then be reviewed and modified in accordance with the demands of a particular event.

Events place considerable limitations and constrains on an organisation. In order to support the development of an appropriate response strategy, prior preparations within the organisation establish how long E.ON can operate without certain organisational elements and functions. Elements that form an essential component within the operation and value chain of the organisation form areas of criticality. Understanding where these areas lie within the organisation and their importance is
essential within addressing the impact of an event. In addition, it is necessary to identify how many people are required to operate critical processes.

Given the criticality of the energy industry within national infrastructure, E.ON has established a close connection to national safety infrastructures and agencies towards the development of robust organisational systems. Preparations and planning are developed in line with emergency services. E.ON also brings in external authorities to review response preparations and assumptions.

“We worked in conjunction with the emergency services there as well. So it is important to look at your planning assumptions and make sure that they link in. That those assumptions do rightly link in with what the emergency services would do.” (Interview-EON-001)

Working in conjunction with national safety infrastructures and agencies, allows the organisation to address the requirements of responders (emergency services and response agencies) and develop robust preparations. Responders have specific processes and procedures within the response to catastrophic or severe events, as such; activities undertaken by E.ON should not undermine the responder’s ability to address the demands of the situation. Instead, E.ON focuses on developing preparations to support responders and avoids assumptions where possible within disruption planning. The relationship between E.ON and national response infrastructure extends through the direct response of E.ON and includes the involvement of the organisation within the development and participation within national response preparations.

“On one element I sit on the national police and improvement agency where we’ve helped them develop their silver and gold command training. Which is simply on public order issues. So from that level we link into their scenarios that they run through and we are actually part of the training that they take the assistant chief constables through.” (Interview-EON-001)

Through the continual development of preparations in relation to potentially disruptive events, E.ON is able to systematically improve the organisation’s capability
to effectively manage disruptive events. Through established prior preparations, the organisation is able to support and facilitate the effective utilisation of available resources and define additional requirements where necessary. Through this the organisation is able to link a proactive approach to resilience with strategic priorities in relation to the adaption of the organisation. Developing resilience within organisational elements and business units is therefore key to overcoming an event.

“I think it fundamentally boils down to it could be the key driver in a business coming out the other side of an incident commercially intact.” (Interview-EON-002)

6.3.4. Preparations

No organisation is immune to the impact of a threat, disruption or crisis event. Within E.ON, preparations in relation to the response of the organisation to threats and risks is achieved through aligning organisational functions with recognised standards. The central standard utilised is BS 25999, which forms the recognised standard for Business Continuity Management.

“Other threats that have affected many organisations worldwide, for example, industrial action, adverse weather conditions, volcanic ash disruption and the fuel crisis all share similar impacts. The key for us is to flex a simple, effective, worst-case scenario plan that meets all of the ingredients of BS25999.” (Interview-EON-001)

The BS25999 provides a readily adaptable framework for the response to and mitigation of risks and threat. The standard thereby provides a level of quality assurance during periods of adversity. E.ON began development towards the standard in order to better position the organisation to mitigate and control the impact of business interruptions. As a result of the certification, the experience and expertise within organisational elements is being shared as part of the ongoing development of best practice across the entire E.ON Group.

Maintaining the continued function of an organisation in the event of a disruption is a critical element of the operation of an organisation. Organisations are exposed to a wide variety of both expected and unexpected risks during the course of operations or as the direct result of an event or incident. Subsequently, BS 25999 was developed in
order to support organisations and minimise the risks associated with disruptions. The standard helps organisations establish the fundamental aspects of Business Continuity Management System (Article-EON-003).

Rather than follow a prescriptive approach within achieving certification, internal Business Continuity Management controls such as operational objectives, policy and standards were developed to recognise the size, nature, complexity and criticality within the operation of the energy provider. This was achieved firstly through an extensive review of operations in order to develop an intuitive understanding of organisational elements. The challenge within establishing a common standard across the organisation was to secure support from organisational members. Through establishing support from senior strategic and operational managers, it was possible to develop the required relationships and connections throughout the organisational network. Through this it was possible to provide confidence and assurance among all organisational members and cultivate a cooperative culture within the organisation in relation to business continuity management.

The subsequent risk based approach within the organisation to business continuity provides effective means of delivering all aspects of the business continuity lifecycle within the operations of organisational elements. This involves: 1) developing an understanding of the organisation, 2) developing a holistic business continuity management approach and strategy, 3) developing and implementing a business continuity management response, 4) exercising the development response, and 5) maintaining and reviewing the developed business continuity management system. This lifecycle is maintained and continually developed through establishing a continuous improvement programme or philosophy within the organisation's approach to risk and potentially disruptive events. This ensures that the developed business continuity management system continues to be effective and aligned with changes and developments within the wider organisation and its supporting infrastructure. The development of this approach involves delivering focused training and empowering organisational members to maintain each business units developed management system. Through this process, E.ON is able to develop an embedded
business continuity management culture and approach across the organisational network.

“From a pure business continuity point of view we broadly for E.ON businesses in the UK we’re aligned to be BS 25999 but for business services, which is the bit that I’m belong to we’re actually accredited to that and now that is deemed to become an ISO standard going forward. And that is what we have used our planning assumptions have been leading the group wide project as well. So it is making sure that we align to a standard rather than doing something, because somebody says that this is the right thing to do... align to the principles of that.” (Interview-EON-003)

During the routine operation of the organisation, operations are exposed to a wide variety of potential risk factors and threats. The key aspect of the organisation’s response in relation to the BS 25999 standard is to develop an adaptable yet effective worst case scenario plan that meets all of the criteria outlined within the specifications of the standard. This eliminates the need to develop plans and procedures for every conceivable disruption and instead manage any number of risk factors that may occur. Additionally, certification of the standard also provides an acknowledge level of assurance. This can provide significant leverage when working with stakeholders, customers, industry and the Government.

6.3.5. Crisis Planning and Risk Management

The risk management system within E.ON is embedded into the entire organisational structure. Through this the risk management system is an integral component of E.ON’s business and decision making processes. The features of this system are shown within Figure 6-7. The key features of this risk management system include:

- Established risk committee
- Group wide guidelines
- Group wide reporting systems
- Standardised strategies
- Established planning and control processes
- Established risk thresholds and monitoring
- Robust auditing processes
6.3.6. Detection

Effectively anticipating a threat or disruption is largely related to the level of strategic planning within a particular business unit or within the organisation’s senior management structure. This is achieved through effective risk management activities and the use of forecasting methods and models. A key element within the effective detection of risks and threats is linked to the organisation’s ability to establish effective risk controls and clearly identify the subsequent strategic implications of events. The organisation must therefore continually assess potential risk factors and develop appropriate controls.
“It to ensure that we understand the types of risks that the business faces and that we understand our risk appetite. And then we put in a series of controls that can control those risks and the thresholds of the risk that we assign. It is very much from developing the strategic intent for the businesses…” (Interview-EON-001)

“These are the likely issues that we are likely to come up against, can we control them, yes, this is how we control them. And you may have to factor in x-amount of budget in addition to the normal capital spend.” (Interview-EON-001)

Within individual organisational elements and business units, the risk management functions strive to establish appropriate risk thresholds. These thresholds establish the risk tolerance of a particular organisational element and allow the organisation to effectively assess the impact of potential events. Established risk thresholds within organisational elements also support the organisation’s ability to effectively manage events through outlining the amount or level of risk or exposure an element is able and prepared to accept before immediate action is required. Additionally, if an identified risk or threat were to exceed an established risk threshold immediate attention and action can be taken within the escalation of the organisation’s response.

“Loss of a facility could be loss of water, loss of sanitation, loss of power, loss of access, fire, there are loads of different events that could ultimately lead up to the loss of a facility so locally we build round that and then the escalation points.” (Interview-EON-002)

“You are use to assessing the threats and the risks and use to putting in controls to protect against them.” (Interview-EON-001)

Within establishing the risk threshold for an organisational element it is necessary to identify the nature, size and complexity of the elements operations. Established risk thresholds determine the operating limits and constraints for organisational functions. These thresholds also establish the capacity of an organisational element to take or withstand risk. While certain organisational functions may be risk averse, others may be able to take acceptable risks within routine operations within the boundaries of the established risk thresholds. Subsequently, within the operations of
individual organisational functions and business units, established risk thresholds provide several operational benefits. These include:

- Provide a framework for decision making and structured strategic development (thinking) within organisational functions.
- Identifying issues at an early stage
- Means to address long-term (strategic) objectives
- Provides an information source

It is therefore vital that the organisation understand the potential escalation of risk. Established risk thresholds will not eliminate a risk factor but support the organisation's ability to manage risk effectively, providing a framework for identification, monitoring and escalation of response in relation to identified risk factors.

“It is also different chemical that power plants have on their facilities, a spill of one may not have a large environmental impact because it is controlled and contained locally but a spill of something else will have larger impact.” (Interview-EON-003)

Subsequently, the organisation must actively assess the potential impact of an event and the accumulation of risk factors. The measurement and assessment of risk forms a complex activity. As such, following the establishment of risk thresholds it may be possible to identify potential indicators of risk factors. These indicators provide a means of assessment within the monitoring of risk and threats. Once a risk threshold has been exceeded, or potential threats identified, the organisation is able to implement risk management processes and controls to mitigate the potential impact.

Potential risk factors to consider include:

- Function of business unit
- Size of business unit
- Nature of the competitive environment
- Market trends and fluctuations
- Business planning
- Support Systems (IT, HR, EH&S)
- Information infrastructure
- Management structure (authority)
- Information exchange
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- Competencies and capabilities
- Areas of innovation
- Geographical location of operations
- Degree of autonomy
- Complexity of value chain
- Interdependencies with other partners
- Political and governmental elements
- Regulatory requirements

This risk management system drives the organisation’s approach to resilience through the continual monitoring and adjustment of organisational functions in relation to risks and threats. The impact of external events can have a direct impact on business strategy and direction.

“It was strategic decision that we were facing a number of issues that could impact the business and that we needed to be more proactive in managing those risks, so that is way the resilience team was set up the way it is.” (Interview-EON-001)

“In response to Fukushima] That is an interesting one for us because we are fundamentally a German organisation. And we took two of our older nuclear facilities offline straight away in Germany and now obviously the German government has said that they want organisations to exit nuclear in Germany by 2022. Which puts some big challenges on us and other German companies alike.” (Interview-EON-001)

Within developing an external awareness the organisation continually monitors its operating environment. There is a constant review of external events influencing or affecting the operation of the organisation. Organisational elements and business units monitor their operating environment and the changing landscape of risk management. The organisation also draws knowledge and learnings from other organisations. An external awareness also involves identifying and responding to trends within the external environment, such as market fluctuations and customer demand. Political and governmental decisions and policy can also have dramatic implications for the organisation. An external awareness is also important in relation to customers. Public perception and opinion in regards to the organisation and its operations is an important facet of organisational success. Emphasis is placed throughout E.ON’s operations on the importance of reputation.
6.3.7. Activation

Figure 6-8 presents a casual network related to detection and activation within E.ON.

Within the development of an appropriate response strategy there are several critical issues that must be addressed. The loss of life and facilities are central concerns in the immediate aftermath of an event. As a result, these considerations form operational priorities within response actives and immediate action is taken around addressing these priorities. Following the onset of an event or the mitigation of a potential threat, an event response team is formed. This team has several responsibilities across all the response activities of the organisation and within the development of a response strategy. Following an event, the team must establish operational limitations and constraints, and ground response activities in the reality of the situation. As such, accurate information not only about the impact and cause of an event is required, but also the operational constraints imposed by the event.

“Maintaining up to date data is vitally important. Absolutely. For instance if you haven’t got you contact data up to date in the event of an emerging crisis or an incident then your success failure could be highly impacted.” (Interview-EON-001)

“And very often tipping point from going from incident to crisis for an organisation can be that communication period. And even after an incident does go into crisis for whatever reason the key element of that is how the organisation communicates that both internally and externally as well.” (Interview-EON-003)

Reacting to an event without adequate information can significantly limit an organisation’s ability to respond effectively. This relates to both a pre-emptive response in relation to the adaption of the organisation to a potential threat or the reaction of the organisation to a direct or retrospective event. Successfully interpreting environmental feedbacks and operational fluctuations and linking this information to an appropriate response system is therefore essential within E.ON’s ability to support a proactive response.
Organisational Case Studies

Constraints
Risk Thresholds
Planning and Control
Processes
Activation
Risk Management
Escalation Points

Operational Priorities
Information
Environmental Feedbacks
Operational Fluctuations
Response System

Operational Limits

Figure 6-8 - E.ON Detection and Activation Causal Network
As highlighted within Figure 6-8, E.ON’s response to incidents and potential threats can be characterised through either ‘mitigation’ relating to identified risks and threats or through a ‘reaction’ following the onset of an event. As such, a proactive response is defined as the response of the organisation prior to the significant escalation of an event.

Within E.ON’s approach to the management of potentially disruptive events, ‘mitigation’ refers to the organisation’s response or adjustment to potential risks and threats prior to impact. These risks or threats are recognised during phases of detection. The process of mitigation relates to the organisation's efforts taken to effectively reduce both the probability and consequences of the identified or potential threat. A critical aspect within the effective mitigation of an identified risk is effectively interpreting the strategic implications (long-term impact) of an event. While the organisation’s response to unexpected events is characterised as being reactive in nature.

The level of impact associated with an event is a large determinant in the level of response for the organisation. Disruptive events are characterised by uncertainty both within their occurrence and potential severity. This places significant limitations in accurately predicting the probability of occurrence and potential impact of an event. In order to address this, the organisation has set risk thresholds for each critical organisational function and element. These provide an initial assessment towards understanding the level of risk that the organisation or individual organisational elements are able to tolerate. This assessment also aids in establishing the strategic implications associated with potential threats and risks on the operation and performance of the organisation. The value of resilience within this approach allows the organisation to understand the criticality attached to each organisation element and the linkages between them. This understanding is vital given the potential cascading effect within disruptive events. Events or impacts in one area of the organisation (direct impact) can carry significant limitations and constraints for another (indirect impact). Subsequently, the organisation strives to develop and maintain appropriate risk controls. These controls involve the direct monitoring of risk
factors as well as direct actions, processes and procedures towards reducing their occurrence and effect.

An intuitive and accurate synthesis of information about a risk or threat is required to meet the needs and interests of decision makers, stakeholders (internal and external) and those elements directly impacted during the response of the organisation. The characterisation of risk or an individual risk factor forms the initial stages of the decision making process during the response of the organisation. The continual assessment and monitoring of risk forms an iterative process within the escalation of response activities. Monitoring risk thereby forms a routine activity within the management of E.ON's operations across all organisational functions. Information and experience in relation to risk management is then exchanged between organisational functions towards the development of a more robust organisational network. A risk register is also kept and maintained throughout the organisation.

6.3.8. Response

Delayed decisions, short-term thinking, failure to communicate effectively and an inability to address uncertainty, undermines an organisation's ability to respond and recover effectively from a disruptive event. Damage following the impact of an event must be controlled, the impact and safety of human life needs to be promptly addressed and losses need to be effectively mitigated. Without firstly addressing these issues, an organisation's ability to take advantage or seek potential opportunities within disruptive events is significantly limited. The response of the organisation to disruptive events requires clear priorities established through the organisation's embedded values. Additionally, the organisation has a fixed responsibility for ensuring the continuity of supply for national infrastructure. The organisation must ensure regulatory compliance across all business units, facilities and operations. In relation to response activities, time parameters on critical processes cannot be breached.

"It is making sure that fundamentally that we have a number of divers. One is making sure that we maintain the safety of life. That is our key driver. That the ability to keep the lights on in the UK. That we maintain shareholder value and don’t breach any regulatory
regimes as well. But fundamentally it boils down to if there is an incident that all our critical processes that have defined our time parameters have been able to be up and running and not breached and they are able to continue their business.“ (Interview-EON-002)

These values are clearly outlined within the purpose and operating objectives of the organisation. E.ON’s organisational values are defined as:

- Integrity
- Openness
- Trust and Mutual Respect
- Courage
- Social Responsibility

In addition to the direct impact of an event on the operation and function of the organisation, response activities should also address the influence of the event on organisational members. Following the onset of an event, organisational members may be subjected to unexpected and increased levels of stress, anxiety, fear and fatigue. E.ON recognise the importance of addressing the human impact in the immediate aftermath of an event. This may even extend further in severe instance and involve the use of counsellors and support groups. This aspect is coordinated through the involvement of the organisation’s Human Resource department.

Figure 6-9 - E.ON Response to Disruptive Events
An overview of the organisation’s approach to disruptive events is shown within Figure 6-9. The effective management of disruptive events can bring several benefits to the organisation. These include:

- Limit the direct and long-term impact of an event
- Develop and improve competencies towards the effective management of major or large scale events
- Validation of prior preparations and procedures
- Improve awareness of organisational dynamics and functions
- Enhance the safety of organisational member
- Enhance security for organisational elements, divisions, customers and stakeholders
- Reduce risk of legal proceeding associated with events
- Develop the level of control within the organisation
- Reduce the potential damage to the organisation’s image and reputation
- Ensure compliance with regulatory requirements
- Empower and motivate organisational members
- Identify areas of development and improvement

Operating through established strategic objectives and drivers extends throughout the operations and functions of the organisation. In relation to the response of the organisation to an event, core response preparations and activities are facilitated through an established support structure and the use of recognised standards (BS 25999). The use of these established and recognised standards and processes provides a robust framework within the operation of the organisation. Response activities can then be adapted in relation to this framework creating a consistent foundation across all response activities. The framework also provides an established process within the escalation of response activities and clearly defines roles and responsibilities. The use of this framework also provides confidence and a level of quality assurance within response activities and the development of bespoke response strategies.
E.ON follows a pragmatic approach to successfully managing the organisation's response to risks and disruptive events. This approach is based upon practical considerations of the impact and potential implications of an event. Fundamentally this approach is based upon ensuring the effective communication of the situation and the efforts of the organisation to all organisational members. Communication is the catalyst for the effective organisational response to disruptive events. The tipping point for a business going into a crisis is the way in which communication is managed. Both internal and external communication is required during and following an organisational response. This creates not only awareness across the organisation, but also aids within the coordination of response activities. Coordination relates to linking the combined efforts of various organisational elements together.

Incidents are typically managed locally. Impacted business units are given support and guidance from corporate divisions and also may draw expertise and resource in from external division. Through managing events locally, involved organisational elements are empowered to not only resolve the issue but take ownership for ensuring recovery. Local organisational elements will also have a unique and embedded understanding of the intricacies and structure of business unit and its operations. This approach is based upon the development of robust local preparations and responses, linked to local knowledge and understanding.

“So from a local, incidence management standpoint, very robust as you would hope for in an engineering based organisation such as E.ON. Local processes, local controls, and local incidence responses is very robust but joining it up to a wider business resilience strategy...” (Interview-EON-001)

To a large extent it is the values set by the organisation that determines the response characteristics of an organisation in relation to a disruptive event. Embedding organisational elements within a consistent set of values and organisational objectives provides a common approach and perspective within response activities. Shared values link organisational elements and function together during periods of adversity.

Accurate and honest communication reduces the confusion, ambiguity and uncertainty experienced during periods of adversity. Effective communication also
Organisational Case Studies

provides an understanding of the impact and potential implications of an event across the organisational network. This aids in reducing delays within critical response activities, given the potential time constraints within disruptions.

Communication can form a bottleneck within response activities, further amplifying the impact of an event and placing further time constrictions on the situation. Established notification systems and communication hierarchies form an effective network to create awareness across the wider organisational network of the event and provide information about current response activities. Within the response to an event, communication is vital in order to achieve several objectives. These include:

- Develop awareness and understanding of organisational operations
- Provide understanding of preparations
- Link expertise to organisational needs and operations
- Develop preventative and adaptive actions and strategies
- Monitor potential risks and threats
- Provide warnings of impending events
- Assess the impact and potential implications of an event
- Identify involved parties, both internal and external to the organisation
- Motivate and empower involved parties within response activities and operations
- Address the impact of an event in relation to the safety of employees
- Alert relevant authorities and support networks, such emergency services and national response infrastructures
- Facilitate the coordination of response activities and operations
- Collect information, data and resources

Additionally, given the importance and criticality of E.ON’s operations in relation to the UK’s energy infrastructure, an established communication network is required amongst not only internal organisational elements but also external parties and authorities as well as the public. Effective communication is required between experts within the organisation, throughout the organisation’s management structure, the event response team, stakeholders, Government officials, external customers, media
outlet and the public at large. In order to support effective communication and information exchange in the aftermath of an event, regular interaction between critical organisational elements involved within response activities is essential in order to develop the groundwork for effective working relationships during response operations.

In order to facilitate an effective response, following the onset of an event, organisational elements must strive to provide reliable information to the best of their ability as soon as possible. This information should be provided in a form that can be widely understood across the organisation, in order to reduce any confusion or assumptions in relation to the impact of an event. It is crucial to limit potential misunderstandings within response activities, as this could have direct implications for resource allocation and response provisions. Future implications and operational limitations may also become ‘hidden’ or unaccounted for. Although the constraints of the situation may limit the ability of organisation elements to provide completely accurate information, factual and practical information is required for the development of an appropriate response strategy towards impact assessment and the coordination of response activities. However, it is also important that the organisation effectively controls the information that is provided to the public.

The plans or response strategies that are developed in order to address the demands of a particular disruptive event, needs to balance with the level of risk associated with that event. Additionally, the response strategy needs to be aligned and linked within support frameworks and external networks. Within developing an appropriate response strategy, it is vital to accurately interpret the impact of an event. Regardless of the specifics related to the cause of an event, the assessment of events or potential threats remains the same. The major concern within disruptive events is that of Health and Safety. Ensuring the safety of impacted individuals is of paramount importance. Events impacting the safety of employees or individuals within affected areas are characterised as severe events. Additional measures of severity include:

- Events impacting power delivery
- Legal and regulatory risks
- Damage to the reputation of the organisation
- Financial implications associated with an event.

Subsequently, in order to develop an appropriate response strategy it is necessary to develop an understanding of the degree of impact an event and the level of resource required over time to restore critical operations. Once these factors have been established, given the constraints and limitations associated within disruptive events, the response of the organisation hinges on accessing individuals with the necessary expertise and skill sets. It is through the support of these individuals that decisions are made which will ensure the continuity of critical operations. This approach involves utilising organisational members that have specific business continuity roles and responsibilities, accessing inherent expertise and providing appropriate tools and support to effectively manage the impact of an event.

During the response of the organisation, strong leadership is essential, as leaders form the focal point within response activities. Leadership is responsible for facilitating and coordinating an effective response, as well as providing a clear direction during periods of adversity. It is the responsibility of leadership, to motivate and empower organisational members. It is through effective leadership that organisations are able to achieve their respective strategies. Leadership provides and establishes linkages and a consistent approach across the organisation. During periods of adversity, strong leadership is essential within the management and response to disruptive events. Established capabilities within leadership ensures a consistent direction and provides organisational members with confidence in the organisation’s operations.

“Strong leadership. I think it is about having people that are steering resilience initiatives, having people who are strong leaders that are fully conversant with the priorities of the business and the strategy of the business and have got the ability to engage and demonstrate that resilience is really an enable rather than a draw on the bottom line.”

(Interview-EON-001)

Leadership during periods of adversity must be grounded in the reality of the situation and should not conflict with the goals and values set by the organisation. A critical role of leadership is to gather a crisis management or event team and gain agreement
about the root cause of the event. Grounding response activities in the reality of the situation is vital, it is therefore important to establish visibility and recognition of the impact and implications of an event.

“So organisations are so complex as well, but not withstanding that you should never put it in the ‘too hard to do’ box. That is why I am saying from a strategic management point of view you really need strong leadership that really understands what it is trying to do and the business is trying to do.” (Interview-EON-003)

Although the demands of the situation may constrain leadership’s ability to take a long-term or even a medium-term perspective, a focus on short-term solutions will only address the symptoms of an event. During the interim following an event, it is vital that response activities focus on addressing the immediate impact of an event. However, a continued focus on short-term issues may fail to address the root cause of an incident and limit future opportunities.

In relation to the organisation’s approach to disruptive events and the management of the organisation during periods of adversity, leaders are required to anticipate, prepare and mitigate an impending threat or potential event. Although supported by various organisational elements, leadership forms a pivotal role within the effective response of the organisation to a disruptive event. Leadership is also responsible for ensuring consistent communication with both internal and external stakeholders.

Although leadership provides a central authority within response activities, in order to provide a robust approach towards the recovery of the organisation a response team is formed. The response team has several responsibilities through the various stages of the organisation’s response to an event. The primary focus of the response team is to establish a clear command and control system within the organisation during periods of adversity. Following the impact of an event, dependant of scale, the operation of the organisation is altered. The organisation must effectively adjust to this alteration or risk extended implications.

The core members of a response team are outlined within prior preparations such as business continuity planning and crisis management plans. Additional members will
then be drafted into the team dependent on the type, impact and potential implications of an event. Experienced organisational members or members with an identified skill or competency may also become involved within the response team. The response team is formed to guide the organisation through challenging periods. The team is formed immediately following the detection of warning signals or the unexpected impact of an event. Typically, a response team is formed when the impact of an event is outside of the capability of local organisational elements or if the event carries a significant threat or impact.

The response team has responsibilities for developing contingencies related to the response of the organisation. Broadly, these responsibilities include:

- Identify what has happened (*Occurrence*)
- Provide an assessment of the direct and indirect impact of the event (*Impact*)
- Identify the necessary immediate actions (*Initial Response*)
- Establish initial priorities (*Initial Priorities*)
- Established roles and responsibilities
- Establish control (*Stabilise Situation*)
- Provide support where required (*Support*)

The response team also has clearly defined roles and responsibilities for each member. These roles will also link into the authority of the individuals involved, with leadership taking top level responsibly. The response team is tasked with developing and executing plans and strategies to overcome the impact of an event and restore operations. These plans will utilise and build upon previously established preparations and initially look to address the immediate impact of an event.

“I have installed in my team that we need to be lean about things. It is not about having volumes and volumes of plans it is keeping it simple, lean and specific and actionable.” *(Interview-EON-001)*

Given the diversity of E.ON’s operational portfolio, both within the capabilities of individual business units and geographically, following the impact of an event it may be possible relocate operations temporarily. Connection to national distribution grids
also provides continuity within supply for end user customers during periods of disruption. Within the UK, connection to the national grid forms a connection across several redundant sources providing a consistent energy supply. The relocation of operations (particularly generation) stands to minimise the impact of the event on the business and customers, through ensuring that critical operations are maintained with little disruption. The ability to effectively relocate operations stems from developing a level of functional redundancy within the organisational system across various business units. Access to additional capacity within the organisational network also supports the ability of operations to relocate.

It is also important to understand wider implications of an event. Events can carry significant impact across the organisational value chain and network, as well as potential implications for stakeholder, customers, infrastructure, the environment and in severe instances regional or national communities. In order to address this, the organisation must understand its position within the energy industry and its connection to national infrastructure. As a result of the significant implications that an event affecting the energy industry can carry, organisations may work together to address risk and potential disruption to the mutual benefit of all involved. This stems from established industry connections.

6.3.9. Approach to Resilience

E.ON is involved in a broad scope of operations within the energy sector and is composed of several closely integrated regional units across Europe, including several functions within critical infrastructure within the UK. As such, ensuring the continued function of operations through periods of disturbance is of paramount concern and great emphasis is placed on safety and security.

“Fundamentally my hope is to become a centre of excellence for resilience here in the UK for issues in E.ON but all for the energy sector. That is what I’m striving to do and linking that in with the business strategic priorities as well.” (Interview-EON-003)
Organisational Case Studies

Holistic Strategy Development

Strategic Priorities

Resilience Drivers

Established Strategic Objectives and Drivers

Need to Change Strategy Development

Strategic Focus

Resilience

Operational Priorities

Establish Operational Constraints

Document Procedures

Capture Information

Communication Management

Relevant and Accurate Information Available

Current Information Communication within Response

Business to Business Information Exchange

Connection to National Emergency Infrastructure

Established External Connection

Industry Connection

Organisational Strengths

Share Learnings and Experiences

Monitor External Environment

Wider Implications of Events

Wider Implications of Operations

Operating Environment

Overcoming Events

Impact of Disruptive Events

Organisational Strategy and Direction

Address Low Probability Events

Risk Thresholds

Acceptable Level of Risk

Understand the Nature of Risk

Develop Appropriate Risk Controls

Impact of an Event

Influence of External Events

Learning

Develop Appropriate Controls and Processes

Establish Risk Controls

Planning for Risk

Understand Criticality

Operations Management Driving Resilience

Buisness Enabling Process

Driver for Resilience

Nature of Resilience

Understanding Resilience

Insurance

Establish Value

Use of Recognised Standards

Quality Assurance

Efficient Operations

Risk Management

Organisational Resilience

Importance of Reputation

Political/Governmental Influence

Environmental Consideration

Issues of Sustainability

Support Structure

Commitment from Leadership

Critical Success Factor

Developing Resilience

Events Managed Locally

External Review

Areas of Future Growth

Investment in Growth Areas

Organisational Development

Innovation

Unconnected Business Units

Financial Approval/Authorisation

Strategic Plans

Figure 6-10 - E.ON Approach to Resilience

Causal Network
“If you take any business that is perhaps looking to emerge in high risk locations it can give that strategic leverage or business leverage to enable it to operate, where some organisations may not be able to. They understand the risk, but they are not able to or mature enough to accept those risks. Where an organisation in my view that has a pragmatic approach to resilience can be a business enabler in those situations.” (Interview-EON-003)

“There were a number of different issues that triggered a number of different events, and the board took the decision that it needed to change its strategic focus. And now we have moved from a position of being a cost to the business to actually being seen as being an enabler for the business and also being able to protect and generate revenue as well.” (Interview-EON-002)

The concept of resilience within E.ON is closely integrated into both the strategic functions and operations of the organisation.

“I think it has to be a strategic aspect of a business, with well entrenched operational and tactical delivery in the businesses. Strategically to make sure that the business is aligned and fundamentally the overarching business priorities are protected but with the ability for people who know their business to be able to tactically be able to implement that on the ground.” (Interview-EON-001)

Subsequently, the organisation follows a mature perspective and approach to resilience within its operations, addressing resilience and the associated elements as more than a mere insurance policy against disruptions. This can be seen through the well established processes through which the organisation evaluates strategic decisions and as well as the organisation’s approach to addressing potential disruptive events. It is through these linkages that the organisation has not only been able to achieve operational benefits, but also develop a more robust organisational system towards potentially disruptive events. Resilience is therefore viewed as a strategic decision to support organisational growth and development and is viewed as a business enabling process.
“But I think in the whole area of risk management I think the whole issue of Fukushima incident has really forced people into turning over a few more stones in their own organisations. And it goes back to my earlier point around business resilience, whatever it is tagged or framed up in an organisation needs to be part of a business enabling process. And not seen as an insurance policy that you never see the benefit of, unless something happens.” (Interview-EON-001)

“Whether it be difficulties in travelling, people taking time off, I think as long as you focus resilience initiatives on holistic approach to managing the loss of facilities or the loss of people then you can massage it to fit in to a number of things.” (Interview-EON-002)

“But what I have tried to do is really ask the question really what is the value of us to the business and then on a monthly basis, half yearly and end of year review,... how we have delivered value to the organisation.” (Interview-EON-002)

Resilience requires an holistic approach within the organisation. The emphasis of resilience across all levels of the organisation stems from a deeply rooted understanding of the organisation’s value chain and operations. Resilience is viewed as a value adding activity (rather than an insurance policy). Following E.ON’s approach to resilience, disruptions are characterised as events involving loss of productivity, disturbance or interruption to routine methods, procedures, processes and functions, impacting the efficiency of the organisation’s operations.

6.4. Within-Case Analysis Company 3 - UAM

Following the coding process outlined within Chapter 4 Section 4.5, approximately 100 nodes were identified and retained. Following the development of a thematic matrix, the nodes were then mapped onto a causal network.

From the organisational response causal network, three themes emerged that encompass the majority of the identified response factors. These themes include Threats and Risk, Organisational Structures and Processes, and Opportunities.
6.4.1. Profile

Advance Uranium Asset Management Ltd (UAM) specialises in uranium related transactions and logistics within the front end of the nuclear fuel cycle. The Company manages Westinghouse's owned uranium inventory and controls supply chain activities between enrichment and fabrication sites for utility owned inventories. Subsequently, the organisation is involved in both supply chain logistics as well as the commercial services including procurement and management. UAM's commercial division is involved within procurement, supply and the management of uranium transactions for utility organisations as well as other market participants. As such the organisation provides integrated transport and logistics operations.

The organisation’s headquarters is based in Lancashire, UK, within the Springfields Fuel site in Preston. UAM also has international bases in Columbia, South Carolina, USA and Tokyo, Japan. The organisation has established itself as one of the world leaders in nuclear material logistics and transportation, with specialisation in road, rail and sea freight.

In February 1996, BNFL Uranium Asset Management Company Limited (UAM) was created. The organisation was created as a subsidiary of British Nuclear Fuels plc (BNFL) with a mandate to control and manage all of BNFL’s uranium supply requirements. The main drivers for the creation of the organisation were to supply the Scottish Nuclear Reactors as well as provide stewardship of BNFL’s uranium supply. The organisation operated under this structure until April 2005, whereupon the organisation became Uranium Asset Management Ltd (UAM Ltd) and a subsidiary company of Westinghouse Electric UK Ltd as a result of the UK Energy Act. Following a joint venture between Toshiba and Westinghouse Electric Company, UAM Ltd became Advanced Uranium Asset Management Ltd (AUAM Ltd), although the organisational brand and identity was still UAM Ltd. The joint venture ownership of the organisation is 60% Toshiba and 40% Westinghouse, although UAM operates autonomously in support of both parent companies.
6.4.2. Organisational Structure

The transportation of nuclear materials is a tightly controlled and regulated activity. UAM operates globally with contracts and customers from around the world, as such, there in close connection and collaboration with various regulatory bodies and governmental departments. Although UAM operates with a relatively small workforce, the organisation boasts highly skilled, experienced and dedicated personnel across all areas of the organisation’s operations. It is this knowledge and experience that allows UAM to operate effectively in its delivery of services and maintain its safety record.

Figure 6-11 - UAM Organisational Structure

As shown within Figure 6-11, UAM is a Toshiba and Westinghouse Electric joint venture company. The organisation provides a range of services for the front end of the nuclear fuel cycle, involving all aspects of the uranium supply chain, from material supply and management, to regulatory consultancy and transportation. UAM formed in 1996 and has been at the forefront of commercial uranium supply for BNFL and Westinghouse. The organisation has also developed a broad portfolio of international customers; with operations across the globe. In order to support the growth and development of the organisation, UAM has developed a commercial aspect to its operations. This division of the organisation, AUAM, extends the services that UAM is
able to provide in order to better support its customers, as well as Toshiba and Westinghouse.

The UAM brand is composed of two organisational divisions. The commercial division, named Advanced Uranium Asset Management Ltd (UAUM), is a joint venture between Toshiba and Westinghouse. The division was formally created in April 2010 as a segment of the Toshiba Uranium Department. UAUM are created in order to support and expand UAM's capabilities within the nuclear front end fuel cycle. The division offers a wide range of uranium supply products and logistics. AUAM also provides uranium procurement and management services for its customers. The second division within the organisation, UAM, was developed to support Westinghouse and its operations. Within this role UAM manages uranium working stock for fuel fabrication sites, as well as coordinating support for Westinghouse and Nuclear Power Plant (NPP) proposals. UAM also provides the logistics for Westinghouse's fuel transport operations as well as supporting several external customers.

“The Managing Director gives us free reign to manage how we see fit and as long as we get the job done then that is fine.” (Interview-UAM-001)

The organisation is lead through the direction of the senior management team. Although the direction of the organisation is often prescriptive, given the nature of the industry and the demands of the stakeholders, both the Commercial and Transport divisions are able to run independently and semi-autonomously where appropriate. Both divisions must continually seek new business opportunities and look to actively engage with new and potential customers. Figure 6-12 and Figure 6-13 present a causal network of the organisation’s structure and operations.
Organisational Case Studies

Organisational Culture

Organisational Priorities

Independent Divisions

Connection between Divisions

Support

Westinghouse Joint Venture

Commercial AUAM

Transport UAM

UAM

Toshiba

Westinghouse

Uranium Transactions

Transport Operations

Group Connection

Intra-Organisational Connection

Inter-Organisational Connection

Customer

Parent Companies

Regulatory Bodies

Authorities

Suppliers

Operators

Focus on Communication

Stakeholder Expectations

Industry Connection

Connection to Suppliers and Operators

Establishing Connection

Customer Connectivity

Operations

Critical Success Factors

Limitations

Organisational Capability

Dependencies

Competitive Advantage

Capturing Innovation and Opportunity

Maintaining Competitiveness

Speculative Trading

Improved Coordination

Indentifying Market Opportunities

Operational Authority

Placements and Local Agents

Opportunities

Figure 6–12 – UAM Organisational Structure Causal Network

Key

Node

Sub-node

Causal Connection

Inferred Connection

Theme

Figure

6–12
Organisational Case Studies

Critical Success Factors

- Establishing Connection
- Uranium Transactions
- Transport Operations
- Support and Coordination
- Contract Security
- Establishing Contracts
- Contracting Procedure
- Dependencies
- Proactive Behaviour
- Security
- Operational Knowledge
- Addressing Uncertainty
- Competitive Advantage
- Large Revenue Potential
- Nature of Industry
- Market Opportunities
- Seeking Opportunities Through Innovation
- Environmental Scanning/Monitoring
- Strategy Development
- Customers
- Support
- Uranium Transactions

Figure 6-13 – UAM Organisational Operations Causal Network
“... That fact that we do have a lot of experience and a lot of knowledge within the people that work for us. The fact that we have a diverse portfolio, the fact that we have transport and Uranium under the same roof. Also the fact that we have good relationships with a lot of the nuclear industry out there.” (Interview-UAM-002)

The Commercial division (AUAM) is exclusively involved within Uranium trading and transactions. As such, the division provides material and service management throughout the front end of the nuclear cycle. The division subsequently operates as an intermediary for both stakeholders and customers. The Commercial aspect of UAMs operations is a unique aspect of the organisation, and through its activities the division is able to reduce UAMs dependencies on external suppliers; limiting several potential external risk factors relating to supply. The division also has the potential to generate significant revenue through Uranium transactions.

6.4.3. Disruptive Events

The organisation is subject to a diverse range of risk factors and threats both internal and external to the organisation. Internal risk factors primarily relate to the support and direction from parent companies, while external risk factor relate to increased competition.

“I think internally it is the support and direction of Toshiba and Westinghouse. Personally I don’t think there is enough focus on us by Westinghouse and I think Toshiba aren’t clear enough on what they want. And they have lots of good ideas but all of these ideas don’t seem to be things that you can do day to day. And they switch from something. And because there is a huge culture difference.” (Interview-UAM-001)

“... externally it’s competition, competition from the like of Arriva the French who can just do everything. And I think fundamentally it’s going to be how the Japan events pans out. I know that if more stuff comes out that may have been held back or if something else happens you know it could just could be massive. That would be. Its massive enough as it is being a natural disaster, who’d have thought, but if it boiled down to inefficiently or inadequacies in the actual nuclear industry that would be devastating.” (Interview-UAM-001)
Threats to the operation of the organisation can take several forms, and can have far reaching implications. Major threats to the operations of organisation include fluctuations within price, demand and global economies, as well as issues such as employee succession. However, given the nature of the materials involved, dramatic and high profile events related to safety, such as terrorism attacks, security threats and environmental exposure, are major industry wide concerns. Subsequently, responsible operations and security within the transport of nuclear materials are of paramount concern. Accidents caused by organisational inadequacies or the inaccurate management and accountability of Uranium accounts, are therefore central concerns within both divisions of UAM.

“There could be security implications, there could be a terrorist incident that could affect the transport business... I’m pretty sure that would be a total monitorial on U308 being delivered around the world and that is part of our business. So yes there could be terrorism that could affect us quite badly really.” (Interview-UAM-008)

“We are sort of expecting something to go wrong, we are ready for something to go wrong and then how to handle it when it does go wrong because we are a very high profile industry and we can’t afford for anyone to cock up and that’s not just us that is anyone including our competitors, if any of us cock up that reflects on the whole industry.” (Interview-UAM-003)

Events external to UAM can have dramatic implications on the organisation as well as the energy industry as a whole. Large scale events are typically outside of normal business considerations, however in relation to the nuclear industry these events pose a significant safety concern and create a negative perception of nuclear energy and the wider nuclear industry. Events such as the Fukushima Daiichi nuclear power plant, highlight both the potentially unpredictable nature and severe threat that disasters pose. These events can have dramatic implications for the continuity and survival of individuals, communities, and organisations, as well as the dramatic implications for the countries involved. As a result, safety and security are central concerns within UAM. Although the events in Japan did not affect UAM directly, events such as Fukushima have a global impact on the nuclear industry. Fukushima has slowed
growth within the industry amid safety concerns associated with the event, limiting the amount of contracts available. The connotations associated with nuclear events, means that events can generate a negative view of the entire nuclear industry.

“Yeah we do. I don’t think that there is anything formal that covers that, there was nothing formal for Fukushima and we are adapting. Mike got told by the senior level in Toshiba change you business model from business development to business orders and that is what we’ve done.” (Interview-UAM-001)

“In relation to Fukushima]... But if it turns out that that wasn’t it then the fundamentals of the whole industry are on the line.” (Interview-UAM-001)

The nuclear industry is a relatively small but highly connected industry. As such, disruptive events associated with nuclear incidents carry global implications for the entire nuclear industry. In addition, events can often have significant long-term implications and carry political influence and connotations. Events are further compounded as there is often a significant time delay in establishing the full impact of large scale nuclear events. As such, the nuclear industry often operates together when responding to disruptive events.

“In relation to Fukushima] New build has taken a hit. A terminal hit in Germany. Switzerland probably. [Following the hard line response of Germany to shut down its nuclear program] We never expected that... It is an entirely political decision we understand. Because of pressure from the Greens in Germany.” (Interview-UAM-004)

Although not a direct threat, misunderstanding the need and the drivers of change would limit the development and expansion of the organisation. If the organisation took an overly conservative approach towards business development this might restrict the long-term performance of the organisation moving forward. Subsequently, understanding the need for change is crucial within the continued success and development of the organisation. As such, the organisation continually identifies and reviews risk factors and potential threats both internal and external to the business divisions.
“There might be no risk at all, but at least it is considering are there any potential risks with going into new types of business and if we don’t go into new businesses what are the risks associated with staying where we are. Are there risks with that. If we don’t grow the business and we don’t look at different avenues and identifying those and putting those down somewhere.” (Interview-UAM-005)

“I suppose being too conservative would be. Thinking that we are alright where we are and not wanting to move forward. You always have to move forward things always have to change.” (Interview-UAM-005)

6.4.4. Preparations

Quality assurance and compliance is a central element within the operations of UAM given the highly regulated nature of the nuclear industry. This can be seen throughout the organisation across both Transport and Commercial divisions. Full compliance and operational integrity are both strategic imperatives within the governance of UAM.

Core quality assurance activities include:

- Maintain third party certification (ISO 9000, ISO 14001)
- Provide assurance to customers and stakeholders
- Manage customer audits
- Maintain Quality Management System

Quality assurance and compliance is primarily achieved through:

- Quality assurance through documented procedures
- Rigorous audit process (Internal and External)
- Rigorous safety test of equipment
- Regular review meetings to address SSIs (Site Instructions)
- Regular management reviews
- Create process log and peer review system
- Track customer history

In order to ensure compliance, regular audits, risk reviews and assessments are conducted across the organisation within both Transport and Commercial contracts
and operations. Audits and risk reviews are conducted by both internal and external representatives. These include Quality Managers, Legal representatives and external auditors. Following the completion of an audit or risk review, corrective actions are generated which are then logged on a database and tracked through to completion. Suppliers and operators are also audited in order to certify operational competency and ensure continuity within UAM’s operations. UAM therefore follows a rigorous process for supplier and operator approval. When required, specialist expertise is brought into the organisation.

ISO 9000 certification provides an internationally recognised standard and framework for quality management systems. Within UAM, this certification is independent to that of the Springfields site and provides:

- A systematic approach for management system
- Management control practices to ensure compliance to regulatory requirements
- Improved quality of product and services
- Customer assurance and satisfaction
- Improved margins through reduced waste
- Internationally recognised standard
- Standardisation across divisions

UAM follows a methodical approach within the contracting procedure within both Transport and Commercial operations. All contracts involve a risk review and assessment, as well as coordination with the Westinghouse legal department. Both regulatory and governmental requirements are developed into the contracts. This is particularly important when transporting through different jurisdictions and regions. The organisation has therefore developed an intricate knowledge of the operational requirements across all operating jurisdictions as well as developing a robust system to capture and implement changes.

In order to ensure contacts are free from error and inaccuracies, contracts are peer reviewed throughout the contracting process. Within the contracting process, attention is also placed on creating awareness between roles and responsibilities of
the individuals involved. Given the intricacy of the contacts, attention to detail is vital throughout the contracting process.

“So knowledge and understanding of the business and industry are the key aspects.” (Interview-UAM-003)

In order to ensure the continued operation of UAM it is essential that the organisation understand the market conditions and the subsequent drivers. This is achieved primarily through the organisation’s close involvement and representation within industry forums. This aids in ensuring that the organisation is aware and compliant with all operational regulations. The organisation is also actively involved in the development of regulations and this provides UAM with a unique awareness of future industry and market trends. This awareness allows the organisation to assess and prepare for market and industry movements; UAM is then also able to establish operational processes in line with regulatory body and governmental requirements.

“Participate in conferences to understand the way the market might be going, we talk to brokers…” (Interview-UAM-004)

“But we are fully integrated. We are full of processes, we comply with EURATOM concurrence, which is a governmental thing in Luxemburg. Under non proliferation we have to say what Uranium has been moved here and there and what the origin and obligation code is, who we’re selling to and who we’re buying from. And we comply with that, and all of those clauses go into our contracts.” (Interview-UAM-001)

Forecasting forms an essential function within the operations of the organisation; through forecasting the organisation is able to anticipate, to the best of its ability, the behaviour and progression of both the market and the industry. This is achieved through the collective experience and knowledge of staff and the management team, historical data, input from regulatory authorities and industry bodies and the direction outlined by the parent companies.

Through continual monitoring of the operating environment, UAM has developed an acute awareness and perception of the organisation’s and the industries susceptibility to potentially disruptive events.
“[Threat to UAM] A huge turnaround by the economy in general to the future of nuclear. It’s had a downturn before in that this site was going to be closing perhaps 10 years ago but never did but things wound down. But now it’s coming back onboard again. I think that if there was a big event and it caused a big big issue, then it could have a downfall impact.” (Interview-UAM-002)

“It has to be in this industry. If there was ever to be a major incident it could shut the whole industry down for years. So none of us can afford for anything to go wrong. There are always going to be things, like you’ll lose contracts based on price and everything but we won’t compromise our price for safety. We do a job at a level and we won’t skim. We won’t use poor quality suppliers, we won’t use poor quality material, everything that we do is first rate because that is the service we’ve got to deliver.” (Interview-UAM-003)

The benefit of monitoring and understanding the organisation’s operating environment is that UAM is able to position itself relative to identified opportunities (when suitable). This means that the organisation is able to take advantage of factors such as material (Uranium) price, emergence of new markets and increased utilisation of nuclear fuel.

“It is really interesting business, no one day is the same. No two contracts will be exactly the same.” (Interview-UAM-001)

UAM is exposed to continual operational fluctuations. At a top level, organisational growth is tightly coupled to the nuclear fuel cycle and the use of nuclear energy. The emergence of new markets within developing countries has provided a platform for growth within the nuclear industry, as emerging economies offer a large potential customer base. Within existing markets, growth can be attributed to the proportion of nuclear fuel utilisation within a countries energy portfolio. As such, new build nuclear plants offer a significant potential revenue for the organisation, and offer the opportunity to develop supply contracts with new customers. However, due to the close coupling between growth and market conditions, decline in nuclear fuel utilisation could have dramatic implications for both UAM and the wider nuclear industry.
“... There was nothing formal for Fukushima and we are adapting. Mike got told by the senior level in Toshiba change you business model from business development to business orders and that is what we’ve done.” (Interview-UAM-001)

This is exemplified through events such as Fukushima that have prompted the retraction of several countries from the development of nuclear energy programmes, notably Germany and Switzerland. This has focused UAM to re-evaluate current marketing and direction.

As such, in order for the organisation to adapt to changes within the operating environment, it is necessary to not only forecast supply and demand but develop an understanding of the external drivers influencing potential fluctuations. This allows the organisation to operate on a less reactive basis and position itself relative to a sustainable long-term position. In addition, in order to take advantage of identified opportunities it is necessary to ensure that appropriate prior relationships are established. Through this UAM is continually developing and establishing connections throughout the nuclear industry and related networks, developing the global reach of the organisation and furthering the organisation’s relationship with customers.

“Being able to adapt, being able to change. And being able to not be entirely reliant on one core activity as it where. Or one key customer, or one key supplier and being able to change tack at short notice really.” (Interview-UAM-002)

As an organisation operating within the nuclear and energy industry, the threat of non-compliance is of major concern within UAM. The nature of the materials involved and the importance of security within supply for critical infrastructure (power generation) means that operations are governed by stringent regulations and legislation. Non-compliance to any regulations related to security could have severe implications for the organisation, including reputational damage, loss of licences, loss of authority for both transport and commercial operations, as well as loss of revenue and other financial liabilities. In order to address this potential threat, UAM has worked to establish strong connections with both industry and regulatory bodies as well as developing connections and relationships with suppliers and operators.
UAM is closely involved with the nuclear industry’s regulatory bodies (IAEA, WNTI, WNA, RAMTUC and TRANSC) as well as several other regulatory and governmental bodies including the Department of Transport, Office for Civil Nuclear Security, VOSA, Lloyds and various other European regulators. These close relationships with industry regulators and authorities ensure that the organisation is fully compliant with legislation as well as being fully aware of any future regulatory changes.

“We would be able to change very quickly. Part of Tony and Joanna’s role is to constantly monitor any new regulations. They’ve got strict procedures in how they can track a new regulations so all of that is formalised... and I would say that that is one of our strengths. That actually we feel very equipped to deal with any regulations from certain industry groups. We are actually involved in the discussion for changing the regulations...“ (Interview-UAM-006)

The organisation has developed a strong presence and reputation within the nuclear industry. This provides UAM with a unique position and understanding of regulatory demands and an early awareness of any regulatory changes. Involvement within various advisory committees allows UAM to not only anticipate and prepare for future regulatory changes but allows the organisation to influence the future directions of the industry.

“In my group one of the ladies in my group is on the EUROATOM advisory committee and they meet twice a year. And anything that does change does come through that way. At the conferences there is the world nuclear association which has a number of working groups, I sit on the contracting one and my team sit on the transport one and we get a market report in terms of what is happens in supply and demand. And then also any trade issues so we’re really up to date with what is happening. But you have to be.” (Interview-UAM-001)

“So if we started with regulatory changes, I think we are resilient in a sense that we do play a part in the regulatory arena. So I, the two main regulations that really have an effect on us are the security regulation which are called the Nuclear Industries Security Regulations 2002 and the carriage of dangerous goods regulations... we participate in the development of those regulations... In both instances we have the ear of the
regulator and we can see over the horizon in regards to regulatory changes and assess the impact to our business, both financially and commercially.” (Interview-UAM-007)

UAM’s involvement within the various committees also provides opportunity to share and exchange knowledge and experience from across the industry. The close involvement with the regulators also reduces some of the barriers and restrictions for entry and operations in new territories. Although the nuclear industry is relatively small, increased development and growth has increased organisational demands and placed an emphasis on establishing an international presence.

6.4.5. Crisis Planning and Risk Management

Within UAM risk management is linked to developing robustness within the organisation and effectively implementing improvements. UAM is able to learn through experience through having an established and robust process to capture learnings and improvements. Within the organisation this process is termed ‘Human Performance’ or ‘HuP’ system. This allows the organisation to not only address incidents, but become more effective in meeting its operational goals and expectations through providing a means of continual improvement.

The HuP system also provides a system to capture and transfer information in a consistent and interpretable form. Allowing organisational members to exchange knowledge from one part of the organisation to another effectively. Through this, identified issues and improvements can be exchanged and realised throughout the organisation. The system thereby supports organisational learning and enables the organisation to develop a wider range of solutions to potential issues. The HuP system provides:

- A system to capture and correct mistakes
- A system to develop more robust processes
- A system to capture and introduce learning

The HuP system offers a less rigid process to a management investigation but still provides a clear analytical process to address incidents and develop organisational improvements. As such, individuals are more open and comfortable with the HuP
process. This has resulted in the organisation actively seeking potential issues before there is an opportunity for them to impact the organisation. The process looks to establish the root cause of an issue and develop and implement improvements to address it. HuP actions and improvements are then tracked through to completion through the use of a dedicated database. As such, the HuP process is used to address:

- Health and safety incidents
- Regulatory incidents
- Operational incidents
- Contractual incidents
- Customer complaints

The system looks to actively engage and involve individuals from across the organisation through the use of multi-disciplinary teams. For incidents involving external events, all involved parties are contacted for involvement within the HuP process. In addition, incidents and issues are not dealt with in isolation, instead the wider implications of an incident or improvement are addressed. This allows the organisation to create a balance between providing an immediate improvement to operational efficiency through resolving the issue and providing a long-term improvement to organisational effectiveness.

In relation to the response of the organisation to larger scale events, scenario planning and event simulation is utilised. Experience of response is essential. The organisational response systems are tested regularly through simulations and desktop scenario planning sessions. Crisis and emergency planning is driven from regulatory frameworks, however given the complexity associated within disruptive events, understanding and acknowledging the limitations of contingency planning is essential. UAM’s involvement and experience within scenario planning and disruptive events has validated the organisation’s physical response procedures.

Given the nature of the material involved, response operations involve multiple agencies and sites. As a result, developing a practical understanding of the interactions and coordination involved within response operations is invaluable. Scenario planning sessions also provide and understanding of the worst case possible, providing an insight into potential risks and threats.
Previous exposure to disruptive events has highlighted a need to mobilise quicker in the wake of operational incidents. In response to this, the organisation has introduced the use of a duty phone or ‘hot phone’ to contact the duty manager in the event of an operational incident. Previous events have also highlighted the importance of analysis and assessment within response and recovery activities. Additionally, following the experience of previous events, the need to provide on-site support and event visibility was identified. Although UAM is not involved within direct response operations related to an operational incident, the importance of sending an experienced and knowledgeable member of staff to the incident site was identified. This not only aids in the coordination between UAM and responders, but also provides assurance to the customer.

6.4.6. Detection and Activation of Response

The process of ‘detection’ within UAM is achieved primarily through intuitive environmental scanning and an embedded connectedness to the nuclear industry and related markets. Understanding the operations and criticalities of the organisation, as well as its dependencies, supports the organisation’s ability to effectively interpret the demands and implications of an event, as well as develop an understanding of the organisation’s susceptibility to potentially disruptive events. A casual network of the process of detection and activation is shown within Figure 6-14.
As illustrated by Figure 6-15, within UAMs response to disruptive events, while the phase of ‘detection’ could be broadly characterised as the organisation interpreting the demands of a situation (internal and external), the phase of ‘activation’ relates fundamentally to the organisation establishing an effective response. This involves:

- Developing a response procedure (Operational Preparations)
- Effective utilisation of resources and capabilities
- Establishing organisational direction (Organisational Strategy)
- Management of communication

Threats and risks are defined by the operating environment and the nature of disruptive events. Disruptive events are also characterised by uncertainty and further compounded through unpredictability. In order to address this, management of communication and the effective exchange of information are crucial elements within the response of the organisation.

“So I think maintaining the communication between the different facets is vitally important.” (Interview-UAM-005)
“...having those clearly established frameworks of communications are the key to responding.” (Interview-UAM-006)

Communication and information exchange are of critical importance within the activation of response activities. The organisation must initially interpret the situation and establish the details of the event. For example, if it is an operational incident related to transport activities, the organisation must liaise with responders to establish the details of the event. This information exchange allows the organisation to develop an appropriate response strategy according to the demands of the situation and the potential impact of the event.

The development of the response strategy creates a strategic view towards event mitigation and organisational development within periods of adversity. The response strategy identifies the potential implications of the event and establishes an event management team. Where necessary, the required expertise can then be brought into the event management team from across the organisation. Following this the management team can begin to develop a means of overcoming the disruptive event.

6.4.7. Response

“Operationally there could be accidents, emergencies or even terrorist activity that we would need to respond to. And in those dramatic circumstances we would need to look at what to do to protect the individuals, the driver for example, the integrity of the load, recovering the trailer or the unit.” (Interview-UAM-008)

The response of UAM to disruptive events can be characterised as either a ‘business response’ to incidents affecting organisational elements or a ‘physical response’ to operational issues. The response of the organisation to operational incidents will have direct implications for operation of the organisation. There is subsequently a linkage between physical response activities and business response activities to organisational incidents.
6.4.7.1. Physical Response – Operational Incidents

The response of the organisation to operational incidents, termed the ‘Physical Response’ is outlined within Figure 6-16. The critical success factors of a successful organisational response to operational incidents include:

- Limit impact on environment and local community
- Gather incident information
- Provide information to responders
- Secure local environment
- Priority in minimising the impact of the event
- Access to secure communication network
- Access to equipment
- Need to establish response timeline (short, medium, long term)
- Ensure access to site (Springfields)

The response of the organisation to operational incidents is predominantly predicated on legislative and regulatory procedures. Given the hazardous nature of the materials involved and the perception of nuclear related activities, operational incidents pose a significant safety and security risk. As such, the major goals of a response to radiological emergencies is to primarily ensure safety and protect the public and wider community as well as protect the emergency personnel involved within response activities. To support this, the organisation has clear responsibilities and liabilities within the response to such events.

The organisation could be exposed to a variety of operational incidents and radiological emergencies. These include:

- Uncontrolled dangerous sources (radiological/nuclear materials)
- Misuse of dangerous industrial and medical sources
- Public exposures and contamination from unknown origins
- Serious overexposure
- Malicious threats/acts
- Transport emergencies
Organisational Case Studies

Figure 6-16 - UAM Physical Response Causal Network

Key
- Theme
- Node
- Sub-node

Causal Connection
Inferred Connection
“The security side of it, we are regulated by the Office for Civil Nuclear Security. Again, we have a very good relationship with them, however, obviously the perceptions of nuclear materials and transport and the perceptions of real security risks has got an emotive connotation. So although at this moment in time the rules that we have to abide by are quite pragmatic...” (Interview-UAM-007)

Over recent years there have been increasing security controls related to the transport of nuclear materials. Different regions and countries will also have different and perhaps more stringent regulations in place to which UAM must abide by. In order to support the response of the organisation, UAM is connected to the National Response Infrastructure and governed through procedures such as the Paris Convention for material clean up. The convention establishes a special legal regime for nuclear third party liabilities. In order to support international operations, UAM is closely connected to the relevant authorities within all areas of operation. In addition to this, the organisation also has agents (organisational representatives) within certain regions.

The crucial role of UAM within the response to operational incidents is to ensure that responders are provided with accurate information related to the incident and the materials and packages involved. There is subsequently continual information exchange between UAM and the incident site. Priority is placed on communication and coordination. Through establishing information directly from the incident site, it is then possible to develop an event timeline which can then be used to support decision making and response activities.

UAM does not physically respond to operational incidents, but is instead involved in the coordination of response activities and supporting responders and emergency services.

“... we won’t be responding to it and dealing with the technical stuff but we can deal with customer expectations and we can deal with any PR that is associated with it.” (Interview-UAM-007)

“And then there would be nuclear second responder that forms part of the emergency response group, so it would be police, fire, ambulance, and then RADSAFE team. On that
Notification of an operational incident can be made through various channels. As all of the logistics operations are tightly scheduled, failure to meet a checkpoint or destination will result in the contact of the duty manager within UAM. In addition, a duty phone or ‘hot phone’ is in continual operation for the emergency contact of the duty manager. Incidents can therefore be reported directly to the duty manager by drivers. For more severe incidents, the responders to an incident will contact UAM directly. Within the documentation associated with the transport of class 7 materials, thorough contact information is provided. Following the contact of the duty manager, appropriate response activities can be initiated.

Following the occurrence of an operational incident, the nearest responders are contacted; these include local services such as medical support, police and law enforcement as well as fire services. First responders have an important role within the response to radiological emergencies involving nuclear materials.

Following an event, UAM establishes an emergency control centre and a central response team is formed. This allows all communication to flow through a central point within the organisation. Nuclear second responders then form the emergency response team. Within the central response team, each member has their own individual role and responsibilities.

“...So my role would be as a coordination role rather than actually get involved in the actual emergency itself. So it is understanding your role within the situation, that is just key.” (Interview-UAM-003)

The location of the incident is a large determinant in the response procedures followed within the event. Primarily, response activities are performed around the safe retrieval and salvage of the packages involved. The priority and major concern within all response activities is public safety and resolving the situation. This may
involve a member of UAM being sent directly to the incident site to offer assistance in the safe retrieval of the package.

“It is really just making secure that particular environment and making sure that the public are safe and we are working with the authorities to ensure, because it is really a salvage operation from that point on, so we just work directly with the fire service and the police and whoever they deem to be fit from the site.” (Interview-UAM-006)

A key document within the transport of radiological materials is the Dangerous Goods Declaration. This document outlines the nature of the materials under transport and details related to handling. Accompanying documents include contact information for UAM as well as key regional and emergency contacts. These documents are thoroughly reviewed to ensure that all of the details are correct and accounted for and that all the appropriate licences are in place before the consignment is sent.

A central organisational operation during the response is coordination with the customer. Despite potential contingencies, customers are reliant on the operations of UAM and as such, UAM has a responsibility to meet customer expectations. However, operational incidents may limit UAM’s ability to fulfil contract requirements. Managing customer expectations is therefore an essential role within the organisation’s response to operational incidents.

“You’re always going to make sure that you cover your safety and security as first priority and then ultimately meeting your customers expectations and then everything else is second in line.” (Interview-UAM-002)

Managing customer expectations during the response to an event requires an understanding of the criticality of UAM’s operations to the customer. Following the occurrence of the event, the customer is notified of the incident and provided with the initial information surrounding the event. As the response activities progress, and as information becomes available, the customer is continually updated. Continual information exchange between UAM and the customer develops a level of transparency about the response to the event.
“And that transparency is vital in order to build endearing relationships with our customers.” (Interview-UAM-003)

Following the occurrence of an incident it is essential that the public and the media are provided with understandable and consistent information from official sources regarding the details of the event. Despite the low probability associated with events involving radiological materials or sources, emergencies involving radiological elements are an emotive issue. Failure to provide appropriate information may result in inappropriate public reactions as well as adverse psychological and economic effects. Failure to effectively manage the media interface may also damage the reputation of the organisation as well as having wider implications for the entire nuclear industry.

6.4.7.2. Business Response – Organisational Incidents

Within UAM, the organisation’s response to potential business interruptions is a largely informal process. Although current organisational initiatives are under development to provide specific plans for business interruptions and contingencies, few formal procedures are currently in place. Despite this, although informal, within the development of a response strategy for organisational incidents, emphasis is placed on ensuring that organisational operations resume as soon as possible. This is shown within Figure 6-17.

“To a certain extent some of us could probably work from home if we had to. But as I said we need to formalise that and we need to be aware of what contingencies need to be in place so if there is a disaster and for whatever reason this building burns down, and that really is the key thing that is going to happen.” (Interview-UAM-005)

The critical success factors of an organisational response to business or organisational incidents include:

- Need to establish operational base on site (Springfields)
- Access to IT network
- Need to establish and maintain communication network
- Ability to operate remotely (Commercial operations)
- Need to formalise response procedure
- Need to identify contingencies
- Gather incident information

The organisation’s response to organisational incidents or events affecting the operations of UAM divisions is largely predicated on the ability to identify and meet organisational priorities. Following the occurrence of an event, the organisation must establish short, medium and long term priorities. This is linked to the organisation identifying what operations are currently underway as well as those that may be effected by the event. The organisation must also identify the limiting factors within the current situation. This allows the organisation to take an holistic approach to developing an appropriate response strategy.

Dependent on the nature of the disruption faced, UAM may be exposed to a variety of limiting factors. These limitations may be either a direct or indirect consequence of the disruption faced and could pose a significant constraint on the response capability of the organisation. These factors can be further compounded by the organisation’s traditional boundaries and operations constraints. Subsequently it is necessary for the organisation to develop the capacity to adapt its business plan when required.

Following the occurrence of a disruptive event or market fluctuation, the organisation must re-establish and assess the direction of the business moving forward (medium and long strategy). As such, the organisation is able to adapt its business plan according to the demands of the situation as well as industry and market alterations. The organisation is then also able to alter and adjust its marketing strategy following industry movements.

Figure 6-17 – UAM Business Response Causal Network
Following an event such as Fukushima, forward planning is conducted. The events of Fukushima have slowed growth within the nuclear industry and had dramatic implications for areas such as nuclear new build power plants. Subsequently, UAM has had to adapt its business concept and plans for existing operations. Rather than a specific change in direction, this alteration in approach has resulted in a change in emphasis. Current operations are focused on re-load business and the existing fabrication customers of Westinghouse. Within the Commercial division, spot trades are heavily influenced and affected by disruptive events, this has resulted in a move towards long-term supply contracts.

6.5. Within-Case Analysis Company 4 – 3M Healthcare

Following the coding process followed within the initial case study organisations, 257 nodes were identified and approximately 150 were retained for analysis. From the organisational response causal network, four themes emerged that encompass the majority of the identified response factors. These themes include Activation and Detection, Crisis Management, Knowledge and Experience, and limitations and Constraints. The attributes and features of the case study are presented within Appendix E and Appendix F.

6.5.1. Profile

“3M captures the spark of new ideas and transforms them into thousands of ingenious products.” (Article-3MH-001)

3M is a diverse technology and science based organisation. The organisation is composed of five primary business groups, creating a diverse operating portfolio. These businesses include: Consumer, Safety and Graphics, Electronics and Energy, Healthcare and Industrial. The research was conducted within the UK Healthcare business in Loughborough, Leicestershire. The 3M Healthcare business is composed of eight functional divisions. These include: Auscultation and Diagnostics, Dentistry and Orthodontics, Drug Delivery Systems, Food Safety, Health Information Systems, Infection Prevention, Medical OEM, Skin and Wound Care (Article-3MH-002).
Globally, 3M operates in over 65 countries with customers in over 200 countries. The organisation employs over 84,000 people, and globally 3M sales exceed $30 billion of which $19.5 billion is from non-US businesses and markets (Article-3MH-001). The organisation then invests a significant portion of this back within the organisation with R&D spending exceeding $6 billion over the past five years.

Within the UK, 3M has 19 locations including 10 manufacturing sites. The 3M Loughborough site is part of the Drug Delivery Systems (DDS) division. The division develops and manufactures customised inhalation and transdermal medical delivery solutions. The division operates through partnerships with other pharmaceutical companies in providing inhalation aerosols, dose valves, aerosol canisters and other drug delivery technologies and solutions. The site is composed of both corporate and production functions and facilities.

6.5.2. Organisational Structure

In 2009 following an organisational initiative, partially due to the impact of the global economic downturn (2007 -2012 Global Recession), 3M Healthcare underwent a period of restructuring. Prior to 2009 the organisation had followed a functional structure with a vertical alignment between organisational elements. The organisation then moved to a horizontal structured value stream. This restructuring followed a global initiative towards standardisation within the 3M organisational network. A causal network representing the organisational structure is presented within Figure 6-18.

“We do adapt the organisation. It’s constantly changing. And I’m changing the organisation in the plant, we’ve moved to a value stream structure. Historically we’ve been in, not silos, but functional organisations. Like engineering, quality, manufacturing, sourcing and logistics.” (Interview-3MH-001)

Through adopting a value stream structure the organisation was able to align organisational elements and functional individuals within products. Product Supply Managers were established to support each value stream. This provided a greater level of control than the previous functional alignment and created a uniform
approach within divisions. Through the value stream structure the organisation was able to realise several operational and organisational benefits. These included:

- Clear structure and alignment between products
- Improved operational efficiency – reduced waiting
- Support an open culture
- Improved response to change
- Improved visibility within operations
- Ability to identify issues more effectively

Although the value stream provided an improved organisational structure and several operational improvements, there were some issues within establishing the horizontal alignment between organisational functions and products. Following the restructuring there was a loss of alignment between certain organisational functions; creating bottlenecks within particular value streams. Employee development and progression within roles also became unclear as managerial responsibilities were removed and centralised. Additionally some areas did not operate effectively within a value stream structure, causing a loss of focus and direction. These areas had previously functioned through informal connections which were then altered or removed. This placed considerable pressure on the Supply Manager roles, and created discontinuities between product value streams and a loss of alignment to centres of excellence. This created a potential ‘loss’ of expertise within the organisational structure and tension between employees. In order to resolve these issues, functional ‘silos’ or ‘centers’ with formal connections between functions were established. Roles and responsibilities were also formalised, deferring some of the managerial responsibilities of the Product Supply manager to other roles. This provided a clear hierarchy and progression within employee development.

6.5.3. Disruptive Events

Given the scale of 3M operations globally, the performance of operational divisions can be significantly impacted by fluctuations and changes within economic markets. As a result, the events surrounding the global economic turndown had significant implications on the performance of several organisational divisions. However, given the diversity of 3M operations across various markets, while certain divisions were
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greatly impacted, other areas were able to capitalise on business opportunities and ventures. This was achieved through an investment in value creation. Through the experience and history of the organisation, 3M had been exposed to previous economic challenges and recessions. As such, the organisation had an awareness and understanding of the demands that these economic uncertainties can place on an organisation. This resulted in a restructuring of the organisation, and a downsizing within certain areas. During this period the organisation followed a much greater top-down approach, with decisions towards the long-term stability of the organisation being made at a corporate level. Through this the organisation was able to withstand and emerge from the impact of the recession.
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3M Corporate Organisational Divisions
- Healthcare
- Global Systems
- International Sites
- Standardised Operations

Established Global Forums
- Regional Forums

Operations
- Regulatory Frameworks
- Diverse Operations
- Resource and Expertise Available

Quality Management System
- Six Sigma
- Value Stream
- Quality Assurance
- Monitor Regulations

Supply Chain
- Dual Source Supply

Organisational Values
- Performance Objectives

Organisational Development
- Established Hierarchy
- Established Communication Structure
- Experienced Management Team

Operational Risks
- Risk Assessments
- Critical Success Factors
- Coordinate Operations
- Seek/Drive Improvement
- Continuous Improvement
- Challenge Expectations
- Continual Change

Develop Leaders
- Human Resource

Access to Resource
- Continual Change

Communication
- Network
- Support Network
- Communication

Innovation
- Investment in Training

Investigation
- Risk Register

Safety Culture
- EH&S

Figure 6.18 - 3M Organisational Structure Causal Network

Key
- Theme
- Sub-node
- Node
- Causal Connection
- Inferred Connection
- Key
- Theme
- Figure
- Causation
- Communication
- EH&S
- Safety Culture
- Exchange Information
- Innovation
- Investment in Training
- Investigation
- Risk Register

- Theme
- Sub-node
- Node
- Causal Connection
- Inferred Connection
- Key
- Theme
- Figure
- Causation
- Communication
- EH&S
- Safety Culture
- Exchange Information
- Innovation
- Investment in Training
- Investigation
- Risk Register

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“A big threat is change. Internally there could be a change in direction. You could be working on a project, things change, and a new direction is taken a year down the line. That is a significant risk to the programme. Customer might decide that they don’t want to emphasise this product anymore, we want to work on this product so you are shifted.” (Interview-3MH-004)

The performance of organisational divisions can also be affected by competitive conditions and changes within customer preferences. The biggest threat to the continuity of operations within 3M is the impact of change on the organisation. Both internal and external change can have dramatic implications for the operations and functions of the organisation. Internal change, either through strategic changes in direction or restructuring, can have a direct impact on the dynamics and internal environment of the organisation. Employees, organisational structures and processes can all be impacted. External change includes factors such as changes in customer expectations, regulatory change and supplier issues. Alterations within these external features can have direct implications on the performance of the organisation.

“The first one is safety, the first thing that we look at is the safety of the people in the plant. For the flood, we had the power off, water in the substation, it is safe for people to be in there. The first thing is to get everyone out of the factory.” (Interview-3MH-001)

“So you say this is what has happened and what are the immediate steps that we need to take. So if there is any harm to any people or patients there are immediate actions to can take. And then what happens is that you can escalate it.” (Interview-3MH-004)

“There is a number depending on the situation. A severe one would be one connected to a product which had the potential to endanger a users life. So something wrong with the product to the extent that it could cause harm to the user of it or ultimately in the worse case cause the death of the patient. That would be absolutely the most significant.” (Interview-3MH-003)

An incident or severe threat is any event that threatens safety or has the potential to cause a business interruption. If the incident cannot be resolved effectively then the event has the potential to escalate into a crisis. Within 3M Healthcare a severe event
would be any event that threatens the safety of employees or eventual patients or end users. The risk of faulty products entering the market is of critical concern and as a result production and distribution operations are governed by strict regulatory and quality procedures. An event which threatens the safety of potential patients could result in a product recall and carry significant legal and liability consequences, as well as threatening the reputation of the organisation. As a result a severe event is one that:

- Threatens safety of employee or customers
- Impacts products within the market
- Impacts upon multiple products
- Impacts the organisation supply chain
- Events threatening the reputation of 3M
- Fire incidents
- Environmental incidents
- Significant near miss incidents
- Events associated with significant potential consequences

Given the nature and end use of pharmaceutical products, quality assurance is of paramount concern. The production of medical equipment and pharmaceutical products are governed by strict regulatory requirements and legislation. As such, each product requires full traceability from sellers and distributors to suppliers of individual components and materials. This is required for operating licences and to support the recall of any defective or dangerous products. If a defect is identified, affected products can be identified and associated batches and components reviewed to establish the cause. This system is in place to ensure the safety of patients and end users. Products carry a unique ID code and are then registered on an electronic system. The system is continually monitored with annual system audits. The system is also verified through scenario tests of product recalls.

“We have to have fully traceable records. Right back to the starting materials of every batch, right through to where the product will have gone. We have to do a re-call query each year to verify that the systems are working. So we audit that system on an annual basis.” (Interview-3MH-002)
Events can create significant barriers and operational constraints. These constraints must be identified and managed effectively if an organisation is to ensure operational continuity. As such, during disruptive events, the priority lies in establishing a response team. Events are then managed and coordinated by the respective members of the response team. The severity and potential consequences of an event drives ownership within response activities. The team is then required to review the organisational crisis preparations and implement an appropriate plan of action. As a result, threats and risks related to people and skills are considered a severe threat. The performance and ability of the organisation to operate is dependent on the knowledge, skill and competencies of employees and management functions.

Potential threats to the continued operation of the organisation include:

- Access to capable individuals
- Loss of key skills
- Lack of experience
- Access to knowledge and expertise

On the 28th of June 2012, flash floods caused by heavy rainfall halted production and resulted in a large scale evacuation of the 3M Healthcare production facility in Loughborough, Leicestershire. The extreme weather resulted in lightening strikes, high winds, heavy rainfall and hail; impacting both businesses and the local community. The local drainage system was unable to cope with the sudden and large amount of rainfall. The large ingress of water into the 3M facilities had immediate implications on production. The site was subsequently evacuated following personnel safety concerns. Following the evacuation of the site, the facilities were secured from an EH&S perspective, ensuring electrical and mechanical safety of individuals and equipment. Impacted and affected products were then identified, inspected and quarantined. Physical recovery and clean up operations were then implemented and within 36 hours the site had restored operations in a limited capacity.

"The whole factory was under about a half inch of water. Which for manufacturing drugs and in clean room environments, not sterile but clean room environments, that hit at noon on the 28th... Went over to the site and was faced as a site manager with a site under water, no power, everything wet, dripping through roofs, coming up through drains..."
and within 18 hours we were back up again running. Fully clean and back running.” (Interview-3MH-001)

The Healthcare production facilities have also been exposed to more localised incidents. A minor fire occurred within a production office as the result of faulty electrical equipment. Fire incidents are regarded as potentially catastrophic events within the organisation. As a result, fire detectors are in place throughout the site and regular fire safety reviews are conducted. Following the initial alarm, the emergency response procedure for such events was followed. The minor fire was easily contained; however evacuation procedures were also followed as a precaution. The organisation is closely integrated with first responders and emergency services. Following the occurrence of an event threatening safety or security, responders are immediately contacted through site security functions.

6.5.4. Crisis Planning and Risk Management

3M utilises risk management tools and techniques in order to identify issues and develop corrective or preventative action plans. These are then developed and used to identify and realise opportunities, drive improvements and enhance EH&S performance. Within the organisation’s approach to risk management it is imperative that organisational elements recognise the nature of risk and identify and raise issues as soon as possible. 3M operates with an established risk register procedure across all organisational functions. The risk registers are continually updated and reviewed in accordance with current operations and projects. The resulting databases are used to communicate risks, highlight potential risks, identify possible threats, establish improvements and monitor performance.

Following the identification of individual risks or the classification of a risk factor, the risks are quantified and rated. Through this risk management functions are able to quantify potential risks and prioritise correction actions. This approach allows for the respective management functions to meaningfully discuss risk and the associated implications; addressing both low and high probability events.

The identified risks and features can then be communicated across organisational levels through a standard platform. The risk registers form an electronic database.
The risk management function within the organisation operates as a collective group, allowing for the open discussion of risk from different perspectives and experiences. The limitations within the use of a risk register, rest within the accumulation and aggregation of risks. However, through the classification of risks, organisational elements are able to provide a robust platform towards the development of the organisation. The development of risk registers within 3M is supported by regular reviews and continual communications and information exchange about risk.

6.5.5. Detection

The detection and classification of risks and threats forms the initial stages within the response of the organisation to any disruptive event. Detection forms a continual process within the functioning of the organisation. The classification of risk and threats prior to the onset of any disruptive event allows 3M to develop an understanding of inherent vulnerabilities and establish associated risk tolerances or thresholds. 3M focuses on establishing both major and minor risk factors towards supporting the routine functioning and operation of organisational elements. As such, detection is linked to effective risk management within the organisation.

“So we through our risk management processes hopefully understand the main critical risks that we have onsite and can appropriately prepare for those.” (Interview-3MH-005)

“So it is establish the facts really. Get down there and have a look, talk to different people. And then I guess in real terms taking the decision to pull people out of the facility, give us a holding position, and then determine how best to start to mitigate the consequences of the water ingress.” (Interview-3MH-005)

Following the onset and immediate impact of an event, regardless of cause, reports from different areas are channelled to the senior management team. These reports may contain varying information about the severity of events or the extent of the impact. Subsequently, the first stage within the response to an event is gaining visibility of the event and establishing the as many details as possible.

A critical element within the detection of a potential threat or event is gaining visibility of the issue. As such, detection of an event is often based on circumstances.
Certain events will raise immediate alarms, however predominantly detection is based on individuals promptly reporting incidents. To support this, the organisation seeks to establish clear operational bounds and follow established protocols. Through this individuals are able to recognise potential indicators or discontinuities outside of routine operations and effectively escalate the response. The limitations and constraints related to the detection of potentially disruptive events are therefore linked to an inability to effectively identify or interpret signals.

“Depends on what the incident is. From a fire perspective, we would get early warning, because we have automatic fire detection in many areas or ways for people to raise the alarms... Other stuff it depends on the circumstances. It depends on people promptly reporting and escalating it, and we've got procedures and protocols for them to do that.” (Interview-3MH-005)

A proactive approach within the response of the organisation limits the opportunity for the escalation of disruptive events and impacts. In approach is supported through the integrated monitoring of organisational elements and functions. These monitoring systems include production, supply chain, safety, strategic objectives and environmental monitoring. Given the nature of the products being produced, the monitoring of the production area is critical. However, these systems extend throughout the operations and functions of the organisation. The systems monitor changes and operational fluctuations. Through setting both operational and risk tolerances within organisational elements, the organisation is able to recognise discontinuities. The systems also support the organisation's ability to identify the potential causes of discontinuities.

The immediate identification of a threat and the potential impact of an event, allows 3M to constrain and restrict the potential consequences and implications of an event to a certain extent. Although, it is almost impossible to completely limit the impact of an event, through immediate action the organisation is able to limit certain factors. For example, restricting faulty product entering the market. As such, a proactive approach to the management of disruptive events relies on the organisation not waiting for the full impact of an event to be realised before responding. This is
supported through an established chain of authority within the escalation of response activities. Initial response activities are also conducted within direct direction from the management team.

“Need to anticipate other issues, not just within 3M but within the market in general that could be perhaps linked to a particular situation.” (Interview-3MH-003)

Following the detection of an event, in order to respond effectively, the organisation is required to anticipate a broad range of issues. The need to anticipate wider issues allows the organisation to appropriately resource response activities and establish the initial extent of the event. Although this assessment may change as response activities progress. The organisation must identify impacted individuals, areas (physical infrastructure), supply chain, stakeholders, operating market, environmental concerns and economic impacts. The organisation must also identify wider issues linked to events such as issues within the market or if the events may be linked to a bigger picture. To support response activities the organisation may also investigate whether similar issues have occurred within the 3M network or within similar industries.

6.5.6. Activation

The period of activation links the detection of an event to response activities. The main functions during this period involve identifying the event and its associated impacts, coordinating an event response team and then developing a suitable response plan and strategy. The organisation must assess the scale of the event and establish the events’ impact. It is through this assessment that the organisation is able to address an. Following this, the response plan can then be developed. Rather than follow a predefined response routine, the event management team develops an event specific plan or strategy towards responding to and mitigating the consequences of the event. The response strategy provides a stepwise approach to response activities, utilising available information and resource.

“Are there people, are there any loss to life, are there any injuries, are there any implications for the local environment, our local neighbours, it is very difficult until you
know the specifics of what’s happened. But in terms of processes to follow there are templates and procedures, but they have to be flexible to cope.” (Interview-3MH-003)

The formation of the event response team is an established process within the organisation and is linked within the escalation of response activities. The core members of the response team are predefined and have clear areas of responsibility. This team is composed of senior managers from across the organisation, including the Site Manager, EH&S, Quality, Human Resources, Communications Officer and departmental managers. The Site Manager assumes the leadership role within the coordination of the response team. Minor incidents are managed locally. If the incident is then outside of the immediate capabilities of the involved organisational members, the incident is escalated to the area management team. Larger scale events result in the formation of an incident management team and in severe instances this can be escalated further to a crisis management team. The formation of the event response team relates to the severity of the event. Following the onset of a severe event, response team members are contacted immediately by site security. The members of the response team are on continual standby for the occurrence of an event. The members of the team are brought together and work to address the event from an onsite position.

The event response team is involved in the physical coordination of response activities. However, the team has several responsibilities within the response to disruptive events. These include:

- Detecting and reviewing early warning signs of potential threats (prior to onset)
- Identifying potential areas of concern (prior to onset)
- Ensure employee safety and site is secure
- Coordinate with responders and emergency services
- Analyse the situation and the issues surrounding an event
- Gather pertinent information
- Understand the main areas of impact
- Develop a specific crisis management plan
- Prioritise critical issues
- Encourage and support employees
• Review and establish contingencies
• Develop alternative plans

Within the functioning of the event response team, effective communication and information exchange is essential. Both internal and external communication is necessary for the detection of events, coordination of response activities and maintaining external perceptions. During the response to a disruptive event, activities and operations are reliant on accurate and consistent information. Established communication networks, protocols and organisational hierarchies support the organisation’s ability to gather and distribute information effectively. However, during an event these channels may become disrupted. As such, the event response team must gain visibility directly from impacted areas. As such, within the event management team the Communications Officer is responsible for supporting communications.

Gathering information from impacted areas allows the response team to develop accurate plans, establish priorities within response activities, allocate resources, develop contingencies and provide support. Externally, communication with stakeholders and other outlets builds the perception that the organisation is under control and capable to resolving the situation. Ensuring confidence in the organisation’s ability to respond effectively and overcome the impact of an event is essential within maintaining the organisation’s reputation. Given the increasing connectedness within the media and social networks, effective communication is essential. Through effectively managing communication, the organisation is able to control the release of information. Working within business confidentiality as well as keeping stakeholders informed.

“We’ve also got robust procedures, I mentioned emergency response but we also have the crisis management team. We have a set protocol to get the right people in a room together to have a discussion, we’ve got that. From a regional or divisional perspective we’ve got support available.“ (Interview-3MH-005)

Large scale events if necessary can be escalated to the UK crisis management group. This group is composed of member from the wider business group, creating a broader
range of individuals towards addressing significant events. Within the UK this function has not been used. Incidents within the UK have previously been managed by local business function or through the direction of corporate functions in some instances.

6.5.7. Response

The organisation’s response to severe and large scale events is based on the formation of the event response team and the development of a specific response plan. Physical response activities are then coordinated and facilitated by the members of the event response team. The senior manager on site assumes responsibility. Initial response activities may be enacted prior to or run concurrently with the establishment of the response team.

“We have two mechanisms really, we have the local emergency response arrangements, so I would coordinate those and they would be documented for site and then we have a crisis management group which is slightly different in that it is made up of a wider business group.” (Interview-3MH-005)

The response of the organisation to an event is support through achieving several critical success factors. These relate to the operational priorities set within the organisation. The central concern following the onset of a disruptive event is the safety of employees and impacted individuals. Externally, given the nature of pharmaceutical products, the impact of patients is also a critical concern. Quality assurance and regulatory compliance are central across all organisation functions in regards to the development and manufacture of products. The causal network representing the response of the organisation is presented within Figure 6-19 and Figure 6-20.

There are several critical success factors within response activities. These extend throughout the various stages of response, and involve both the identification and resolution of event impacts. The critical success factors of response include:

- Containment
- Leadership
- Communication
- Speed of response
• Access to resource and expertise

Response activities must also ensure that EH&S is not compromised and that there are no implications for potential patients. However, within the response of the organisation, several challenges are presented. These include:

• Understanding what skills and expertise are available
• Identifying where these skills and expertise lie within the organisation
• Establishing access to skills and expertise
• Connecting available skills and expertise to response activities
• Recognising opportunity
• Access to information

The organisation seeks to establish a controlled approach within the management of disruptive events. This is in turn supported by the emergency response plan and procedures. The first objective within response activities is to ensure the safety within impacted areas. As a result, events physically impacting the organisation will result in a halt to production and a site evacuation. This allows responders to access and secure the site.

Within disruptive events, securing the site is the first objective within response activities. Through this the organisation may be able to contain the impact and limit the potential damage or associated consequences. Securing the site supports the organisation’s ability to control operations and activities. Most importantly, the process of securing the site also provides a direct opportunity to assess the scale of the event. Identifying impacted areas and operations and assessing the extent of direct damage.

“So really it is a stepwise approach and making sure everything is initially safe... What is the scale, where is affected, once we’ve got that under control, making sure everything is safe from an engineering perspective to pulling people out.” (Interview-3MH-005)
Figure 6-19 - Organisational Response Causal Network (pt1)
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Figure 6.20 - Organisational Response Causal Network (pt2)
The end point of a crisis or disruptive event is largely subjective. The initial impact of an event is typically the most severe, however extenuating circumstances and resolved issues can cause significant long-term implications. A return to routine operation and function does not always signify the recovery from an event. Dependent on the type, scale and impact of an event, the end point or recovery may vary significantly. Small scale events may also carry significant consequences. Instead, response operations focus towards a point of stability within the functioning of the organisation. It is at this point that the organisation is able to focus on recovery operations.

“So it is the potential severity of the situation and the consequences will drive who owns it. The key to any investigation is getting the right people involved, using the skills and experience that we have available, it is an integral part of the investigation pulling the right people in.” (Interview-3MH-005)

6.5.7.1. Leadership

While operations are largely self directed or semiautonomous, during periods of adversity or crisis a central leadership function provides direction and support. The response of the organisation to large scale events is coordinated through the establishment of a management team. It is through this team that an event specific response plan is developed. The team leader is reliant on the individuals within the group. During response activities, leadership roles provide direction and form the central authority within decision making. However, decision authority may be deferred to areas of expertise when necessary.

“It would depend on who is on site at the time, or who is going to come to site if it is an incident. The senior manager on site would take the lead I guess and put together the team and then it would be based on your technical expertise what level of decision making autonomy you have. So it would be a team based approach we would have typically a lead.” (Interview-3MH-005)

Within the organisation, and across the 3M group, there is a strong focus on developing leaders. With organisational members gaining increasing experience and
responsibilities as they progress within leadership programmes and training. Organisational members also have clearly defined roles and areas of responsibility.

“So we do a lot of leadership development with all of our people to make sure, not always before the change which isn’t always the best thing, but ongoing we are constantly developing our leaders.” (Interview-3MH-001)

6.5.7.2. Effective Communication

Communication during an event is critical. Communication and information exchange is fundamental across each stage within the response of the organisation. The response team must establish a direct link and connection to the impacted site or organisational function. Following the formation of the event response team, the event management team must inform organisational elements and stakeholders about the incident. Communication must provide complete awareness across the organisational network in order to open channels of support and access available resources and expertise. Within the physical response to an event, communication is focused on providing awareness, exchanging information, providing instructions and directives, and coordinating operations.

“And it is making sure that the communications response to a crisis or a disruption to business continuity works in parallel to the business response.” (Interview-3MH-003)

Honest communication about the extent of an event and the potential impacts is critical. Information exchange is the central within the development and coordination of response activities. Early identification of the cause of an event can help direct response activities. However, it is often only through a full review and investigation that the underlying root cause can be identified and resolved.

6.5.7.3. Established Prior Preparations

Threats and disruptive events carry the potential to escalate into crises if unresolved. Addressing events quickly through a robust response, can therefore limit the potential impact and long-term implications of an event. Unresolved issues or extended exposure to disruptions can significantly constrain long-term performance or result in the reoccurrence of an event. The speed at which the organisation is able to respond is
therefore a critical success factor. The speed of response is dependent on the level and quality of information exchange and the organisation’s ability to access resource effectively.

In order to overcome an event, an organisation must address the associated impacts, risks and threats. This is achieved through the organisation’s ability to effectively link resources to impacts and organisational needs. Dependent on the specifics of the event at hand, these needs will vary in priority. Identifying what areas of the organisation have been impacted and those likely to be affected, and understanding what resources are available and required, supports an effective response. Subsequently, ensuring accurate site information and up to date performance metrics supports an organisation’s ability to resource response activities effectively.

Prior preparation within an organisation will outline and develop resources that the organisation is then able to draw upon during times of need; developing the organisation’s capacity to address disruptive events over an extended range of operational variations. Understanding where resources and expertise lie within an organisation and the linkages between resources is therefore vital. 3M Healthcare continually reviews and updates information about the organisational structure, operational performance and employee competencies. Through this the organisation is able to develop an understanding of the capabilities of organisational elements. During periods of adversity the organisation is then able to effectively draw upon these inherent capabilities and capacity.

6.5.7.4. Access to Resource

In some instances an event will limit an organisation’s ability to provide and access resource. It is during these instances that the organisation must look to develop novel solutions; utilising available resources in often unique ways. If the organisation is severely impact, or the ability of the organisation to function is compromised, the organisation is able to call of support and resource from across the wider 3M network of organisations. Expertise, resource and capital can be provided if necessary.

“We are a global organisation so we’ve got regional resource and divisional resource, we’ve got resource in the UK we could pull in certainly from an engineering standpoint
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and a EH&S technical standpoint and then we have divisional resource which sits in the US... We have plenty of resource available, we aren’t an island by any stretch of imagination.” (Interview-3MH-005)

6.5.7.5. Limiting Impacts and Implications

Following the onset of an event, there is an immediate protection of critical elements. This is essential within limiting the long-term damage and impact of an event. Critical elements include certain production modules, essential production equipment, power sub-station, communication systems and quality control functions. Efforts are also made to contain any damage, in order to prevent external impacts. Primarily these efforts are focused towards limiting impacts related to products. These include:

- Identify impact to products under production
- Log and document products
- Isolate and quarantine damaged products
- Quality control and assessment
- Identify distribution network
- Identify potential long-term impacts

Following the immediate mitigation of event impacts, a monitoring programme is established in order to ensure issues and factors related to the event have been resolved. Exposure to previous events such as flooding and fires, have provided an opportunity for future microbial contamination of products. Following these events, affected areas were closely monitored and routine inspections conducted. This approach ensures that any factors or extended impacts linked to an event are resolved. Additionally, the monitoring programme ensures confidence that any future incidents are not linked to previous exposures. The establishment of a monitoring programme thereby forms a means of detection.

As response activities and operations progress the level of control and direct authority of the management team is spread and deferred to local areas of expertise. The management team forms the central decision making function during periods of adversity. While the management team will retain ultimate responsibility and authority, the physical direction and coordination of operations is performed by local management teams. The management team is then able to focus attention on the
long-term implication of the event and possible strategic and operational implications.

6.5.8. Resilience

Within 3M Healthcare, resilience and the organisation’s ability to overcome disruptive events stems directly from the capabilities of organisational members and the structure and support provided within the wider 3M group. The organisation looks to establish structures and systems during routine functioning which the organisation is then able to draw upon when required. Organisational processes, procedures and operational protocols ensure consistency within operations and that organisational objectives are continually achieved. The organisation is structured through established hierarchies and systems, composed of knowledgeable and experienced management team members and employees.

“I think to continue doing the right thing through any set of circumstances. Not being knocked off track from an ethical or safety aspect, that we will always do the right thing.” (Interview-3MH-001)

“I think one of the big strengths is the people. At the end of the day, people cause problems because we’re only human but the greatest asset of a company is its people. Any company is only as good as the people that are running it... so if there is an issue on site the first thing that they do is pull a team together. And it is that team that manages that situation.” (Interview-3MH-002)

The organisation’s approach to innovation and improvement establishes a continual cycle of improvement and development within the organisation. This is reflected by 3M’s approach to Six Sigma and quality improvement programmes. Across all organisational operations, 3M is governed by established organisational values and strong business ethics. These values and beliefs are entrenched within all organisational members and then reflected in the approach of the organisation to potential threats and disruptive events. The organisation is unwilling to compromise on these organisational values, continuing to ‘do the right thing’ regardless of circumstances. Prioritising the safety of employees and customers (patients) over the financial performance of the organisation. Focusing instead on maintaining and
enhancing the ethical and safety position of the organisation and its functions. As a result, 3M has established a good reputation within its respective industries and sectors.

“And it is supported by the continual development of processes within the organisation. I think everybody’s individual commitment to doing things the right way. It is about making sure that we have the right people, support and material in place, so that in the worst case, we’ve got them ready if something significant does happen. But also that you have tested them. There needs to be this ongoing process of validating and refreshing it. And being part of such a large organisation making sure that everything is interconnected.” (Interview-3MH-003)

“I think we have knowledgeable people in the business. So if you look around we have people that have quite a long period of service, we’ve got experience. And that experience and knowledge helps us in crisis situations. We’ve also got robust procedures, I mentioned emergency response but we also have the crisis management team.” (Interview-3MH-005)

The diversity within the wider organisational network provides support between 3M divisions and access to group resource. This is a significant strength within the global operations and structure of 3M. Individual businesses are then able to draw on operational support, experience, expertise and resource when required. This includes routine operations, functioning, projects as well as during periods of adversity. If within the functioning of an individual business, expertise or advice about a particular issue is required, the organisation is able to access a diverse range of skills and expertise. During periods such as the global economic downturn, although the organisational group underwent a period of restructuring and downsizing in some areas, the organisation was able to withstand the impact of the recession. Accessing group resource and support when required in order to sustain function. In regards to the physical disruption of operations, geographically separate facilities means that production can be transferred to alternative manufacturing sites. Additionally, alternative distribution networks are also available.
“I think we are sufficiently networked and we have the right external support in place. That we could bring in additional resource if necessary. I think, the strength of the global organisation is so important because if you had a situation where it impacted business continuity we have the possibility to transfer manufacture.” (Interview-3MH-003)

Ensuring operational elements are all interconnected with established operational and risk thresholds, supports the organisation’s ability to respond effectively. Understanding operations and the capabilities of organisational elements, allows for the development of appropriate response plans towards the mitigation of a disruption. Interconnection between operational elements means that information and resources can be effectively exchanged and transferred. Communication between organisational elements is essential within establishing the impact of an event and the coordination of response activities. An increased number of connections between elements provides several alternative channels of exchange in the aftermath of a disruption. Information and resource can then be transferred within the constraints of the disruption.

“We are supported by other divisions and we support other divisions. So there is that link there, so if it is needed then we can go wider. If it’s not, if we are doing brilliantly and other division is struggling we can support that... From that perspective, you could say that it is quite resilient.” (Interview-3MH-004)

Established operational and risk thresholds outline the operational capabilities and tolerances of organisational elements. In regards to production this is a critical function within restoring operations. Understanding the potential capacity of operations and the amount of risk and element is able to withstand. Operational and risk threshold also support a proactive approach within the management of potential risks and threats. Thresholds provide an operational level that cannot be exceeded and as such provide a means of detection and monitoring.

“... Secondary to that is the global 3M and you’ve got people around the world. So again it’s people. It comes back to people... So long as you’ve got people you can still rebuild and perform. You’ve got to throw money at it but that the way it is. But any way I look at it you can’t not put people at the top." (Interview-3MH-002)
In addition to established internal connections and structures, connections with stakeholders are also an important aspect within the organisation’s response to disruptive events. Stakeholders should be made aware of an event and the potential impacts as soon as possible. Controlled and open communication about events and response activities ensures stakeholder confidence is maintained in the 3M’s ability to respond effectively. Additionally, established connections with stakeholders, including suppliers and customers, provides awareness of external events which may in turn impact 3M. Events outside of the organisation or within the extended supply chain can carry implications for the organisation. Visibility and awareness of these events or issues can often be difficult to establish. As such, awareness through stakeholders of these events allows 3M to establish preparations and contingencies towards mitigating and limiting their impact.

6.6. Conclusions and Implications

Following the within-case analysis and the development of thematic matrices for each organisation, the identified emergent themes included: 1) Organisational Structure and Processes; 2) Threats and Risk; 3) Opportunities; 4) Organisational Strategy; 5) Organisational Development and Growth; 6) Organisational Capabilities; 7) Organisational Dynamics and Behaviour; 8) Activation and Detection; 9) Crisis Management; 10) Knowledge and Experience; and 11) limitations and Constraints. These themes were identified within each organisation and relate to organisational features both prior to and following the impact of disruptive events.

In relation to these emergent themes several key conclusions and implications can be drawn. These are:

1) The effective management of risks and threats is a central concern within the management and coordination of organisational operations and decision making processes.

2) Disruptive events are characterised by unpredictability. The impact of an event is dependent on the aggregation of certain threats and risks.
3) A proactive response is dependent on established prior preparations and the development of appropriate strategies towards addressing threats, risks, areas of improvement and potential opportunities.

4) The development of an effective strategy to potential disruptions must create a balance between internal strengths and capabilities and external threats and opportunities.

5) Past experiences of threats and disruptions aid in the development of robustness within organisational elements and preparations.

6) Understanding the capabilities and competencies within an organisation is essential in order to elicit an effective response.

7) Each organisation has a unique approach within addressing the impacts of an event. This response is typically linked to the type of event faced and the available capacity and resources of the organisation.

The case studies outline the features and characteristics of disruptive events; outlining the importance of effectively addressing both low and high probability events. Events present a diverse range of challenges to the operation and functioning of an organisation. As such, a proactive response to change and discontinuities is necessary; emphasising efficiency and organisational effectiveness within response activities. Organisational effectiveness is related to an organisation’s capacity to address and achieve critical success factors during periods of adversity. While organisational efficiency relates to the ability to implement a response strategy and conduct response activities.

Within organisational case studies, a proactive approach to the management of risk and uncertainty allows an organisation to address potential events or incidents prior to their escalation. Risk management is thereby closely linked to the value chain within the organisation. Events are then managed locally with the capacity to escalate response activities if necessary. These escalation procedures and operational thresholds within organisational elements provide a robust response capability. Following the escalation of an event, a specific response strategy is then developed for the event by either an incident management or crisis management team. In relation to the response of an organisation to a disruptive event, the case studies
identify several influencing factors including *leadership and event management teams*, *decision making*, and the development of a *resilience based approach* and *organisational response strategy*. Within an organisation’s response to potential threats and disruptive events, organisational resilience is supported by a number of key factors. These include:

1) *Experienced individuals within the organisation with extensive operational knowledge and previous exposure to crisis situations.*
2) *Development and validation of robust procedures, processes and preparations; including established emergency response arrangements (connection to responders)*
3) *The development of a consistent response protocol, including an established escalation process, crisis management team and communication structure (internal and external)*
4) *Established risk management processes and preparations linked to critical risks*
5) *Availability and access to external support and resources*

6.7. Summary

Following the research design outlined within Chapter 3, this chapter presents evidence from each of the four organisational case studies. Each of the case study organisations was analysed separately through the development of a coding database following the coding process outlined within Chapter 4 Section 4.5. Key factors and variables related to the response of an organisation are discussed in relation to each case study. These identified features were then illustrated graphically through the development of causal networks.
Chapter 7 - Cross-Case Analysis

7.1. Introduction

Following the evidence presented within the previous chapter, this chapter firstly presents the key findings within the research and then discusses these within a wider context, including a comparative analysis (cross-case) and identification of influencing factors. A causal network of an organisational response is then presented towards outlining a typology of resilience within organisations. Through this the chapter addresses the research objectives RO3 and RO4 (presented within Chapter 1, section 1.3).

7.2. Comparative Analysis of Case Study Organisations

A comparative cross-case analysis of case attributes between each of the four case study organisations was conducted. The resulting thematic matrices are shown within Appendix E and Appendix F. The thematic matrix presented within Appendix E outlines the distinguishing features of each organisation in relation to the sections of the case study protocol. Appendix F presents a factor comparison between each of the case study organisations.

The comparative analysis indicates that while organisational disruptions and preparations are varied and often unique, many of the features of a successful response are similar between organisations. While response strategies and operations are largely predicated on the type and characterisation of an event, response activities are grounded within recognising change (including event impacts), gaining visibility of the impacts, effective communication and the exchange of information as well as embedded response protocols and systems. Through this the ‘positive adjustment’ or a ‘resilient response’ relates to an organisation’s ability to provide support for immediate needs while minimising long-term implications. Central within all response activities is ensuring the safety of employees and securing the local environment.

The following sections outline the key features identified within each of the case study organisations.
7.2.1. Company 1 - ABB

Within ABB, resilience is not a direct consideration within the daily operations and activities of the organisation. But is instead is the indirect result of the developed processes, procedures and structure within the organisation and the wider organisational group. The organisation focuses on actively anticipating potential disruptions, risks, and threats, and then developing the necessary attributes and capabilities towards address these events should they occur. Through this the organisation is able to develop robust preparations aligned to the organisation’s operational capabilities. This is reflected within:

- Crisis management plans
- Disaster recovery plans
- Travel plans
- Security plans
- Employee management

Resilience within ABB thereby relates to the strengths and capabilities of the organisation’s operations, and the organisation’s ability to effectively address both small and large scale disruptions. This is achieved through the organisation’s established prior preparations and the ability to mobilise quickly and effectively during an event. The response of the organisation to disruptive events is dependent on the organisation effectively interpreting environmental feedbacks and establishing appropriate controls. In order to ensure the continued operation of the organisation, the organisation must:

- Understand the operations of each business and department
- Understand the areas of criticality and dependency
- Understand the risks faced by each business and market

Within the organisation, value is placed within the development of employees. The UK senior management team is primarily composed of individuals internally promoted through the organisation’s hierarchy. However, across all organisational levels there is investment within developing employee competencies through training initiatives and opportunities. Through providing these training opportunities towards improving employee skill and knowledge, ABB is able to increase the level of competencies within the organisation.
7.2.1.1. Readiness and Preparation

Readiness and preparation relates to a proactive approach towards actively addressing potential events before they have an opportunity to escalate into high impact crisis events. Given the nature of disruptive events it is difficult to predict their occurrence and impact with any degree of certainty. However, in order to develop appropriate preparations, ABB invests time in considering both LIHP and HILP events as well as alternative means of conducting business following the occurrence of an event. Through this the organisation not only develops procedures for known threats and risks, but also addresses unique events outside of traditional consideration. Improvement within front end planning thereby reduces potential future issues.

Within the routine operation of the organisation, proactive behaviour relates to communication within and across the organisational network. The ABB group forms a diverse organisational network, both operationally and geographically. This diversity provides a broad range of resources that the organisation or individual business units are then able to draw upon. In relation to the response of the organisation to an event or a potential threat, the proactive response of the organisation to discontinuities relates to prior preparations and the development of the organisation's response capabilities. Proactive preparations include:

- Established planning – Crisis and Disaster Planning and Emergency Procedure, Continuity Planning
- Established systems – Management System, Crisis Management, Risk Management
- Established employee responsibilities and duties
- Established communication hierarchy
- Established authority hierarchy – Power Structure

7.2.1.2. Response and Adaption

ABB is able to respond to crisis events through the individuals within the organisational group. The considerable size of the organisation and its associated organisational networks offers a diverse and strong pool of knowledge and experience.
upon which the organisation is then able to draw upon when required. As such, the successful response of the organisation to a disruptive event requires access to individuals with the required experience and expertise related to a particular event.

Within the response of the organisation, senior management takes ownership of the coordination of response activities. Dependent on the severity of the event, different levels of response may be followed. This is linked to the organisation's ability to successfully interpret demands during periods of disruption and the classification of an event or threat. Within the varying levels of response, different organisational elements will become involved dependent on the severity of the event. Smaller events will be managed locally, while events posing a significant threat will involve a specific crisis team. The criteria for the classification of events and the responsibility of different organisational elements is outlined within the organisation’s business continuity planning and emergency response procedure. These plans and procedures act to facilitate the response of the organisation, rather than provide a rigid guide.

Severe events are those that:

- Involve serious or multiple loss of life
- Overextend the security of the business
- Impact the image or reputation
- Impact the share price and value of the organisation

A proactive response to disruption is supported through the effective utilisation of human resource within the organisation. It is the employees that enable the organisation to respond effectively and adapt to discontinuity. This is possible through the employee’s ability and willingness to adapt to change when required. Depth within the management structure and the global reach of the organisation also provide a stable platform from which the organisation is able to adapt through periods of disruption and adversity. Ensuring that the ‘right people’ are in the correct roles and are fully supported within the organisation is crucial in ensuring the flexibility of the organisation.
7.2.1.3. Recovery and Adjustment

Recovery from an event is characterised through establishing the learnings following the mitigation of a disruption or threat. This requires the development of a learning culture within an organisation, and the exchange of learnings across the organisational group. Past experience has resulted in the development of support infrastructures throughout the organisational group. This can be seen through several functions of the organisation including, staff development and training, acquisition integration, crisis management and planning and efforts to establish commonality and brand identity across the organisation.

Following the organisation’s previous exposure to risk and disruptive events, the organisation has an astute awareness of the importance of developing crisis management capabilities and processes within the organisation. There is a clear business and organisational need to develop appropriate mechanisms towards the adaption and response to unplanned events that could adversely affect the operation and continuity of the organisation. As such, within the organisation and its wider network there is a concerted effort and specific focus on developing processes and procedures towards addressing disruptive events. This is achieved through continually monitoring the organisation’s operating environment and seeking continual improvement throughout the organisation’s operations. The organisation’s exposure to previous events and identified operational improvements have highlighted a need to align elements of the organisational network. The diversity within ABB business units and portfolio has resulted in an organisational structure composed of almost separate companies. The ‘One ABB’ initiative looks to align and create synergies between organisational elements. Without developing this connection and commonality there is potential for organisational elements to become disjointed.

Through a process of continual improvement and development, organisational learnings and guidance from across the group and organisational network are introduced into the training programmes to ensure and improve the standard and quality of risk and crisis preparations. This approach also provides standardisation,
compliance and awareness through the alignment of processes and procedures towards the strategic development of the organisation.

7.2.2. Company 2 - E.ON

E.ON is involved in a broad scope of operations within the energy sector and is composed of several closely integrated regional units across Europe, including several functions within critical infrastructure within the UK. As such, ensuring the continued function of operations through periods of disturbance is of paramount concern and great emphasis is placed on safety and security.

Resilience is closely integrated into both the strategic functions and operations of the organisation. Subsequently, the organisation takes a mature perspective and approach to resilience within its operations. This can be seen through the well-established process through which the organisation evaluates strategic decisions and the organisation’s approach to addressing potential disruptive events. It is through these linkages that the organisation has not only been able to achieve operational benefits, but also develop a more robust organisational system towards potentially disruptive events. Resilience is therefore viewed as a strategic decision to support organisational growth and development. The organisation focuses on developing and understanding and awareness of both internal and external influencing factor. Through this the organisation is able to position itself relative to potential threats and opportunities. The organisation is then able to respond effectively and proactively to a disruptive event.

7.2.2.1. Readiness and Preparation

In order for the organisation to respond effectively to threats or disruptions, E.ON is required to develop the ability to effectively recognise change. This involves an intuitive approach to monitoring both the internal and external operating environment of the organisation. The organisation also identifies factors or events that may impinge on the performance of business divisions.

In order to effectively interpret operational and environmental fluctuations, it is necessary for the organisation to develop an in-depth operational and organisational
understanding. Fluctuations and events affecting performance can thereby be effectively recognised and assessed. Events outside of the operational bounds or operational capacity/capability of the organisation can then be recognised and addressed through a suitable response. The benefit of monitoring and understanding the organisation’s operating environment is that the organisation is able to position itself relative to identified opportunities (when suitable). This means that the organisation is able to take advantage of factors such as material price, emergence of new markets and increased utilisation of energy (capacity).

Preparations in relation to the response of the organisation to threats and risks is achieved through aligning organisational functions with recognised standards. The central standard utilised is BS 25999, which forms the recognised standard for Business Continuity Management. The BS25999 provides a readily adaptable framework for the response to and mitigation of risks and threat. The standard thereby provides a level of quality assurance during periods of adversity.

7.2.2.2. Response and Adaption

The organisation’s ability to respond to events is largely determined by the event itself. The critical stages within the organisation’s response to disruptive events involve an assessment and characterisation of the event. The organisation must identify and understand what organisational elements have been impacted and affected in order to respond effectively. Following this identification, the strategic importance of the effected elements must be established in order to develop a suitable response strategy. Dependent on the perceived severity of the event, different levels of response may be appropriate. The central concern is speed within response, before the event is able to develop into a large scale crisis.

The critical success factors within the response to a disruptive event include:

- Effective leadership
- Use of alternative supply relationships
- Close connection to regional management structure and wider organisational network
• Having specialised expertise within the organisation (E.g. specialist crisis team)
• Continual access to support network
• Availability of support and advise from knowledgeable source
• Effective tools for managing an event
• Established emergency procedure
• Access to information database (remote access)
• Effective means of exchanging information and communicating
• Establish event timeline

Within the organisation’s response to disruptive events, communication forms the primary mechanism of coordination between organisational elements as well as external networks. Ensuring communication during response operations is achieved through the use of established and formalised communication networks and channels within the organisation. Transparency within communication means that information is able to transfer across the organisation openly. This creates and promotes awareness across the organisation.

External communication is also essential within response operations, as the organisation may have to coordinate with emergency services and responders. The organisation must also communicate with stakeholders and customers in regards to the nature and impact of the event. Given the size and profile of the organisation, there is a clear need to establish a media interface during the organisation’s response. Negative media associated with a disruptive event or the response of the organisation could cause significant reputational damage.

7.2.2.3. Recovery and Adjustment

The successful recovery from a disruption or crisis is dependent on establishing the full impact of the event and ensuring adequate processes and controls have been implemented. Recovery is also linked to the monitoring of organisational elements following response activities in order to ensure all issues have been resolved effectively. While response activities will primarily focus on addressing the immediate impact and issue related to an event, thereby focused on short or medium-term
priorities, the recovery and adjustment of the organisation addresses a long-term perspective. Identifying and implementing learnings and improvements is central activity within the recovery and adjustment of the organisation.

The recovery of the organisation following response activities relates to stabilising the operations and functions of impacted organisational elements. Recovery marks the return to expected levels of performance and functioning, however, the level of performance may be lower than pre-event levels. Additionally, response activities may require or create considerable operational constraints. Recovery operations will also focus on addressing these constraints.

The adjustment of the organisation relates to long-term improvements and embedding change and improvement across the organisational network. Following a response to disruptive events, organisational elements may be exposed to considerable turbulence and change. During the adjustment of the organisation it is possible to formalise changes and implement learnings and improvements. It is also during period of adjustment, that the organisation is able to position itself relative to potential opportunities presented within disruptive events.

**7.2.3. Company 3 - UAM**

Within UAM, resilience is achieved through adaptability and the continual development of organisational functions. The organisation is composed of both commercial and supply chain logistics divisions. Within the organisation these divisions operate individually, however there is a common and shared approach across organisational functions. Through this the divisions are mutually supportive, able to exchange learnings and create business opportunities. Given the nature and complexities associated with the nuclear industry, the organisation is also required to develop robust procedures while ensuring operational flexibility. Ensuring regulatory compliance is critical across all operations.

Within the structure and function of UAM and its associated networks, disruptive events can be broadly classified as either operational or business incidents. While incidents will affect and carry ramifications for both the organisation and its operations, operational incidents are primarily events that impact the physical
operations of the organisation, whereas business incidents are events that restrict or limit the performance of the organisation or the organisation’s ability to function.

In relation to the response of the organisation to crises or operational incidents, emergency planning and crisis management is primarily driven by regulatory frameworks set by governmental and industry authorities. Given the nature of the energy industry and the potential wider implications of events, preparations and response activities to operational incidents are strictly governed by regional and regulatory requirements and procedures. Responses to operational incidents are thereby linked to national response infrastructures. Subsequently, the organisation is not directly involved within physical response activities for operational incidents, but is instead involved within the coordination of response operations; providing responders with appropriate information and support within their response activities. As such, preparations related to operational incidents are developed to support the response activities of responders; providing accurate and pertinent information about the materials and products involved as well as providing an interface for customers.

7.2.3.1. Readiness and Preparations

Through an established operational knowledge and understanding of organisational dependencies and criticalities, the organisation is able to develop a proactive response to potentially disruptive events. Detection of potentially disruptive events is achieved through a continual information exchange both internally and externally to the organisation. Continual monitoring and feedback of environmental and market fluctuations allows the organisation to adapt to operational alterations effectively through an acute situational awareness.

Actively seeking and exchanging information is closely linked to the formation and development of the organisation’s strategy. In addition to identifying potential operational threats and restrictions, environmental scanning allows the organisation to identity opportunities within favourable market conditions and forms a large component within the organisation’s decision making process. The organisation is also closely involved and aligned with various industry bodies and regulators. The organisation has developed a strong presence and reputation within the energy
industry and this provides the organisation with a unique position and understanding of regulatory demands and an early awareness of any regulatory changes.

Involvement within various advisory committees allows the organisation to not only anticipate and prepare for future regulatory changes but allows the organisation to influence the future directions of the industry. This involvement also provides ample opportunity to share and exchange knowledge and experience from across the industry.

Preparations for incidents affecting the continuity of the organisation’s operations (business interruption incidents) are largely informal. Preparations are fundamentally structured around providing a platform from which appropriate response activities can be conducted. As such, preparations are in place to establish and understand 1) operational and organisational capabilities; 2) operational criticality; 3) organisational vulnerabilities; 4) organisational connections; and 5) limitations and dependencies.

### 7.2.3.2. Response and Adaption

Within the response of the organisation to an event (either operational or business), safety and security are of paramount concern. Events involving potentially harmful materials are considered severe events and carry potentially devastating implications for those directly involved, as well as the local community and environment. As such, response activities are developed around minimising the impact of the event, as well as securing the incident site and local environment. The organisational response to events impacting or adversely influencing the performance of the organisation are developed around establishing appropriate contingencies through the organisation’s management team.

As an organisation operating within the energy industry, the threat of non-compliance is of major concern. The nature of the materials involved and the importance of security within supply for critical infrastructure (power generation) means that operations are governed by stringent regulations and legislation. Non-compliance to any regulations related to security could have severe implications for the organisation, including reputational damage, loss of licences, loss of authority for both transport and commercial operations, as well as loss of revenue and other financial liabilities. In
order to address this potential threat, the organisation has worked to establish strong connections with both industry and regulatory bodies as well as developing connections and relationships with suppliers and operators. The organisation also follows a rigorous audit process.

### 7.2.3.3. Recovery and Adjustment

While the response of the organisation is closely linked to established regulatory agencies, requirements and legislation, the adjustment of the organisation is often towards addressing factors influencing its competitiveness and improving flexibility. In order to remain competitive within the energy industry UAM is continually developing operations and broadening its organisational portfolio. This adjustment of the organisation promotes the development of flexibility, while actively reducing dependencies and internal costs within the organisation.

Following the response of the organisation to an event, either an operational or business incident, UAM looks to identify areas of improvement and opportunities for organisational development. Identifying learnings and areas of improvement in the aftermath of an event is a key element within the continual development of the organisation. These improvements are captured through a robust and well established HUP process within the organisation.

### 7.2.4. Company 4 - 3M Healthcare

Globally, 3M is involved in a diverse range of industries and sectors. The organisation develops innovative technology, products, patents and solutions within the divisions of Consumer Products, Safety and Graphics, Electronics and Energy, Healthcare and Industrial. The UK is one of the largest subsidiaries outside of the United States. 3M Healthcare, operates through multiple businesses including Drug Delivery Systems. The division develops and manufactures customised inhalation and transdermal medical delivery solutions. The organisation is governed by strict regulatory and quality requirements. Ensuring compliance and safety are central concerns within the operations of 3M Healthcare.
The organisation’s approach to resilience is embedded within the organisation’s culture. Innovation and continuous improvement are central elements within the operation of the organisation. The ability of the organisation to change and adapt its approach and function supports organisational flexibility in response to potential threats and disruptive events. The culture of resilience is developed through the direction of leadership and supported through clear organisational values and beliefs.

Organisational structures, systems, procedures and processes are then developed around supporting organisational members and providing a framework to address disruptive events. A proactive approach to the management of risk and uncertainty allows the organisation to address issues prior to their escalation into large scale disruptions or crises. Established escalation procedures and operational thresholds within organisational elements provide a robust response capability. Organisational linkages across the 3M network ensures expertise and resource can then be transferred and accessed if necessary.

7.2.4.1. Readiness and Preparation

Preparations in relation to the response of the organisation are linked to a critical understanding of the organisation’s value chain structure and established response escalation procedures. Understanding the critical risks that the organisation faces allows for the development of appropriate controls and monitoring systems. Taking a proactive approach to the management of risks and threats drives improvement and performance within organisational elements.

Following the identification of a significant risk, a mitigation procedure is followed to ensure that appropriate measures and controls are put in place to resolve the risk or issue. These controls also provide a level of monitoring and a risk threshold within organisational elements. The risk mitigation plan involves effectively identifying what has happened (impact), establishing the harm or potential implications for people and patients and outlining immediate corrective actions.

The risk register and the subsequent mitigation process focus primarily on significant risks and features of the critical path within organisational elements. Risks and events related to the organisation’s critical path can have a direct impact on performance. As
such, risk management is closely linked to the value chain within the organisation. Organisation therefore outline the identified risk tolerance of each individual organisational element.

7.2.4.2. Response and Adaption

The response of 3M Healthcare is supported through established escalation procedures. Events are managed locally with the capacity to escalate response activities if the event is outside the direct capabilities of the impact organisational element. Response activities are based upon the effective assessment of impacts and the exchange of information both internally and externally. The critical success factors of an effective response include:

- Containment
- Leadership
- Communication
- Speed of response
- Access to resource and expertise

The critical success factors of an effective response revolve around safety, security and returning the facility to a manufacturing state. Firstly, the organisation must respond safely to the impacts of an event. Ensuring the safety and security of the site and employees is of paramount concern. Response activities must ensure that EH&S is not compromised and that there are no implications for potential patients. However, within the response of the organisation, several challenges are presented. These include:

- Understanding what skills and expertise are available
- Identifying where these skills and expertise lie within the organisation
- Establishing access to skills and expertise
- Connecting available skills and expertise to response activities
- Recognising opportunity
- Access to information

3M follows an established emergency response procedure within forming either an incident management or crisis management team. It is through the formation of either of these teams that the organisation is able to respond to more severe events.
Senior management forms the steering group within the development and coordination of response activities. The response strategy for an event is developed on an event specific basis. Organisational systems and procedures provide a supportive framework within addressing the specific impacts related to an event. The global 3M network provides access to expertise and resource that an organisation is then able to draw upon during periods of difficulty.

7.2.4.3. Recovery and Adjustment

In order for the organisation to recover from an event it is essential that the root cause and specifics of the event are clearly established and resolved. Within 3M, a rigorous investigation and incident review process is followed. This review includes a comprehensive review, root cause investigation, risk assessment, human behaviours and human factors, and the identification of preventative measures. Although the process may be limited within addressing complex events, the investigation establishes a consistent approach within the mitigation and review of disruptive events. The investigations provide an opportunity for improvement and development within the organisation. The process utilises established Six Sigma tools and techniques, but is not hard linked into the organisation Six Sigma approach. This protocol provides a supportive framework and structure for investigations and reviews. Investigations are then peer reviewed to ensure a robust resolution.

The review process provides a mechanism to capture learnings and improvements. Following the investigation, the organisation or individual organisational elements and functions are able to develop a preventative and corrective actions. These are then monitored and reviewed to form a continuous cycle of learning. Processes and procedures may then be updated incorporate improvements. Investigations also identify areas of vulnerability and concern within the functioning and operation of the organisation. Appropriate controls and thresholds may then be established within these areas.
7.3. Influencing Factors

Following the evidence presented within both the organisational survey and case studies, the following sections detail the influencing factors within the response and adjustment of an organisation to a disruptive event.

7.3.1. Disruptive Events

Organisations rarely, and if so briefly, operate in an environment of stable equilibrium. The demands and requirements of the business environment are continually changing and organisations must deal with regular discontinuities and disturbances. These typically take the form of either low-impact/ high-probability (LIHP) events or high-impact/ low-probability (HILP). Within LIHP events the subsequent mitigation procedures and practices are often well developed and understood within organisations. However, HILP events require planning and action outside the normal channels of response for many organisations. Therefore developing organisational systems with the ability to adapt to these dramatic threats is an area of growing interest within industry. Figure 7-1 outlines the fundamental disruption process within organisations; utilising this simple framework it is possible to outline several features related to organisational level resilience.

![Disruption Process](image)

**Figure 7-1 - Disruption Process**

Organisations are subject to an uncertain future characterised by a diverse range of potential risk factors, threats and possible perturbations. Disruptive events are often characterised by unpredictability and may be internal or external to the organisational system. Events also carry far ranging consequences. The potential impacts of an event include, but are not limited to, financial implications, legal ramifications, operational impacts, supply chain disruptions, damage or failure of a product or service, health and safety incidents and environmental implications. Additionally, events carry both direct and indirect impacts. The perceived impact of an event is dependent on the...
event influence over the operating priorities and objectives of an organisation. Events threatening or impacting core operating values or impinging operations is perceived as a severe of high impact event. The potential impacts of an event include:

- Future liabilities linked to events
- Altered management structure
- Altered organisational controls
- Altered organisational processes
- Media exposure of events
- Legal threats
- Large scale disruptive events can have dramatic implications for an entire country
- Potential threat to national supply chain
- Severe events impact all stakeholders
- Events from external sources are more severe
- Event in one area can have implications in another
- Threats to group resource
- Threats from competitors
- Psychological impact of event on organisation
- Severe risks are those that overextend the security of the business
- Serious or multiple loss of life

As such, despite the simplistic linear representation within Figure 7-1, disruptive events create a complex environment which requires the development of dynamic organisational responses and interactions. As outlined within Figure 7-2, the magnitude and severity of an event is dependent on the accumulation and culmination of certain risks and organisational factors. Each event carries the distinct possibility of escalating into potentially high impact organisational crisis if the appropriate mitigation strategy or organisational response is not followed. Organisations must therefore be capable of a variety of responses and reactions to disruptive events. These responses are linked to both the features of the event itself as well as attributes of the organisation.
An effective response or reaction must ensure that the organisation is able to survive and overcome the impact of events or crises both internal and external to the organisation and its business divisions or organisational network. Disruptive events caused by external sources or events originating outside of the controls of an organisation are typically more severe and often carry dramatic implications for the organisational elements involved, as well as a substantial psychological impact. This is possible due to the events occurring outside of the traditional considerations and preparations of the organisation. This has resulted in the development of increasing security protocols related to external events and the close monitoring of external environments.

Disruptive events can also have far ranging impacts on the structure and operation of an organisation. As identified within the organisational case studies, disruptive events create complexity, uncertainty and significant constraints within the operations and functioning of an organisational system. The subsequent impact of events may include altered management structures, controls and processes, restructured accountability and implications for associated stakeholders. These issues are further complicated as disruptive or crisis events may create open ended and future liabilities, resulting in further implications for the organisation. Following the occurrence of an event or the mitigation of a potential threat, several learnings can be introduced to support organisational development and the validation and improvement of response procedures. Disruptive or crisis events also provide a means of validation for prior preparations and crisis management procedures. Past experiences of threats and disruptions aid in the development towards a more robust organisation. Following the
response to previous events, several organisational learnings were identified across the case study organisations. These include:

- The need to clearly establish responsibilities within preparations
- The need to develop robust communication system/network
- The need to establish visibility of event
- The need for better integration of companies and operational divisions

7.3.2. Proactive Organisational Responses

As outlined within Burnard and Bhamra (2011), organisational responses to disruptions can be characterised as either rigid or flexible. This is shown within Figure 7-3. The rigid response of an organisation is characterised through a centralisation of authority and the use of pre-defined strategies of response. These include Business Continuity Planning, Crisis Management and Risk Management procedures and processes. The flexible response of an organisation relates to the development of bespoke response strategies related to the specific circumstances and impacts surrounding an event. Through this the organisation is able to utilise developed capabilities and available resources towards addressing the demands of an event. This typically results in alterations to organisational elements and the development of unique solutions. However, unlike previous contentions, as outlined within Burnard and Bhamra (2011), both the rigid and flexible responses may relate to the features of resilience within an organisation.

![Figure 7-3 - Potential Organisational Responses](image)

Following the evidence gathered across each of the case study organisations, information utilisation and communication form the predominant elements within an organisation’s response to disruptive events or crises. Many of the identified variables
are dependent on effective communication and the exchange of information. Throughout both the preparation and detection phases, right through the activation and eventual response of the organisation, the ability to collect, analyse, interpret and utilise information effectively forms a central junction in an organisation’s ability to overcome the demands of complex disruptive events. Even within LIHP events, communication and information exchange supports an effective response and prevents the accumulation and escalation of risk factors.

In order to take a proactive approach towards the management of disruptive events, organisations require an astute situational awareness of influencing factors both internal and external to the organisation. A detailed knowledge and understanding of the operations and structure of an organisation provides organisational actors with an understanding of the capabilities of the organisation as well as a means of identifying the potential impact and influence of a disruptive event. Organisational actors are then also better positioned to understand the availability of resources and other supportive elements.

Organisation must look to take an immediate and proactive response to disruptive events; recognising the unpredictability and dramatic impact of crises. A proactive response to events limits the opportunity for the event to escalate or cascade across the organisational network. During the response of an organisation to a disruption there is an increased exchange of information as information is accessed from a variety of sources. This is further emphasised when the disruption occurs outside of the competencies and traditional capabilities of an organisation. During such an event effectively seeking information becomes the predominant factor within the response and coordination of operations within an organisation.

7.3.3. Characterisation of Events

As outlined previously disruptions can be broadly classified by their impact and probability of occurrence. Although these features may be difficult to interpret, the distinction between disruptions creates a matrix towards the characterisation of response activities. This is shown within Figure 7.4. Within the matrix, the mitigation and response to low impact events is typically well covered within the daily scope of
operations and organisational management activities. As such, these events relate to elements of robustness within an organisation. However, high impact events require a response outside of the traditional bounds of the organisation and are subsequently of greater concern. High-impact/ high-probability (HIHP) events pose an immediate threat to an organisation and therefore require immediate action. Given the high probability and consequences of such events, without addressing these events the organisation may be unable to operate or function. The distinction of resilience lies within an organisation’s ability to address and overcome HILP events. However, due to the low probability of high impact events, there is a potential risk that indicators of disruptions may be overlooked. As such, robust systems are required to identify potential threats.

As outlined by several respondents within all of the case studies, successful organisations understand and appreciate the nature of risk and disruptive events. The uncertainty associated with disruptive events means that a broader range of information processing and coordination is required in order to respond effectively. However, the impact of disruptive events often stands to hinder or limit an organisation’s ability to follow pre-existing channels of operation. Subsequently, organisations are often required to adapt and develop novel and often unique solutions to the demands of disruptive events. As such, capabilities related to innovation and creativity are emphasised within the routine operation of proactive organisations.
Although prior organisational planning and preparations can support an organisation through adversity, it is impossible to account for every conceivable occurrence or unique combination of risk factors. There are a range of possible causes and outcomes related to risks and threats and it is often difficult to provide an accurate assessment of potential event probabilities. Typically, the assessment of probability is based on experience and what is understood from past events. This may be either an analytical or a cognitive assessment. As identified through the case studies, during an organisation’s response, organisational actors are required to successfully interpret the demands on the situation. This assessment should be balanced against the areas of criticality and the organisation’s core operating values. As a result, different ‘types’ of events are often characterised within response activities; this is shown within Figure 7-5.

The ‘type’ of event is linked to the classification and potential impact of a threat. The limits or borders between different ‘type’ events are determined by the bounds of an organisation. Low impact events are typically characterised through a Type 1 classification. Fundamentally, the responses to Type 1 events relate to the level of robustness within organisational systems. Robustness relates to the ability of organisational systems to withstand stresses and turbulence; maintaining operations across a broad range of potential issues or threats. Type 1 events relate to an...

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**Figure 7-4 - Classification of Disruptions**

Although prior organisational planning and preparations can support an organisation through adversity, it is impossible to account for every conceivable occurrence or unique combination of risk factors. There are a range of possible causes and outcomes related to risks and threats and it is often difficult to provide an accurate assessment of potential event probabilities. Typically, the assessment of probability is based on experience and what is understood from past events. This may be either an analytical or a cognitive assessment. As identified through the case studies, during an organisation’s response, organisational actors are required to successfully interpret the demands on the situation. This assessment should be balanced against the areas of criticality and the organisation’s core operating values. As a result, different ‘types’ of events are often characterised within response activities; this is shown within Figure 7-5.

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organisation’s approach towards routine operational incidents. These are typically managed locally and well covered within the scope of daily management and operational activities. Responses are governed by employee capabilities and competencies, training and standard operating procedures. Type 1 events do not seriously threaten or impact the functional capacity of an organisation.

While Type 1 events relate to robustness, Type 2 and Type 3 events are much more dramatic and carry a far greater impact. Typically, these events will threaten or impact the core business and operations of an organisation and affect an organisation on a much wider scale; although the cause may be acute and context specific. As such, these events pose a significant threat to the continuity of an organisation. The response and adaption of an organisation to these higher impact events relate to the features of resilience within an organisational system or network.

The distinction between Type 2 and Type 3 events lies in the probability that the event may occur. Both event classifications have a higher potential impact, causing damage or an interruption to organisational functions and operations. Typically, Type 2 events are ‘recognised’ or ‘expected’ with a range of severe incidents, while Type 3 events are relatively ‘unplanned’. Events related to a Type 2 classification pose the most direct threat to the continuity and success of an organisation. This is due to the events
carrying a high probability of occurrence and a high impact. As a result, organisations are required to take immediate precautions to ensure the continued operation of organisational systems and functions. To support this organisations are required to establish risk thresholds on vital operations to identify potential events prior to full escalation.

While Type 3 events also carry a high associated impact, these events are characterised through a lower probability of occurrence. As a result, organisational responses to these events are typically outside of the traditional planning considerations of organisations given the low probability of the associated threat. As a result, Type 3 events are potentially the most damaging to an organisation as they are often unexpected and occur without warning. Organisations may subsequently become ‘blind-sided’ by these events. These events may also occur through the escalation of an event past the established operational and risk thresholds. Resulting in an organisation becoming increasingly overwhelmed by an event and its impacts.

7.3.4. Levels of Response

In order to address the identified event classifications, organisations may elicit varying levels or tiers of response. Through this organisations are able to match the organisational response to the impact of an event. These are outlined within Figure 7-6. These levels of response are outlined from the perspective that an event has been identified or has already occurred. As indicated within Figure 7-6, an organisation may progress through different response Levels within addressing an event. An organisation may subsequently ‘escalate’ or ‘de-escalate’ a response dependent on a variety of factors.

In relation to the potential impact of an event, the Level of response can be illustrated graphically. This is shown within Figure 7-7. As the response of an organisation occurs following the onset or identification of an event, the axes relate to the severity (impact) and magnitude (scale) of an event. These features of an event are large determinants within the eventual organisational response. In addition to the direct and indirect implications of an event, the scale of an event can be a large influence on the events’ impact. Events affecting the organisation on much larger scale often carry
far greater consequences than acute events. The number of exposure points within an event is therefore a critical determinant within the severity of an event.

The boundaries between levels of response are dependent on the capabilities and established thresholds within organisational elements and functions. As shown within Figure 7-7, the Level of response can be determined by either the severity or magnitude of an event, or a combination of both features. However, a Level 4 response would only be followed within both a high severity and high magnitude events.

Following the identification and classification of an event, an organisation may elicit varying tiers of response. A Level 1 response is the lowest level response and as such is associated within low impact and minor scale events. A Level 1 response forms a functional response to routine operational incidents. Deviation from standard procedures or variations within routine operations typically results in a Level 1 response. The response to these events relies on the competencies of involved individuals and relates to range of possible incidents within the operations of an organisation. Typically risk assessments and full investigations are not conducted,
given the low level impact of events. Instead incidents are reported and recorded towards developing awareness of potential issues.

Level 2 responses involve locally managed incidents. This response relates to events outside of the direct capabilities of an impacted element. As a result, the coordination and control of response activities may be escalated to managerial functions. Events related to a Level 2 response are within a range of expected and possible incidents. In certain circumstances response activities may also be linked to first responders. Events are reported through normal communication channels and the response follows an established emergency plan. This plan is then implemented towards achieving a robust and standardised response. Safety and security are primary concerns within response activities. Following the response, a full investigation is conducted towards limiting future re-occurrence and developing operational robustness. Through this the organisation is able to develop and grow from incidents.

If an event exceeds the defined thresholds within an organisational element or is perceived as a significant threat to business objectives, a Level 3 response is activated. This response level involves the use of an organisation's emergency management system. Response activities are specific to the event and coordinated through the formation of a Crisis Management Team. The Crisis Management Team is formed of individuals from senior management positions or areas of necessary expertise.
The final escalation of response is through the use of an organisation’s Crisis management function. Level 4 responses relate to high impact events that threaten the operation and continuity of an organisation on a large scale. A Level 4 response also relates to an organisation’s adjustment to ‘precursor’ events or severe threats which could impact the future operation and performance of the organisation. As such, the organisation may be responding to external events or changes in the operating environment. A Level 4 response is therefore characterised through a significant change and adjustment within an organisation. Through this the response is coordinated through a corporate team or function.

7.3.5. Situational Awareness and Understanding

In order to take a proactive approach towards the management of disruptive events organisations require an astute situational awareness of the influencing factors both internal and external to the organisation. Recognising changes or fluctuations within the operating environment (both internal and external) allows the organisation to take an adaptive approach to potential discontinuities instead of following a primarily reactive perspective following the occurrence of an event. The organisation is then able to adapt its operations and functions accordingly. There is subsequently a continual exchange between the organisation and the external environment, with organisational actors recognising impinging factors and developing an appropriate response through continual adjustment. A detailed knowledge and understanding of the operations and structure of the organisation provides an understanding of the capabilities of the organisations as well as a means of identifying the potential impact and influence of a disruptive event.

7.3.6. Phases of Response

During the initial stages of response, the organisation must identify and inform key individuals and stakeholders about the event. Internal awareness across organisational elements and functions ensures that support and resources are made available. Organisational elements may also be able to offer assistance within response activities. Informing relevant stakeholders and continually providing awareness during response activities ensures stakeholder confidence is maintained. A
thorough understanding of an organisation’s value stream and supply chain allows for the quick identification of stakeholders and potential implications of an event. The perception of stakeholders is essential within an organisation successfully emerging from a disruptive or crisis event. Informing stakeholders as soon as possible following can limit the impact of an event across the entire value stream and supply chain as stakeholders may then implement contingencies of their own. Stakeholders’ may also provide support and resource within response activities.

The Interim Response focuses on addressing the impact of an event and restoring operations and organisational functions. It is through this ‘medium-term’ strategic response that an organisation is able to utilise its inherent resources and capabilities. The developed response strategy begins to mitigate the damage of the event and address the potential cause of the event. The organisation must identify the extent of the impact and identify contingencies within operations. The long-term response strategy focuses on recovery and adjustment.

Within response activities the responsibility within decision making is shifted to higher levels within the organisation. While crisis management is viewed as the strategic positioning of an organisation relative to the demands of its operating environment, decision making within the response to disruptive events follows primarily operational and tactical decision levels. As a result, decision makers must balance immediate needs and requirements against the longer term objectives. While organisations, as shown within the case study organisations, may take a strategic approach towards disruptive events, following the impact of an event, the imposed demands and constraints mean that the organisation must manage each distinct phase within the escalation (development) of a crisis. Organisations must prevent crisis escalation and the potential cascading effect of disruptive events. However, as highlighted within each of the case studies, this may not be a linear process. Disruptive events create complex environments for decision making and it is this complexity and uncertainty that constrains the decision makers’ ability to identify the implications of an event (Long-term impact).
7.3.7. Features of Organisational Systems

As shown within Figure 7-8, an organisational system is composed of several elements and attributes. As such, in addition to an operational understanding of the organisation, it is necessary to clearly establish the criticalities and dependencies within the organisation. Incidents impacting areas or elements of criticality or dependency can carry dramatic and far reaching consequences. Criticalities relate to the importance associated with a particular organisational element. Integral organisational elements through which the organisation’s continued operation and performance are reliant upon forms areas of criticality within an organisation. Dependencies relate to the elements upon which the continued operation of an organisation is reliant. Dependencies may be internal or external to the organisation, and relate to elements within the wider organisational networks (supply chain) and the external environment that are reliant upon the continued operation of the organisation. Incidents affecting or impacting these areas are of vital concern within the organisation as they carry direct implications for the organisation.

![Organisational System Attributes](image)

In addition to the level of criticality and dependency associated with a particular organisational element, it is also necessary to address the connectedness between elements and other organisational components. Understanding how individual...
organisational elements operate independently as well as together is essential in order to assess the potential implications of a threat or risk. An event in one area can often have implications in another or cause a cascading effect throughout the organisation and associated networks.

This is further compounded as certain organisational elements will have vulnerabilities and varying degrees of susceptibility to potentially disruptive events. Achieving a level of commonality and shared understanding between organisational elements and divisions, stands to partially address susceptibility within the organisation. However, developing an understanding of potential vulnerabilities allows organisations to establish the relative risk, susceptibility and resistance of organisational elements to disruptive events and supports an organisation's ability to effectively interpret the demands of an event. Through this organisational actors may be able to develop a response strategy to potential disruptions and events through creating a balance between internal strengths and capabilities and external threats and opportunities. Within the response of the organisation to an event, efforts should focus on addressing areas of criticalities. This is supported by an understanding of potential constraints and limitations within response activities.

### 7.3.8. Nonlinear and Complex Interactions

As a result of these response dynamics the simplistic representation of the impact of a disruptive event presented within Figure 7-1 does not account for the complex interactions between response variables. The response of an organisation to a disruptive event subsequently forms a nonlinear system. A nonlinear system, such as an organisational system facing a disruptive event, is a system where the relationships between time-dependent variables do not satisfy the superposition principle (Thietart and Forgues, 1995). The superposition principle states that within linear systems, the resultant response or output of a variable caused by two or more stimuli is the sum of the responses which would have been caused by each stimulus individually. However, within the response of an organisation there is a deviation from linearity, giving rise to unpredictable changes and interactions within the organisation. The superposition principle is therefore not held. As such, Figure 7-9 presents the key features and
variables within the response of an organisation to a disruptive event. This model identifies the linkages and interaction between organisational response variables.

7.3.9. Crisis Management and Organisational Responses

The response of the organisation is largely predicated on the type of event (Event Characterisation) and the events impact on the organisation (Impact). The classification of the event is therefore a critical stage between the detection of a disruptive or crisis event and the formation of an organisation's response strategy (activation). The crisis management procedures should provide guidelines and criteria for impacted business to assess the event in order to determine the appropriate level of response. Severe events are those that pose a significant threat the safety of employees or impact the continuity of an organisation's operations. In addition to the type of event, the response of the organisation is heavily influenced by where the necessary expertises lie within the organisation. Events outside of the traditional expertise or competencies of a business or division will typically have greater implications for the organisation. Subsequently, understanding the capabilities of an organisation is essential in order to elicit an effective response and minimise the potential impact of an event.

Within the response of the organisation it is essential that the cause of the event be established. The occurrence of a disruptive event can dramatically alter the functional routine and capability of the effected organisation or operational division. Through this, the organisation may no longer be able to operate through traditional channels or processes. In order to respond to the demands of the situation, the organisation is required to introduce novel solutions to potential issues utilising the inherent and available resources within the organisation. These may form temporary solutions until the disruption is resolved or provide an improvement upon previous processes or procedures. Understanding the root cause of an event may also aid in developing appropriate solutions towards the resolution of the event.

Unlike direct threats and identified risk, uncertainty by nature, both within internal and external elements, can never be fully controlled and mitigated. As the operating environment of an organisation becomes increasingly uncertain, possibly through the
influence of external factors, the means for an organisation to effectively reduce risk and take advantage of potential opportunities becomes increasingly important and complex. As such, decision making forms a critical element within crisis management and the proactive response of the organisation to threats and uncertainty.

From the evidence presented within the case study organisations, the tipping point of an organisation falling into crisis can often result from the ineffective management of communication, the failure to exchange information and the inability to prevent the escalation of risks. Subsequently, potential risks and threats cannot be addressed in isolation, but instead require communication, collaboration and cooperation in the adjustment of the organisation to discontinuity. The principles of resilience stand to address these issues within crisis management as the mechanisms of organisational resilience strive to improve an organisation’s situational awareness, reduce organisational vulnerabilities to systemic risk environments and restore efficacy following the events of a disruption (Burnard and Bhamra, 2011).

Across each of the case study organisations, with the exception of Company 2 (E.ON), when asked directly about resilience, respondents typically showed little direct awareness of the concept within the operation of the respective organisations. However, after a brief description of the field of resilience, respondents related resilience to the ability of an organisation to effectively address and manage the impacts of an event. Echoing a strategic approach of an organisation towards ensuring operational continuity during periods of adversity. Through this, the capacity of resilience is found in an organisation’s culture, attributes, capabilities and operating values.
Figure 7-9 - Features of an Organisational Response
In relation to crisis management, resilience relates to an organisation’s ability to:

- Anticipate and understand risks and emerging threats
- Understand the structure and operation of the organisation and its associated organisational networks (supply chain)
- Understand both the direct and indirect impacts of an event on the organisation and its associated infrastructures and networks
- Respond flexibly to adapt to disruptions
- Clear strategic direction within response and recovery activities
- Increased organisational linkages
- Willingness to change and actively seek opportunity for improvement
- Understand organisational interdependencies, vulnerabilities and constraints
- Establish risk thresholds of organisational elements

As shown within Figure 7-9, the response of an organisation to a disruptive event is largely predicated on an organisation understanding the demands of the current situation. Environmental scanning therefore forms a central activity within an organisation’s approach to developing resilience. This is linked to decision makers effectively interpreting the demands and potential impact of an event relative to current state of the organisation; recognising the organisation's criticalities, dependencies and potential vulnerabilities (susceptibility). Monitoring both the internal and external operating environment ensures that the organisation has an intuitive situational understanding and is supported through activities such as environmental scanning and regular organisational performance reviews (monitoring). Recognising the resilience perspective, crisis management forms an iterative process through which the organisation not only responds to events but continually monitors the operating environment and continually adjusts. Crisis management forms a critical element within the strategic approach of an organisation towards addressing disruptions and discontinuities both prior to and following the onset of crisis events. Following the evidence presented within each of case study organisations, in order to take a proactive approach towards crisis management, an organisation is required to develop not only an operational understanding but the
ability to flexibly adapt during turbulent operational conditions. The ability of an organisation to effectively manage the complexity and uncertainty associated within disruptive events is often dependent on an effective decision making process grounded by an understanding of the organisation, its capabilities and the surrounding environment. Through this decision makers are better positioned to understand the potential impact of an event and develop appropriate response strategies relative to the capabilities of the organisation and the available resources.

7.3.10. Leadership and Event Management Teams

Following the detection of an event or possible threat the coordination of response activities and the management of events becomes a largely centralised function. Leadership and management functions typically assume responsibility and ownership for the management of an event. Depending on the nature of the event or the risks that the organisation faces, certain activities may become decentralised across organisational divisions or functions. In regards to the coordination of response activities, leadership functions may defer to areas of expertise within the decision making process. As such, experienced or knowledgeable organisational members may advise event management teams. However, given the dynamic nature of disruptive events, organisational members may be required to assume responsibility for decision making. Within these instances, capturing and reporting information is vital. The organisation may also seek external support. Through this decentralisation the organisation is able to access utilise available experience and expertise towards addressing an event.

Event or crisis management teams are formed in the event of a severe threat or emergency situation. The establishment of a management team provides a clear control system within the response of an organisation. The team is responsible for developing and implementing plans to overcome the impacts of an event and the mitigation of any adverse implications. Utilising prior planning and preparations, the team must develop bespoke strategies within addressing the direct impact of an event and establishing a long-term strategy for returning the organisation to functioning. Following the impact of an event, a diverse range of operational and strategic
objectives and priorities can emerge. Subsequently, the key function of the management team is decision making during periods of adversity. The team is also responsible for facilitating and supporting collaboration between organisational functions and elements. Through this the management team provides a clear focus and direction within response activities. The use of scenario planning sessions can help develop the formation and functions of the management team.

The management team must analyse the situation, establish priorities, ensure the safety of employees, develop a response strategy and protect the reputation of the organisation. As a result, multifunctional event or crisis management teams are formed. The teams are typically composed of individuals from senior management positions. However, specialised individuals may become involved as required. Dependent on the event at hand, team members may vary. Core team members typically include: Chief Executive Officer (CEO) or Site Manager; Head of Departments; Senior EH&S Manager or Business Continuity Manager; Senior Quality Manager; Human Resource Manager; and Communications Officer. The use of senior managers as members of the management team allows for the team have a wide perspective and understanding of the operations of an organisation while maintaining a relatively small and dynamic team. Within the management team, these individuals have clear roles and responsibilities.

Within the management team a team leader is appointed. This is typically the most senior team member (CEO or Site Manager) or individuals that have undergone specific crisis management training. The role of the team leader is to facilitate and coordinate the management team and the development of the response strategy. Although decisions may be deferred to appropriate team members, the team leader provides a central authority within the organisational response.

7.3.11. Decision Making

Although the impact of a disruption will be specific to each organisation, following the evidence gathered across all of the case study organisations, information utilisation and communication form the predominant elements within an organisation’s response to disruptive events or crises. Decision making during periods of adversity is
largely predicated on organisational actors effectively interpreting the demands of the situation and balancing these against the capabilities and resources available. As highlighted by all of the respective case study organisations, the difficulty within decision making during response activities both prior and following an event, lies in creating a balance between short-term (operational), medium-term (tactical) and long-term (strategic) priorities. Short-term priorities focus on addressing the immediate impact of an event, while medium-term priorities lie within ensuring or re-establishing operational continuity. Dependent on the scale of the event and the robustness of organisational elements, the impact of an event, regardless of its characterisation, can create complexity and ambiguity within the operations of an organisation. The change to the organisational environment requires an immediate response while ensuring the strategic position of the organisation is not adversely affected. This trade off is often balanced by the demands and impact of the event, and the position of the organisation. The effective gathering and exchange of information from across an organisation reduces the assumptions made during the decision making process.

Decision making within disruptive events relates to organisational actors ability to ensure that critical success factors are met prior and during disruptive events. The critical success factors of effective management of disruptive events include:

- Capturing information that is required for the mitigation of disruptions prior to events
- Continually learning and developing organisational processes and capabilities
- Flexibility to adapt to circumstances
- Recognition of the importance of risk and crisis management
- Ability to effectively escalate response activities
- Understanding and establishing areas of criticality and dependency

Decisions and the subsequent decision making process is steeped in ambiguity, characterised by risk, uncertainty and operational constraints. The elements that constitute a successful decision are often unclear and relative to a specific element, individual and situation. The issue of decision making during response activities is
further complicated as events do not affect organisations in isolation. The far reaching implications and potential impact of events mean that management activities cannot be carried out through a linear or seemingly rational process. Disruptive events create a complex environments characterised by uncertainty and vulnerability, in addition, activities such as decision making are often constrained by time and resource limitations. Decision making within disruptive or crisis events is therefore an imperfect process.

7.3.12. Resilience Based Approaches

Within the case study organisations, a significant change in the strategic approach of the organisations towards addressing risk and the implications of disruptive events can be seen through a change in focus from robustness to an approach based on resilience. This change may be unconscious or as a response or result of exposure to significant threats or disruptive events. Approaches based on robustness emphasise the prevention of failures and the ability to withstand disruptive events, while the resilience approach is fundamentally based on early detection and effective recovery. As such, the resilience approach is characterised through the adjustment of the organisation. Although the notions of robustness and resilience are inexplicably linked, the change in emphasis moves an organisation from a ‘reactive’ to ‘proactive’ approach within the management of risk and disruptive events.

7.3.13. Organisational Response Strategy

The response of the organisation is largely predicated by the type of event and where the expertise lies within the organisation. Following the occurrence of an unexpected and disruptive event, regardless of scale, a robust local response is required. Organisational actors must look to take an immediate and proactive response, recognising the inherent unpredictability of crises. This is shown within Figure 7-10. At a primary level, this response ensures that an accurate picture of the initial impact of an event can be established.
Establishing the impact of an event is paramount within the development of an appropriate response strategy. Once the initial impact of an event has been established, organisational actors are better positioned to address the level of response required. The level of response is determined by the impact of the event across the areas of criticality and dependency within the organisational network. In order to achieve a robust local response, coordination between first responders (emergency services) and the organisation is required. Direction within response activities and operations is provided through the organisational leadership structure. Within response activities, ensuring the safety of employees and the local community is also a key priority within any event.

During the response of an organisation to a disruption there is an increased exchange of information across the organisation. Information is accessed and exchanged between a variety of sources, including external elements. This is further emphasised when the disruption occurs outside of the competencies and traditional capabilities of an organisation. During such an event effectively seeking information becomes the critical success factor within the response of the organisation. During an event, communication across the organisational network is crucial. Not only is internal communication important within the coordination of response activities, but the organisation but also interact with stakeholders such as customers, suppliers, and other third party elements. Even if an organisation is able to overcome an event,
stakeholder and investor confidence within the management team can be significantly reduced or damaged. As a result, open communication is essential within response activities and operations.

![Organisational Response Strategy](image)

**Figure 7-11 - Organisational Response Strategy**

Fundamentally, the development of an appropriate response strategy, shown within Figure 7-11, involves identifying the impact of the event and actively seeking information (*Analysis*), establishing operational objectives and identifying potential opportunities.

The development of a response strategy involves short-term (*Immediate Response*), medium-term (*Interim Response*) and long-term (*Strategic Response*) considerations. A response strategy forms an integrated and strategic approach towards addressing and overcoming a disruptive event. Following the onset and initial impact of an event, an organisational system is subject to considerable strain and discontinuity. Dependent on the type and scale of an event, a variety of factors may impact an organisational element or system. Short-term response strategies focus on meeting the immediate priorities in the aftermath of an event. The safety of organisational members is critical; and response activities primarily revolve around securing the safety of employees. This may include the evacuation of buildings and facilities in severe instances. Response activities may also include protecting and maintaining critical organisational elements and resources. As such, first responders may be involved within response activities.

### 7.4. Organisational Capabilities

The following section outlines the features of identified organisational capabilities across the case study organisations. Organisational capabilities are defined as an
organisation’s capacity to develop and deploy its assets in order to improve the performance of the organisation or perform a specific activity (Maritan, 2001). Organisational capabilities therefore refer to the attributes that enable or support an organisation’s ability to coordinate and effectively utilise available resources and assets (Barney, 1995). Through this organisational capabilities result from a combination of organisational resources, routines and interactions (Grant, 1991).

Within the case study organisations, capabilities are outlined in relation to the adaption or response of the organisation to a threat, disruption or change event. Capabilities thereby refer to both tangible and intangible resources, as well as areas of strength (or advantage), skill and experience. While developed organisational competencies refer to operationalised or embedded capabilities. These competencies may then provide an organisation a competitive advantage over competitors (Mills et al, 1995)

The identified organisational capabilities are focused on a specific purpose towards the performance of the organisation during periods of adversity and support the development of an organisation’s adaptive capacity. The features of each organisational capability are outlined within Appendix G. Following the evidence of organisational survey and case studies, the identified organisational capabilities can be broadly characterised through four distinct groups. These include: Adaptive Capabilities; Strategic Capabilities; Operational Capabilities; and Organisational Development Capabilities. However, it is important to note that capabilities will develop over time.

7.4.1. Adaptive Capabilities

Adaptive Capabilities relate to an organisation’s capacity to respond to changes or alterations in the organisation’s operating environment. This response may be the result of either internal or external events. The identified capabilities, Flexibility, Resourcefulness and Creativity, relate to an organisation’s ability to identify demands, develop solutions, adapt operations and provide continued support for organisational elements. These capabilities relate to the capacity of both organisational elements and organisational members (human resource). In relation to the response of an
organisation, these capabilities support an organisation’s ability to develop and implement adaptive solutions towards addressing potential discontinuities and uncertainty.

Developing flexibility within organisational elements allows the organisation to react quickly to operational fluctuations and changes. This includes both operational and behavioural adjustments. Flexibility thereby involves developing adaptability within operational, structural and strategic organisational elements and processes. Through this flexibility relates to an organisational element’s ability to support change and forms a key element within organisational performance during periods of turbulence and adversity.

Resourcefulness relates to an organisation’s ability to meet situational demands and operate effectively during periods of adversity. Resourcefulness relates primarily to the capacity of organisational members. Following the impact of an event, organisational elements are required to effectively utilise the available resources. Organisational structures and operations may all be affected or altered following an event. As a result, cultivating elements of resourcefulness supports an organisation’s ability to meet objectives during these periods of discontinuity.

Creativity is central within the planning and containment of an event as an organisation must often develop multiple contingencies. The ability to develop unique solutions in the face of disruption and discontinuity is an important feature of resilience within an organisation. As a result, creativity supports problem solving and decision making during periods of adversity. Prior to the onset of an event, creativity is linked to elements of innovation within an organisation. Innovation and creativity are also important capabilities within addressing the challenges and constraints imposed by a disruptive event. Developing these capabilities supports an organisation’s ability to develop new ways of working or structuring operations during periods of adversity. Developing solutions and applying processes and available resources to new situations where required.
7.4.2. Strategic Capabilities

Strategic capabilities broadly relate to an organisation’s ability to deliver a strategy. These capabilities support and organisation’s capacity to function and perform as intended. Strategic Capabilities are focused on providing a sustained and continued long-term performance for an organisation. These capabilities relate to Robustness, Leadership, Decision Making and Situational Awareness. In relation to the response of an organisation, these capabilities relate broadly to the management of risk and uncertainty.

Robustness relates to the ability of organisational elements to ‘absorb’ or ‘withstand’ the impact of certain disruptions. Robustness involves the prevention of failure within an organisational system and the development of rigour within processes and procedures. As a result, following the impact of an event, robustness supports an organisation’s ability to contain or limit the impact.

Capabilities and established competencies within leadership are essential within the operation of an organisation. Leadership provides clear strategic direction within an organisation’s operations and facilitates an effective response to disruptive events. Following the impact of an event, leadership forms the central authority within the development and coordination of response activities.

Decision making forms a critical junction within the response of an organisation to a potential threat. Decision making involves analysing information and utilising knowledge in order to resolve problems or issues. Through this, capabilities related to decision making rely on an embedded understanding of the organisation’s structure and value stream, as well as an ability to recognise impinging risk factors and influencing elements.

Situational awareness forms a continual process, through which an organisation develops an understanding of organisational elements of both internal and external factors. A situational awareness thereby relates to the perception and understanding of an organisation and the surrounding environment. Developing this capability within organisational elements, allows for potential event indicators or ‘warning signs’ to be
recognised or the identification of potential opportunities. An improved situational awareness also provides a foundation for effective decision making.

7.4.3. Operational Capabilities

Operational Capabilities relate to the organisational features and attributes that support and maintain an organisation’s ability to operate as intended. As such, these capabilities support the operational capacity and functioning of the organisational system. Organisational Development Capabilities are focused towards improving or developing organisational effectiveness. These capabilities relate to Efficiency, Diversity, Operational Capacity, Redundancy and Rapidity. Fundamentally, these capabilities are rooted within the development of the human resource and management of innovation within an organisation. In relation to the response of an organisation, these capabilities relate to an organisation’s capacity to restore operation.

7.4.4. Organisational Development Capabilities

Organisational Development Capabilities or Developmental Capabilities support the capacity of an organisation to seek opportunities for improvement. Organisational Development Capabilities relate to the development of the human resource and innovation within an organisation. As such, these capabilities involve knowledge creation and problem solving. These capabilities relate to Employee Development, Strength of Staff and Innovation. In relation to the response of an organisation, Organisation Development Capabilities relate to the capacity of employees and the organisation’s approach to capturing opportunities for improvement. Capabilities such as innovation also provide a significant source of competitive advantage as well as supporting the growth and development of an organisation.

7.5. Cross-case Causal Diagram/Network

The following section details the development of the Cross-case Causal Network. The development of this network forms a comparative analysis between each of the individual case study organisations. The resulting network outlines the most influential variables in relation to the response of an organisation. This cross-case
analysis is based on the previously proposed conceptual model for the resilient response of an organisation. The cross-case causal network, presented within Figure 7-12, is composed of 69 identified nodes. These nodes represent both dependent and independent variables within the response of an organisation to a disruptive event.
Cross-Case Analysis

Figure 7-12 - Cross-case Causal Network
7.5.1. General Findings and Application

Following the development of the Cross-Case Causal Network (Figure 7-12), the following sections detail the general findings and applications.

7.5.1.1. Nature Disruptive Events

_Disruptive events carry both internal and external implications, as well as potential organisational opportunities._

Events may be either disruptive in nature, or present organisational opportunities. As a result, events may pose a diverse set of challenges and restrictions for an organisation. These risks, threats and impacts may be either internal or external to the organisation. Events may carry business, operational, market and political impacts and implications. An organisation’s ability to overcome these impacts or take advantage of opportunities is dependent on the capacity to adapt and effectively address risk factors. Organisations are required to develop and establish systems for addressing risk and the management of disruptive events. These systems provide a common platform to address risk across an organisational network, supported by an organisation’s ability to the transfer and exchange information. As a result, the developed causal network recognises both the response of an organisation to disruptive events, as well as the adjustment or ‘proactive response’ of an organisation.

Events may also carry both internal and external implications. As a result, events impacting an organisation, particularly within the context of critical infrastructure, may also carry national implications. Following the impact of an event, significant limitations may be placed on the functioning and operations of an organisation. Internally, disruptive events may impact organisational priorities and objectives within the operation and performance of an organisation; restricting the organisation’s ability to perform or function as intended. Externally, events may result in supply chain disruptions or the loss of essential services. The tolerance (threshold) of organisational elements, areas of criticality, organisational dependencies and vulnerabilities are large determinants within the eventual impact of an event. These organisational features relate to the robustness of the organisational system. As a
result, establishing these organisational features is an important feature within the characterisation of an event and the level of response followed.

7.5.1.2. Risk Management

*Central to the management of risk is establishing operational and risk thresholds within organisational elements.*

Operational and Risk thresholds outline the capacity and tolerance (boundaries) of organisational elements; this is in turn linked to the value chain of the organisation. Operational thresholds set the capacity and capabilities of individual organisational elements. While the risk threshold identifies the parameters of acceptable risk and sets the boundary beyond which additional risk can no longer be tolerated. A risk profile of organisational elements may also be developed which outlines all characterised and known risk factors and threats. These thresholds and tolerances are linked to areas of criticality, dependency and vulnerability. This information is crucial within decision making and the coordination of response activities; understanding the capacity and capability of individual organisational elements. Additionally, established thresholds provide an element of monitoring and ‘early warning’ within the organisational network.

7.5.1.3. Detection of Events and Impacts

*In order to take a proactive approach to the management of disruptive events, organisations need to develop an embedded system to recognise change.*

Environmental scanning and monitoring forms an important aspect of the detection of disruptive events. Through this the organisation is able to adjust or adapt prior to the full impact of an event. Established communication networks allows for the effective exchange of information both internally and externally. Communication forms the central mechanism within the behaviour of the organisation during disruptive events. Communication and the effective exchange of information is the primary challenge within the response to a disruptive event.

The capacity of an organisation to elicit a proactive organisational response or mitigate any potential events or threats is limited due to the difficulty within
predicting or quantifying the potential impact of an event. In the immediate aftermath of an event, there is limited information available in relation to the impacts of the event. As a result, initial activities within the activation of a response relates to gathering and exchanging information across the organisation. Established communication networks and reporting hierarchies support the organisation's ability to transfer information and data. However, this exchange of information can generate large amounts of inaccurate or misleading information. Management functions are then required to rationalise this information and develop appropriate plans. As a result, management functions often strive to gain direct visibility of the impacts of an event. Through understanding the organisation’s value chain and established response protocols, the organisation is then able to begin to address the event. During this period, it is also important that the organisation inform any potentially impacted stakeholders.

7.5.1.4. Activation of Response

*Initial response activities are typically linked to established response procedures and protocols within an organisation.*

During the activation of response, initial local response activities may be initiated following the immediate impact of an event. Initial priorities following the impact of an event relate to the safety and security of employees and facilities. Securing the site following the detection of an event stands to limit the potential impact and help support the control of response activities. Although safety and security may not be direct considerations within all events, physical impacts such as fire, flooding, security threats (terrorism) or machine failures can pose a significant threat. As such, securing the site and suspending operations supports an organisation’s ability to respond effectively. Simplifying the direct considerations within the management of an event.

The response of the organisation is further complicated as disruptive events result from unique combinations of risks and threats. This limits the ability of organisational elements to follow pre-defined response procedures. The threats and risks presented within disruptive events are defined by uncertainty and may carry significant long-term implications. As a result, the management of disruptive events often requires the
development of specific plans which in turn can be adapted as response activities progress. Prior planning and preparation provides an embedded framework to structure and support response activities. This is reflected in established protocols related to the formation of an event management team. However, it is important that an organisation recognise the limitations within this planning.

Established emergency procedures and crisis management plans provide a standard template and outline the critical stages of response. These plans provide a formalised structure for the development of event specific planning. The organisation’s emergency procedures and crisis management plans outline the priorities, roles and responsibilities within response activities. Dependent of the characterisation of an event, varying levels of response may be enacted. These levels of response are linked to areas of expertise within the organisation, such as incident management teams or dedicated corporate crisis management functions.

7.5.1.5. Priorities within Response

Central to all response activities is providing an immediate and localised response.

Ensuring the safety and security of employees and the local environment is of paramount concern. The ability of the organisation to escalate response activities through established levels of response provides a robust response to disruptive events. The organisation is then able to access specialised skills and knowledge or even defer decision making to areas of expertise within response activities. Leadership function assumes responsibility within the ownership and coordination of response activities. Established management teams are subsequently linked to the classification of an event. As such, control and coordination become centralised activities within the response of an organisation. However, specific decisions may be deferred to areas of expertise.

Following the impact of an event, the organisation must begin to establish both internal and external connections. These linkages provide a temporary structure within the organisation to support the exchange of information and resources across the organisation. Additionally, in order to support the response of an organisation, organisational elements and businesses should be connected to local responders and
national response infrastructures. Through this an organisation is not isolated within addressing the impact of an event. Responders are able to provide immediate support within response operations. Responders are primarily concerned with addressing the physical impact of an event, such as employee safety, medical concerns, fire, environmental safety, or security threats. Linking response procedures and protocols to local responders ensures an efficient response in the event of an incident.

7.5.1.6. Features of Response

Disruptive and crisis events require the development of rational, specific and focused response activities.

The response of the organisation to the impacts of an event is characterised through four distinct nodes: Response Strategy; Countermeasures; Containment; and Stabilisation. These nodes relate to the development of specific response plans, as well as the implementation of controls and activities towards restoring the operation of the organisation. The development of a response strategy outlines an adaptable course of action that the organisation will follow. A Response Strategy should outline short, medium and long term plans and priorities. Following this strategy, a number of event countermeasures or controls are developed towards addressing the impact of an event. Countermeasures relate to the short-term response strategy priorities within the immediate response of an organisation and support containment activities. Countermeasures begin to address the impact of an event, as the organisation is able to link resources to response activities.

Containment and Stabilisation relate to the tactical decisions made during the management of a disruptive event. As such, these nodes relate to the medium-term priorities within an organisational response strategy. After ensuring the safety and security of an organisation, these priorities focus on establishing operational continuity. Dependent on the type of event, initial response activities may have resulted in the suspension of certain operations. Through establishing appropriate controls, certain operations may be restored; although possibly only within a limited capacity.
Containment fundamentally relates to limiting and controlling the impact and spread of an event. Minimising any further impact on organisational elements and restricting the potential escalation of an event. Effective containment is based on an accurate assessment of the impacts of an event and establishing organisational linkages. Containment operations are supported by prior preparations and procedures related to risk management and established contingencies. Containment activities focus on mitigating any effects of an event and establishing a monitoring system within impacted areas. This involves establishing controls and thresholds to ensure the resolution of an event.

Stabilisation activities relate to restoring function to impacted operations and processes. Following the impacts and alterations to the structure of an organisation, reorganisation and restructuring may be required. Alternative structures and configurations may emerge as a result of the impacts of an event or subsequent response activities. Effort must be placed on re-establishing organisational linkages and if appropriate formalising emergent connections. During this stage, a review and investigation into the event may be conducted to support recovery operations. This investigation identifies the impacts of an event and the resultant outcomes of response activities. An evaluation of response activities also ensures that robust controls have been implemented. If the event or the associated impacts have not been effectively addressed or an event escalates further, once recognised, response activities may be re-initiated.

7.5.1.7. Recovery from an Event

Key considerations within recovery from an event relates to the strategic position of an organisation and addressing the long-term implications of the event and the associated impacts.

Long-term strategic planning relates to the recovery of an organisation. Recovery is the final stage within the response of an organisation to a disruptive event and relates to restoring the organisation to full operation and performance. A key element within this is identifying learnings and improvements towards the development of the organisation. Learnings from an event not only improve future preparations but also
help develop robustness within organisational elements. In the immediate aftermath of an event, organisational priorities revolve around ensuring the safety and security of organisational members and elements. Within the stages of recovery, organisational priorities focus on ensuring operational continuity and the long-term survival of the organisation.

Events such as supply chain disruptions, impacts to national infrastructures, economic instability, damaged facilities, natural disasters and terror attacks all carry significant long-term implications for organisations. As a result, organisations are required to develop a strategic plan towards addressing long-term performance. The development of this plan is supported by prior preparations such as business interruption and business continuity planning. Forecasting is also an important aspect within restoring the long-term performance of an organisation.

7.6. Conclusions and Implications

Following the cross-case analysis of the organisational case studies, several implications can be raised. These relate to the nature of disruptive events, the response of an organisation and the influence of resilience.

Disruptive events pose a complex threat to the operations of an organisation. These events are characterised by uncertainty and unpredictability, and present a diverse range of implications; including both operational and functional constraints. As such, disruptive and crisis events present dynamic situations that carry the distinct possibility of escalating impacts. A proactive response is determined by an organisation’s ability to effectively recognise change through an embedded situational awareness. Following the evidence of the case studies, three types or categories of event were identified. Type 1 events relate to routine operational incidents and are addressed through elements of robustness within an organisation. Type 2 events are ‘planned’ or ‘expected’ with a range of severe incidents, while Type 3 events are relatively ‘unplanned’. Type 2 and Type 3 events therefore pose a more severe threat and are therefore addressed through elements of resilience.

Within the response and adjustment of an organisation to disruptive events, several response activities run concurrently. Information utilisation and communication are
central mechanisms within the effective response of an organisation. These activities form the foundation for development and coordination of operations and response activities. Effective decision making is key within an organisation achieving critical success factors in response to an event. Additionally, given the nature of disruptive events, robust responses require the ability to escalate responses and controls where necessary. As a result, four levels of response were identified.

A Level 1 response is the lowest level response and as such is associated within low impact and minor scale events. A Level 1 response forms a functional response to routine operational incidents. Level 2 responses involve locally managed incidents. Level 2 response are within a range of expected and possible incidents. A Level 3 involves the use of an organisation's emergency management system. Response activities are specific to the event and coordinated through the formation of a Crisis Management Team. Level 4 responses relate to high impact events that threaten the operation and continuity of an organisation on a large scale. A Level 4 response also relates to an organisation's adjustment to ‘precursor’ events or severe threats which could impact the future operation and performance of the organisation.

Resilience provides a dynamic view of organisational performance and competitiveness. Recognising the non-linear interactions and exchanges between organisational elements and external factors (environmental factors, competitors, customers, etc.). Through this resilience provides a different approach to change, in which organisations seek opportunities for improvement and development rather than stability.

7.7. Summary

The chapter presents a cross-case analysis between each of the participating organisations. Through this comparative analysis the features of resilience in relation to readiness and preparation, response and adaption, recovery and adjustment are discussed for each organisation. The influencing factors and supporting organisational capabilities are then identified and discussed. Following this analysis, a cross-case causal network for the response of an organisation is presented.
Chapter 8 - Research Output and Discussion

8.1. Introduction

The first five chapters provided the theoretical and methodological frameworks necessary for the development of individual case analyses within Chapter 6. Utilising the factors identified within previous chapters, Chapter 7 outlines the key findings of the research and presents a cross-case comparison in order to develop a causal network for organisation responses. This chapter presents a discussion related to the findings of the Organisational Resilience Survey and the development of the generalised (cross-case) causal network. The chapter also presents key concepts from literature related to the development of this network. The implications and limitations of the causal network are also outlined. This chapter addresses the research objectives RO1 and RO4 (presented within Chapter 1, section 1.3).

8.2. Organisational Resilience Survey

Although the Organisational Resilience Survey was only conducted across a relatively small sample size, 117 respondents across 39 organisations, there are several implications for both organisational responses and resilience that can be inferred from the results. From the evidence of the statistical analysis it is clear that resilience resides across both individual and organisational levels, including structures, resources and attributes. This creates a broad concept related to issues such as risk, threats, adaption and vulnerability. Given the exploratory nature of the developed survey, these areas are explored further through the organisational case studies.

The statistical analysis indicates that an organisation’s ability to effectively interpret demands during an event is paramount within establishing a ‘proactive’ or ‘resilient’ response (ORS2). The ability of an organisation to take this proactive approach towards addressing environmental or operational fluctuations is supported by an improved situational awareness of both internal and external influences (RES2). This improved level of awareness is largely predicated on establishing organisational capabilities towards a strategic approach (OCS1). This is reflected by the Bivariate correlation analysis which indicates a significant correlation between the factors RES2
and OCS1. Additionally, although less statistically significant (r(117)= 0.392, p < .001), the ability to interpret demands is also linked to employee development (RES1). Through this the organisation is able to cultivate a broad range of potential competencies within its employees that it is then able to draw upon when required.

Following the onset of an event, response activities are supported by effective decision making processes linked to an organisation’s ability to utilise inherent organisational strengths and resources (ORS1). During decision making there is an increased information exchange from across the organisation. This exchange aids in reducing both the ambiguity and uncertainty that surround disruptive events and supports the organisation in effectively understanding and addressing the impact of the event.

**8.2.1. Case Study Organisations Factor Scores**

Following the analysis of the organisational survey an exploratory factor analysis was conducted. Following this analysis, twelve factors across the three survey scales (RES, ORS, OCS) were extracted. The factor analysis produces factor loadings which indicate the correlation of a variable (survey item) with an extracted factor. This analysis is presented within Chapter 6. Additionally, the factor analysis also produces factor scores for each subject relative to the extracted factors. Factor scores are calculated by multiplying the standardised values of each variable by the corresponding factor loading. This produces a set of standardised factor score for each scale on each participant (Ward *et al*, 1995). As such, the factor score represents the degree to which an individual scores highly on the group of items that have high loadings on a particular factor. The factor scores are standardised to have a mean of 0 and a standard deviation of 1.

For each of the four case study organisations, the factor scores for each extracted factor within each of the survey scales is displayed within a respective radar chart. The displayed factor scores are standardised in which a value of 0 indicates an intermediate loading, which a value of 1 and -1 indicate either strongly positive or negative loading. The factor scores represent the standardised values of involved participants perception of items relative to each extracted factor. As such, the use of
factor scores is not an absolute assessment of the features of organisational resilience. However, the factor loadings highlight perceived areas of strength within the organisations relative to the extracted factors.

**Table 8-1 - Organisational Resilience Scale Factor Scores**

<table>
<thead>
<tr>
<th></th>
<th>RES1</th>
<th>RES2</th>
<th>RES3</th>
<th>RES4</th>
<th>RES5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employee Development</td>
<td>3M</td>
<td>0.359</td>
<td>0.271</td>
<td>0.322</td>
<td>0.253</td>
</tr>
<tr>
<td>Situational Awareness</td>
<td>ABB</td>
<td>0.443</td>
<td>0.173</td>
<td>0.393</td>
<td>0.121</td>
</tr>
<tr>
<td>Adaptability</td>
<td>E.ON</td>
<td>0.599</td>
<td>0.671</td>
<td>0.422</td>
<td>0.682</td>
</tr>
<tr>
<td>Shared Understanding</td>
<td>UAM</td>
<td>0.147</td>
<td>-0.028</td>
<td>0.230</td>
<td>0.264</td>
</tr>
<tr>
<td>Organisational Learning and Development</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Across the case study organisations the majority of factor scores indicate an intermediate loading (around 0) across each of the survey scales. Few factors indicate either a strong positive or negative loading. Within the Resilience Scale (RES), all of the organisations showed a slight propensity towards the factor RES3. This factor represents items related towards adaptability (RES3) and an organisation’s ability to effectively adjust to changes and fluctuations within its respective operating environment or market. This loading highlights the importance placed by senior management on an organisation’s ability to adapt in relation to change and discontinuity. Adaptability emphasises reliability and the capacity of an organisation to tolerate and recover from the impact of an event.

The factor scores for 3M and UAM were equally balanced across each of the Resilience Scale factors. While the factor scores for 3M were subtly higher, the factor scores suggest an intermediate loading between factors. Suggesting that equal importance and emphasis is placed on each of the identified resilience factors. The factor scores for ABB indicate an investment within employee development across the organisation. Within E.ON, the factor scores indicate a significant loading onto the factors RES2 and RES4. These factors represent items related to an increased situational awareness and developing a shared understanding across the organisation.
Table 8-2 - Organisational Response Scale Factor Scores

<table>
<thead>
<tr>
<th>ORS</th>
<th>Decision Supported by Expertise and Strengths</th>
<th>Interpret Demands and Information</th>
<th>Develop Effective Solutions</th>
<th>Established Prior Preparations</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORS1</td>
<td>0.289</td>
<td>0.311</td>
<td>0.331</td>
<td>0.479</td>
</tr>
<tr>
<td>ORS2</td>
<td>0.173</td>
<td>0.141</td>
<td>0.241</td>
<td>0.475</td>
</tr>
<tr>
<td>ORS3</td>
<td>0.633</td>
<td>0.678</td>
<td>0.454</td>
<td>0.733</td>
</tr>
<tr>
<td>ORS4</td>
<td>0.07675</td>
<td>0.050652</td>
<td>0.177539</td>
<td>0.240773</td>
</tr>
</tbody>
</table>

Figure 8-1 – RES Factor Scores
Across the Organisational Response Scale, each of the organisations’ factor scores loaded highest on the factor ORS4. This factor is composed of items related to established prior preparations within an organisation. The most significant of these factor score loadings was that of E.ON with a loading of 0.73. While both 3M and ABB had slightly lower loadings around 0.47. The factor ORS2, related to the development of effective solutions, also had a slightly higher loading across each organisation. This factor involves an organisation’s ability to develop alternative ideas and provide effective solutions to identified issues and threats. This is further supported by
effective risk management within the organisation. As such this factor relates to an organisation’s ability to reduce the magnitude and probability of a threat or risk factor and support the organisation’s ability to respond effectively to these possible events.

Table 8.3 - Organisation Capability Scale Factor Scores

<table>
<thead>
<tr>
<th>OCS</th>
<th>Strategic Approach</th>
<th>Flexible Response</th>
<th>Development</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OCS1</td>
<td>OCS2</td>
<td>OCS3</td>
</tr>
<tr>
<td>3M</td>
<td>0.290</td>
<td>0.236</td>
<td>0.257</td>
</tr>
<tr>
<td>ABB</td>
<td>0.043</td>
<td>0.213</td>
<td>0.154</td>
</tr>
<tr>
<td>E.ON</td>
<td>0.565</td>
<td>0.454</td>
<td>0.545</td>
</tr>
<tr>
<td>UAM</td>
<td>-0.050</td>
<td>0.131</td>
<td>0.210</td>
</tr>
</tbody>
</table>

Within the Organisational Capability Scale, all of the organisations indicate a positive propensity towards the factor OCS3. This factor relates to organisational capabilities
related to the development of an organisation. This involves organisational capabilities focused towards performance development and operational effectiveness. UAM showed a slight negative loading onto OCS1, however the loading (-0.050) is not considered significant. Typically the factor loadings are spread equally across the three extracted factors for each of the organisations. This loading suggests that organisations create a balance between the three extracted factors in relation to organisational resilience. Different factors and the associated organisational capabilities are then utilised at different periods within the response of an organisation.

8.2.2. Survey Findings and Implications

Following the factor score analysis for each of the case study organisations, the results indicate that organisations may approach resilience and the response of the organisation through the development of specific factors or through creating a balance between various factors. In relation to the response of the organisations’ to an event (ORS, OCS), the factor scores indicate that each organisation places equal importance across each factor. Given the complexities and uncertainty associated within disruptive events, the results suggest the development of a holistic approach towards addressing the impact of an event. Organisations are required to balance interpretation, planning, decision making and available resources within response activities and operations. As such, factor scores related to organisational capabilities are also balanced across each of the extracted factors.

However, the approach of each organisation towards resilience, as reflected by the factor scores for the Organisational Resilience Scale (RES), is subtly different. Each organisation highlights a different area of strength or focus in relation to the development of resilience. From the results, it is suggested that 3M creates a balance between each of the five identified factors. ABB focus on employee development within the organisation, as highlighted by the factor score loading of 0.44. Through this, resilience and the response of the organisation is achieved through the capabilities and competency of employees. Focus is placed on the development of the human resource within the organisation. E.ON focus on a more strategic approach
towards resilience. This is achieved through the development of an improved situational awareness and understanding within the organisation; addressing both internal and external factors. This supports the organisation’s ability to take a proactive approach within the management and mitigation of risks and threats. Within UAM emphasis is placed on the development of adaptability, a shared understanding and organisational learning and development. Through this resilience is developed through continual development and flexibility within the organisation.

8.3. Generalised Causal Diagram/Network

Based on the evidence from each of the organisational case studies, the following section details the development of the generalised causal network. Presented within Figure 8-4, the developed causal network outlines the central nodes within the response of an organisation to a threat or disruptive event. Developed from the grounded theory coding process, the network identifies both the dependent (Table 8-4) and independent (Table 8-5) variables involved within the resilient response of an organisation.

The developed network represents a refined causal network to those presented within previous chapters. Utilising the previously discussed conceptual framework of a resilient response (Chapter 4, Section 4.2), causal networks were developed for each case study organisation in order to identify the independent (cause) and dependent (effect) variables within a resilient response. The causal networks provide a graphical representation and understanding of 1) the key organisation features related to resilience; 2) the antecedent and process variables (factors); 3) the interaction between organisational variables; 4) the critical stages within the response to disruptive events; 5) how the mechanisms’ of resilience facilitate the response of an organisation; and 6) the underlying mechanisms within cognitive processes.

The generalised causal network provides an adaptable framework to illustrate the key features and elements within the response of an organisation. Conceptually, the developed network outlines the key concepts and constructs related to resilience within the response of an organisation. The empirically derived linkages between
identified nodes thereby provide both a theoretical and conceptual insight into the response process of an organisation and the associated antecedent variables.

The developed causal network extends the previously published work of Staw et al (1981), Barnett and Pratt (2000), Sutcliffe and Vogus (2003) and Powley (2009), drawing specific attention to the features of *Detection, Activation* and *Response*. The resulting network highlights an organisation’s ability to not only absorb disturbances (Engineering Resilience) but also adapt and respond effectively to threats and change (Ecological Resilience). This is shown through the nodes of *Adjustment* (Node (5)) and *Response* (Node (6)). Through this the network acknowledges both the ‘positive’ and ‘negative’ adjustment of an organisation (Sutcliffe and Vogus, 2003), and presents the response of an organisation as a dynamic process rather than a linear chain of events. The developed causal network also conceptualises organisational learning and development following the response of an organisation to an event. These concepts are central elements within the resilience discourse; recognising that resilience is more than an abstract concept related to an organisation’s ability to restore efficacy.

Using the developed causal network as an analytical tool, organisations and practitioners can better understand and structure response preparations and activities. The generalised causal network outlines the key nodes or features within the response of an organisation to identified threats and spontaneous events; identifying the underlying mechanisms and linkages between response activities. Using the generalised causal network as a lens, organisations can then review response planning and preparations within key areas. Through this, the developed causal network provides a structured approach within identifying areas of improvement and aligning organisational processes and capabilities within response activities.

### 8.3.1. Causal Network and Response Variables

The presented causal network, Figure 8-4, highlights the decision making process within the management of disruptive events and draws specific attention to the elements of resilience related to the response of an organisation. Within the model, the phases of *detection* and *activation* form the critical junction in the response of an
organisation to potential events. The resilience perspective within crisis management promotes an active engagement within the monitoring of both internal and external environmental feedbacks. Through this an organisation is able to continually adjust to operational fluctuations, while actively developing organisational attributes towards the response of the organisation to potential larger scale events. This is highlighted within the developed decision making model through the phases of *adjustment* and *environmental scanning/monitoring*. The causal network is not an analytical solution, but is instead a representation of the dependent and independent variables involved within the response of an organisation and the relationships between them. Through this the causal network provides a framework and rational to support decision making; identifying the critical elements within the response of an organisation.

Table 8-4 - Causal Network Dependent Variables

<table>
<thead>
<tr>
<th>Node/Variable</th>
<th>Linkage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact (2)</td>
<td>(1) (3) (16)</td>
<td>- The resultant effect of an event or threat</td>
</tr>
<tr>
<td>Detection (3)</td>
<td>(2) (4) (10) (11)</td>
<td>- The active process through which the determinants or impacts of an event are recognised</td>
</tr>
<tr>
<td></td>
<td>(12) (13) (16)</td>
<td></td>
</tr>
<tr>
<td>Activation (4)</td>
<td>(3) (5) (6) (15) (16)</td>
<td>- The process forming the initial stages of response.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Elements begin to deploy response protocols and available resources within the organisational system</td>
</tr>
<tr>
<td>Adjustment (5)</td>
<td>(4) (7) (9)</td>
<td>- The alteration or change to organisational function or processes in response to an event or threat</td>
</tr>
<tr>
<td>Response (6)</td>
<td>(4) (7) (17) (18) (19)</td>
<td>- The behaviour due to an internal or external stimulus</td>
</tr>
<tr>
<td></td>
<td>(20) (21)</td>
<td></td>
</tr>
<tr>
<td>Outcome (7)</td>
<td>(5) (6) (8) (22)</td>
<td>- The result of response activities</td>
</tr>
<tr>
<td>Organisational Development (9)</td>
<td>(5) (8) (10) (14)</td>
<td>- The implementation of learning and improvement following the response of an organisation</td>
</tr>
<tr>
<td>Environmental Scanning/Monitoring (10)</td>
<td>(3) (9)</td>
<td>- Process through which an organisation monitors both the internal and external environment</td>
</tr>
</tbody>
</table>
### Table 8.5 - Causal Network Independent Variables

<table>
<thead>
<tr>
<th>Node/Variable</th>
<th>Linkage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event (1)</td>
<td>(2)</td>
<td>- An incident or combination of risk factors</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Events may be internal or external to an organisation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Events may carry both negative implications or opportunities</td>
</tr>
<tr>
<td>Evaluation (8)</td>
<td>(7) (9)</td>
<td>- Assessment of response activities and determinants related to an event or threat</td>
</tr>
<tr>
<td>Criticalities (11)</td>
<td>(3)</td>
<td>- The importance associated with a particular organisational element</td>
</tr>
<tr>
<td>Dependencies (12)</td>
<td>(3)</td>
<td>- Elements upon which the continued operation of an organisation is reliant</td>
</tr>
<tr>
<td>Vulnerabilities (13)</td>
<td>(3)</td>
<td>- Susceptibility and resistance of organisational elements</td>
</tr>
<tr>
<td>Organisational Capabilities</td>
<td>(9) (15)</td>
<td>- The ability and capacity of an organisation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Organisational features and attributes that allow an organisation to achieve objectives</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Attributes supporting the competitiveness of an organisation</td>
</tr>
<tr>
<td>Available Resource (15)</td>
<td>(4) (14)</td>
<td>- Financial Resources</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Human Resources</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Information Resources</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Physical Resources (Operational)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Intangible Resources</td>
</tr>
<tr>
<td>Establish Implications (16)</td>
<td>(3) (4) (17)</td>
<td>- Identifying the impacts and effects of an event on individual organisational elements</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Provide an assessment of potential long-term impacts</td>
</tr>
<tr>
<td>Event Characteristics (17)</td>
<td>(6) (16) (18)</td>
<td>- The attributes or determinants of an event</td>
</tr>
<tr>
<td>Local Response (18)</td>
<td>(6) (17)</td>
<td>- Need to provide robust response at source or site of impact</td>
</tr>
<tr>
<td>Gather Information (19)</td>
<td>(6) (22)</td>
<td>- Collect and centralise available information and data pertinent to the event and response activities</td>
</tr>
<tr>
<td>Monitor (20)</td>
<td>(6) (22)</td>
<td>- Process through which the organisation monitors response activities and event implications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Thresholds and controls are set</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Identify any related incidents and events external to the organisation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Identify any outstanding or reoccurring issues or incidents</td>
</tr>
<tr>
<td>Analysis (21)</td>
<td>(6) (22)</td>
<td>- Evaluation and review of event and response activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Investigation into event</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Identify learnings and improvements</td>
</tr>
</tbody>
</table>
| Response Strategy (22) | (7) (19) (20) (21) | - Outlines specific approach that will be following within response activities  
- Utilises prior preparations  
- Specific to an event and impacts  
- Outlines short, medium and long-term plans and objectives |
Figure 8.4 - Resilient Response Causal Network
8.3.2. Elements of Response

The following section details the elements identified within the causal network (Figure 8-4) in relation to the response and adjustment of an organisation. From the evidence of the individual case studies and the cross-case comparison the resilient response of an organisation is characterised through several key features. Fundamentally, the resilient response of an organisation relates to an organisation’s ability to effectively address the impact of an event, mitigate risks, restore function and develop organisational robustness. As reflected within the developed causal network, the key features of a resilient response thereby include:

- Ability to interpret environmental fluctuations and impending threats – Node (3), (10)
- Understanding of internal organisational structures, operations, procedures and capabilities – Node (14)
- Effectively identifying event impacts and implications – Node (2), (16)
- Ability to provide robust local responses – Node (18)
- Ability to escalate response activities and controls – Node (6)
- Capacity to alter function and develop temporary structures (establish linkages) – Node (6)
- Link response activities and operations to preparations and resources – Node (4), (15)
- Establish an event specific response strategy – Node (22)
- Capacity to develop and learn from experiences – Node (8), (9)

8.3.2.1. Internal and External Awareness

Internal and external awareness is essential within eliciting an effective response. In addition to the determinants of an event, the effects and implications of an event are compounded by an organisation’s criticalities (Node (11)), dependencies (Node (12)) and vulnerabilities (Node (13)). Events impacting these areas will carry far greater consequences and require immediate attention. As such, organisational functions must understand where these areas lie within the structure and value chain of an organisation. Developing appropriate bounds and thresholds around these areas
provides a level of robustness and an embedded monitoring function. Following the impact of an event, securing these areas is paramount within limiting possible implications and restoring operations and function.

Activities related to environmental scanning and monitoring (Node (10)) can provide an organisation with an acute awareness of the external environment. Customers, suppliers, external resources, competitors, economic variables, technology, laws and regulations are all components of this external environment. Events or change related to these elements can affect the operation of an organisation. In relation to resilience, environmental scanning provides an opportunity to recognise possible threats or environmental changes prior to their potential impact. The organisation can then respond accordingly. In addition, the organisation may be better positioned to identify potential opportunities and gain advantage through them.

In relation to resilience, preparedness is linked to:

- Developing response capabilities and established competencies
- Situational awareness and environmental scanning
- Understanding operations and value stream

### 8.3.2.2. Proactive and Reactive Response

Broadly, the response of an organisation can be either proactive or reactive in nature. Within a proactive response, the organisation alters function and operation as the result of an event or perceived threat. While within a reactive response, the organisation responds directly to the impact associated with an event. As such, the response of an organisation is characterised through a significant change or alteration within the dynamics or operations of an organisation or organisational elements.

Within response activities, an accurate assessment of the event (either internal or external) and the associated risks is essential; this is reflected by Node (16) and (17). It is this information that is then used to determine the level of response. In addition, organisational elements must recognise the limitations and constraints imposed by an event. Information exchange thereby forms the underlying mechanism within the effective response of an organisation.
The response can be proactive through the mitigation of potential threats or through the adjustment of the organisation in response to a significant environmental fluctuation or potential events. This is reflected through the distinction between Node (5) and (6) within Figure 8-4. The ability of the organisation to adjust and adapt is largely predicated on the organisation establishing the possible implications and severity of an event. Understanding the circumstance surrounding an event also supports a proactive response. The adjustment of the organisation must have a business justification in order to achieve stakeholder support and ensure effective implementation. The adjustment of the organisation to a potential threat will typically only be followed in response to significant risks. While low-impact threats or events, may result in the establishment or adjustment of organisational procedures and processes. As a result, a proactive response requires an element of anticipation or forecasting within the response of an organisation.

The reactive response of the organisation follows the direct impact of an event. This is reflected in the linkage between Node (17) and Node (6). The difficulty within eliciting a proactive response lies in recognising subtle fluctuations or the antecedents of a larger event. Events in one area may also carry indirect implication for another. As a result, while a proactive approach is favourable, resilient organisations are required to develop the attributes and capabilities necessary to support the organisation’s reactive response to disruptive events.

8.3.2.3. Escalation of Response

The resilient response of an organisation to an event also requires the ability to escalate response activities through established protocols and preparations. The organisation must recognise when an event is outside of the direct capability of an organisational element. Clear operational bounds and capabilities within the escalation of response activities provide a robust framework of support. As a result, Activation (Node (4)) forms a central mechanism within the response of an organisation. The escalation of response activities is reflected within the generalised causal network (Figure 8-4) through established feedback loops between the nodes of
Response (Node (6)), Outcome (Node (7)), Evaluation (Node (8)), Organisational Development (Node (9)) and Adjustment (Node (5)).

Figure 8-5 - Causal Network Feedback Loops
As reflected within Figure 8-5, three feedback loops are identified within the causal network. These feedback loops are outlined within Table 8-6. If necessary, an organisation can then cycle through these loops to ensure an effective response and the resolution of an event or threat. Through this the response and adjustment of an organisation may form an iterative process in response to changing and escalating events.

Table 8-6 - Feedback Loops

<table>
<thead>
<tr>
<th>Feedback Loop</th>
<th>Nodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustment Loop</td>
<td>(4)-&gt;(5)-&gt;(7)-&gt;(8)-&gt;(9)-&gt;(5)</td>
</tr>
<tr>
<td>Response Loop</td>
<td>(4)-&gt;(6)-&gt;(7)-&gt;(6)</td>
</tr>
<tr>
<td>Complete Loop</td>
<td>(4)-&gt;(6)-&gt;(7)-&gt;(8)-&gt;(9)-&gt;(5)-&gt;(7)</td>
</tr>
</tbody>
</table>

Typically, small scale events involve local response provisions, while larger events are escalated to senior management or crisis management team functions. While events require the development of an event specific response strategy, procedures within the escalation of response provide organisations with established mechanisms of response. Larger events or events carrying severe threats or impacts may result in a suspension of operations. This suspension provides an additional element of control within the management of an event. Simplifying the immediate concerns of the
organisation to focus on the events at hand. Initial concerns or response priorities relate to safety, security, containment and stabilisation.

Safety and security are the paramount concerns within the effective management of a disruptive event. Ensuring the safety of employees and providing immediate support is critical within response activities. These activities form the short-term concerns and priorities for the organisation. Emergency services, police, fire and rescue services provide essential support within these response activities. As a result, response procedures and protocols are linked to primary and first responders. Prior preparations aligned to the requirements and procedures of these responders further supports the ability of responders to effectively address an event.

8.3.2.4. Containment of an Event

Where possible, limiting the potential impact of an event through containment operations limits the spread of damage and reduces future implications. Constraining the number of exposure points through establishing countermeasures and controls provides stability within the functioning of an organisation; keeping disruptions localised to directly affected organisational elements. Within the causal network this is represented through the linkage between the nodes of Event Characterisation (Node (17)) and Local Response (Node (18)). The containment of an event is supported by established procedures and protocols. Embedding and formalising these functions within organisational elements helps improve the speed of response and may streamline response activities. These procedures and protocols focus on effectively reducing the risk and uncertainty associated with an event and provides an element of control within the management of disruptive events.

Within production elements, identifying and segregating impacted products provides a robust containment strategy. Communicating externally to stakeholders, customers, distribution network and suppliers across the impacted value chain and organisational network provides an awareness and warning of possible threats. As such, understanding the interconnection between elements is critical to establishing containment.
An important feature within the containment of an event is providing robust support for areas of criticality and organisational dependencies. Disruption or damage to these organisational elements can significantly constrain an organisation’s opportunities for recovery. Additionally, implementing countermeasure and controls can help to reduce the vulnerabilities within an organisational system.

### 8.3.2.5. Establishing Linkages and Connections

Following the initial suspension of operations, as a result of the impact of an event the internal organisational structure (resources and assets) and functioning (coordination of activities) may become altered. Dependent on the severity and impact of an event, this alteration may vary and will be specific to each organisation or affected organisational element. In order to respond, an organisation must be able to establish linkages across organisational elements. These linkages, including both formal and informal connections, may only be temporary within response activities. However, these linkages are required to enable organisational elements to exchange and transfer information and resource towards addressing an event. As such, following the onset of an event an organisation must seek to establish linkages across the organisational network. This is shown within Figure 8-6. The black nodes represent damaged organisational elements as a result of an event. The organisation must then establish alternative connections between available nodes in order to support response activities.

![Figure 8-6 - Establishing Organisational Linkages](image)

Internal connections provide a network within the coordination of operations. The exchange of information is central to the effective response of an organisation. This exchange reduces uncertainty surrounding an event and eliminates assumptions
within the decision making process. Internal connections allow the organisation to place resource effectively and access capabilities. External connections provide access to support and expertise outside of the organisation. As a result, establishing and formalising these connections prior to the onset of an event supports an effective response.

As a result of the altered organisational structure and functioning, considerable strain can be placed on organisational elements indirectly affected by an event. Impacted inventory, reduced (or inconsistent) supply, reduced capacity, increased demand, reduced availability, issues within scheduling, altered operational sequencing, quality issues and altered operations can all impact or restrict functioning. Understanding the capabilities of organisational elements, both tangible and intangible, supports effective restructuring and functioning during periods of adversity. Organisation must therefore develop an understanding the operational capacity and availability of various organisational elements.

8.3.2.6. Resolution and Stabilisation

Resolution and Stabilisation form the penultimate phases within the response or adjustment of an organisation following the influence of an event. These phases focus on achieving stability within the operation and functioning of an organisation. The resolution and stabilisation of an event relates to an organisation’s ability to effectively address and overcome the immediate impacts of an event and establish a response strategy towards the long-term performance of an organisation. Effective resolution and stabilisation is dependent on an organisation’s ability to effectively maintain criticalities, restore dependencies, understand organisational connectedness and manage susceptibilities.

Following the resolution of an event or the stabilisation of an events impact, the structure may again alter. While the resolution of an event may mark a return to routine operation, the long-term impact of an event may influence the structure and functioning of an organisation. Alternative structures, functioning, processes or changes to a value stream may emerge following the impact of an event.
8.3.2.7. Recovery and Development

Recovery following an event is a complex aspect within the response of an organisation. Recovery may be defined as the point at which an organisation switches focus from managing immediate concerns towards addressing the long-term implications of an event. However, the point of recovery following the impact of an event remains ambiguous, as this may take weeks, months or in severe instances years. Instead, recovery relates to the identification and implementation of learnings and improvements following an event. As such, recovery is not a static point in time but instead represents a dynamic process within the development of an organisation. The recovery of an organisation may therefore be described by the transition of an organisation into a new and favourable stability domain (Gunderson, 2000).

An important aspect within the recovery of an organisation following an event is the assessment and evaluation of the event’s impacts and cause, as well as the subsequent response activities. Through this the organisation can then identify learnings and improvements towards developing robustness within organisational elements and systems. Effectively capturing learnings is critical within the development of an organisation. Through linking these improvements to the variables of the organisational system, the organisation is able to embed change throughout the organisational system. This limits an organisation returning to previous work patterns and behaviour. Additionally, analysis of response activities may validate prior preparations; identifying short comings and areas of improvement.

8.4. Literature Review (Grounded Theory)

A key characteristic within the grounded theory approach is the comparison of extant literature with emergent concepts, constructs and theories (Eisenhardt, 1989). Following the initial literature review presented within Chapter 2, the following sections details key findings from the research in relation to the existing literature base.
8.4.1. Resilience

Resilience relates to the response of an element or system to impacts or turbulent conditions. In relation to the performance of an organisation, this adaption relates to the response of the organisation to threats and disruptive events and the ability to restore function. Implicit within this definition are four critical conditions: 1) exposure to a significant threat or event; 2) achievement of critical success factors within response activities; 3) capacity to alter function and operations; and 4) ability to develop from experiences. Through this, developing resilience within organisational elements provides a dynamic adjustment process; recognising the complexity and non-linear causal relationships within the response of an organisation. As such, resilience supports the fundamental dimensions of effectiveness and efficiency within organisational performance, as identified by Neely et al. (1995), during periods of adversity.

Resilience, regardless of context, is often referred to as a concept, defined as the “capacity to absorb impact and recover” (Linnenluecke and Griffiths, 2010), the “ability to return to stable equilibrium and avoid the tipping point” (Rudolph and Repenning, 2002), or the “ability to adapt and strengthen in the face of challenge, trauma, or stress” (Gallos, 2008). However, these definitions give rise to a complex concept composed of multiple elements. The resilience of a system or element is not observed directly but is instead the result of multiple interactions and linkages between variables. As such, several authors (Gunderson, 2000; Sutcliffe and Vogus, 2003; Turner et al, 2003; Dalziell and McManus, 2004; Gallopins, 2006) emphasise elements such as vulnerability, awareness, robustness, resistance and recovery within their respective definitions of resilience. As such, resilience forms a dynamic capacity within organisational systems related to adaptability that develops over time (Wildavsky, 1988). Subsequently, rather than a discrete concept, resilience forms a construct within the adjustment of an element or system.

The diverse range of definitions related to resilience gives rise to the notion of ‘active’ and ‘passive’ resilience. While some definitions promote a proactive engagement and adjustment of a system in relation to change (active resilience); others highlight the
ability to withstand or absorb disturbances (passive resilience). The notion of passive resilience emphasises resistance to change and robustness within system elements. Through this the resilience of a system may be characterised through the capacity of a system or system elements to maintain structure and function during periods of adversity or following the impact of an event. While active resilience addresses features of adaption. These definitions are shown within Table 8-7.

Table 8-7 - Active and Passive Resilience

<table>
<thead>
<tr>
<th>Author</th>
<th>Definition</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holling (1973)</td>
<td>The measure of the persistence of systems and of the ability to absorb change and disturbance and still maintain the same relationships between state variables.</td>
<td>Passive Resilience</td>
</tr>
<tr>
<td>Walker et al (2004)</td>
<td>The capacity of a system to absorb a disturbance and reorganise while undergoing change while retaining the same function, structure, identity and feedback.</td>
<td>Passive Resilience</td>
</tr>
<tr>
<td>Gunderson (2000)</td>
<td>The magnitude of disturbance that a system can absorb before its structure is redefined by changing the variables and processes that control behaviour.</td>
<td>Passive Resilience</td>
</tr>
<tr>
<td>Horne and Orr (1998)</td>
<td>Resilience is the fundamental quality to respond productively to significant change that disrupts the expected pattern of event without introducing an extended period of regressive behaviour.</td>
<td>Active Resilience</td>
</tr>
<tr>
<td>McDonald (2006)</td>
<td>Resilience conveys the properties of being able to adapt to the requirements of the environment and being able to manage the environments variability.</td>
<td>Active Resilience</td>
</tr>
<tr>
<td>Hollnagel et al (2006)</td>
<td>The ability to sense, recognise, adapt and absorb variations, changes, disturbances, disruptions and surprises.</td>
<td>Active Resilience</td>
</tr>
</tbody>
</table>

However, Walker et al (2002) acknowledge both active and passive elements within their definition for resilience within socio-ecological systems. Resilience is defined as “… the ability to maintain the functionality of a system when it is perturbed or the ability to maintain the elements required to renew or reorganise if a disturbance alters the structure of function of a system” (Walker et al, 2002). Additionally, within the context
of social psychology, Pooley and Cohen (2010) suggest that resilience is the potential of an individual to exhibit resourcefulness through utilising all available internal and external resources in response to different contextual and developmental challenges. These definitions relate to the capacity of a system or individual to withstand the impact of an event while retaining essential structures and function. However, if required, the system or individual is then also able to reorganise and adapt in response to perturbation. As such, these definitions provide a more holistic representation of resilience.

This is reflected by Seville et al (2006) stating that resilience is a function of the overall vulnerability, environmental awareness and adaptive capacity of an organisation within a complex dynamic system (Seville et al, 2006). As shown by a variety of authors (Dooley, 1997; Comfort et al, 2001; Dalziell and McManus, 2004; Vogus and Sutcliffe, 2007; Pettus et al, 2009) within an ever changing environment capable of significant turbulence, a system is required to change and adapt in response to environmental fluctuations in order to sustain function and retain function or advantage. Without this change in the face of adversity, systems will follow a primarily recovery based approach which may introduce maladaptive cycles of development. Instead a resilience approach in the face of perturbation is suggested to enable a system to adapt to new risk environments and circumstances (Bhamra et al, 2011).

Bruneau et al (2003) outline that the resilience of a system is defined through four properties: Robustness, Redundancy, Resourcefulness and Rapidity. It is through these properties that a system is able to effectively mitigate threats and address the impacts of an event. Robustness relates to the ability of a system to withstand a particular threshold of stress without the loss of function. Redundancy is the extent to which system elements are substitutable. As such, redundancy reduces the loss of functionality within a system following the impact of an event. Resourcefulness is the capacity of a system to solve problems, establish priorities and effectively mobilise resources following a disruption. Rapidity relates to the capacity of a system to meet objectives and priorities effectively.
Within the context of organisations, resilience relies upon processes, structures and practices that promote competencies, restore efficacy and promote growth and development. Through this, resilience provides organisations with the dynamic capabilities to mediate and overcome major disruptions (Vogus and Sutcliffe, 2007). Resilience thereby forms a multidimensional construct within organisations, that results from the interactions between cognitive, behavioural and contextual elements (Lengnick-Hall and Beck, 2003, 2005). Organisation resilience thereby forms both a top-down and bottom-up approach within organisations (Braes and Brooks, 2011). Resilience reflects the “ability to combine information with a range of other factors to flex, mould, adapt and redefine themselves to face ever changing conditions” (Horne, 1997).

Following Ponomarov and Holcomb (2009), organisational resilience is composed of three elements or stages. These include: Readiness and Preparation; Response and Adaptation, Recovery and Adjustment. Through these three elements resilience relates to: 1) the positive adjustment of an organisation (Weick et al, 1999; Sutcliffe and Vogus, 2003); 2) the ability to recognise and adapt to both positive (opportunities) and negative (threats) events; 3) the ability to maintain function and achieve priorities and objectives regardless of surrounding circumstances; 4) the ability to rebound and effectively restore function following the impact of an event (Sutcliffe and Vogus, 2003); 5) the ability to develop from previous experiences (Paton et al, 2000); and 6) the ability to effectively manage environmental variability (McDonald, 2006). These elements emphasise that resilience relates to the functioning of an organisation prior to, during and after the impact of an event.

As a result of this perspective, resilience highlights the need to develop capabilities towards enabling and supporting the response of an organisation prior to an event. Developing and embedding these capabilities within organisational elements provides established competencies within the operation of an organisation. Following the onset of a disruption or change event, organisational systems or elements are then able to draw on these capabilities and competencies when required. Subsequently, organisational resilience draws on the attributes of both active and passive resilience. This is reflected within the generalised causal network (Figure 8-4) through the
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The linkages between the nodes of Adjustment (Node (5)) and Response (Node (6)). Resilience thereby forms an overarching construct related to the response and adaption of an organisation. The various elements related and involved within the development of resilience present a diverse and complex construct. This is reflected within Figure 8-7.

![Figure 8-7 - Elements of Resilience](image)

Pheng et al (1999) outline a five stage hierarchy of crisis preparedness. These stages range from organisations that are relatively unprepared or ‘crisis prone’ to well established ‘crisis prepared’ organisations. The stages within this hierarchy include: Crisis Prone; Crisis Susceptible; Crisis Adjusted; Crisis Braced; and Crisis Prepared. Within the higher levels or stages of preparedness, organisations will have formalised crisis management functions and established in-depth plans and procedures for a number of potential crises. Through developing elements of resilience within organisational systems, these stages may be further refined and developed. Resilient organisations are required to be ‘crisis prepared’ and respond effectively to significant change and disruptions (Horne and Orr, 1998).
As a result, there is a correlation between the crisis preparedness of an organisation and an organisation’s adaptive capacity. The adaptive capacity of an organisation relates to the ability to prepare for changes and discontinuities and then respond effectively to any implications caused or related to an event (Engle, 2011). Improvement and development of an organisational system’s adaptive capacity, improves the ability of a system to effectively manage the impacts of an event and alter approaches when necessary. Established prior preparations, such as business continuity planning (BCP), risk management and crisis management thereby provide a framework to structure and support response activities.

**8.4.2. Critical Discourse of Resilience**

As highlighted within Table 8-7 and the various definitions of resilience presented within Chapter 2 Section 2.7.1, dependent on the specific context, various perspectives have been applied to resilience. Whether focused on ecological, individual, organisational or infrastructural levels, the resilience narrative has developed a diverse literature base within addressing the response, recovery and adaption of elements and systems to threats and perturbations. However, the varying definitions and perspectives within this emerging literature base highlights the contested nature of the term. This is reflected within the characterisation of Active and Passive resilience as presented within Section 8.4.1. While resilience may be viewed as a process of ‘bouncing back’ (*Passive Resilience*), it may also be viewed as a dynamic process (*Active Resilience*) of change and constant re-invention (Raco and Street, 2009). This distinction between perspectives and definitions can also be characterised as ‘conservative’ and ‘radical’ constructs of resilience.

Shaw and Maythorne (2013) define this contrast as either a focus on ‘recovery’ or ‘transformation’ within the resilience discourse. Through a ‘recovery’ driven focus emphasis is placed on resistance to external events and an efficient return to pre-disturbance operations as soon as possible. While the ‘transformation’ driven focus acknowledges that the impact of an event or disruption may be greater than the existing structures of a system are capable of withstanding. As a result, the impact of an event is not absorbed and the system is required to adapt in response to the impact.
or threat (Shaw and Theobald, 2011). This perspective echoes the ecological foundations of the concept as outlined by Holling (1973).

Although several authors recognise the ecological perspective of resilience, Adger (2000), Carpenter et al (2001), Walker et al (2002), Folke et al (2002), Starr et al (2003), Sutcliffe and Vogus (2003), Ponomarov and Holcomb (2009), the relationship with organisational resilience is yet to be clearly defined. As highlighted by Raco and Street (2012), dependent on the context, varying perspectives have established their own selective narrative around the concept of resilience. Additionally, as highlighted by Manyena (2006), resilience related concepts are also steeped in linguistic ambiguity; adding further complexity to the resilience narrative.

Resilience, as a concept, has a strong relationship with that of the notion of stability; this is reflected within Holling’s (1973) original work within ecosystem stability. In addition to this, as shown by Gallopin (2006), resilience may also be conceptualised a subset of vulnerability and a system’s capacity of response. Although the conceptual linkages between these concepts and resilience is recognised, there is still little empirical based evidence to support the proposed relationship. However, while resilience and vulnerability may be viewed as factors of each other or separate entities, there is a need to adopt resilience thinking that extends beyond vulnerability reduction and management (Manyena, 2006). As a result, a more ‘radical’ approach has emerged emphasising a narrative of adaptation and transformation (Shaw and Maythorne, 2013).

In relation to the increasing discussion around resilience, the concept has become a byword for the security response of agencies (Walker and Cooper, 2011) and a metaphor within the policy-making process (Coaffee, 2013). This is due to the political prioritisation of the safety and security within communities against potential threats and hazards; this focus has highlighted a greater requirement for foresight and preparedness in response to disruptive events (Coaffee, 2013). Preparedness is achieved through the development of resilience within a system or community; this enhances the system’s capacity to cope with disruptive events (Walker and Cooper, 2011). Within this perspective, resilience is proactive rather than reactive (Coaffee,
However, as discussed by Mackinnon and Derickerson (2013), the contested perspectives within the resilience narrative create a paradox of change; recognising the potential impact of turbulence and crises, yet accepting these events passively and placing the onus of response and adaption on the impacted systems or communities. To address this, Mackinnon and Derickerson (2013) emphasise the importance of resourcefulness and the distribution of resources within and between communities.

As a result, it is important to recognise the context in which the concept of resilience is applied. While the term may be used to express the ability of a system or element to restore efficacy, resilience may also be used as a means to conceptualise adaption and performance within dynamic and complex environments. Therefore, it is important to identify the bounds within any narrative related to resilience and outline the foundations and epistemological positioning of any definition applied to it.

8.4.3. Organisational Response

The analysis of the Organisational Resilience Survey extracted 12 factors across the three developed survey scales. These extracted factors address a broad range of features including organisational awareness, adaptability, preparations, response mechanisms, as well as features of learning and organisational development. The analysis indicates that organisational capabilities related to a strategic approach and flexible response support the fundamental properties of resilience within organisations. Following the previously proposed working definition of organisational resilience, the mechanisms of organisational resilience thereby strive to improve situational awareness, reduce organisational vulnerabilities to systemic risk environments and restore efficacy following the events of a disruption (Burnard and Bhamra, 2011). Capabilities aligned to these features of resilience, support an organisation’s ability to affectively address the demands of disruptive events.

Following the evidence from the case study organisations and the cross-case analysis, in relation to developing resilience within organisational elements, three categories of organisational capabilities were identified. Adaptive Capabilities relate to an organisation’s capacity to respond to changes or alterations in the organisation’s
operating environment. These include Flexibility, Resourcefulness and Creativity. Strategic capabilities relate to an organisation’s ability to deliver a strategy. Strategic capabilities include Robustness, Leadership, Decision Making and Situational Awareness. Operational Capabilities relate to the organisational features and attributes that support and maintain an organisation’s ability to operate as intended. These include Efficiency, Diversity, Operational Capacity, Redundancy and Rapidity.

Organisations with established structures and communication networks linked to effective planning procedures are best positioned to address the demands of disruptions and elicit a proactive response during turbulent periods. Although focused on the organisational level, the results of the Organisational Resilience Survey also indicate the importance and influence of employees within an effective response to disruptions. Employee development is highlighted as a critical factor within the development of resilience within an organisation. The effective management of unexpected events is primarily achieved through the development of employee knowledge and competencies prior to the onset of the event. As such, employees are then able to use their knowledge and competencies to develop novel solutions towards overcoming the impact of unexpected events. The organisation is then also able to draw upon a broad range of employee expertise when required, improving the potential response capability of the organisation.

Employee development is crucial within maintaining and developing the capabilities and competence of both individual employees and the organisation as a whole (Lee and Bravold, 2003). Improved capabilities can aid in the development of an organisation’s competitive advantage through the development of advantageous features, processes and structures (Lopez-Cabrales, Valle and Herrero, 2006). This can be achieved through providing adequate training opportunities towards improving employee knowledge and skills, thereby increasing the level of competencies within an organisation. Employee development can bring several benefits for an organisation (Fill and Mullins, 1990). These include:

- Increase the confidence, motivation and commitment of staff
• Provide recognition, enhanced responsibility and the possibility of increased pay and promotion
• Give a feeling of personal satisfaction and achievement and broaden opportunities for career progression
• Help improve the availability, quality and skills of staff
• Help improve the quality of human assets available to the organisation

The analysis of both the survey and case study evidence indicates that an organisation’s ability to effectively interpret demands is paramount within establishing a ‘proactive’ response. The limitations of traditional system responses are highlighted by the difficulty in interpreting low-probability events during the decision-making process (Camerer and Kunreuther 1989). This is possibly due to uncertainties being large and difficult to characterise (Sheffi 2007). Recognising and interpreting threats effectively is therefore an important stage in the positive adjustment of a system to a potentially severe event. This positive adjustment in the face of adversity is supported by an organisation’s decision making processes and ability to utilise inherent organisational strengths and resources. In addition, during the response to a disruption there is also an increased exchange of communication as information is processed from a variety of sources from across the organisational network. This exchange seemingly results from a need to reduce the ambiguity and uncertainty within disruptive events, in order to support effective decision making. The exchange also acts as a means to increase potential linkages within the organisational network. It is through these linkages that resources (both tangible and intangible) are able to be transferred across organisational boundaries.

The increase within information exchange and the establishment of linkages across the organisation following the onset of an event is also necessary for the coordination of response activities. Crises, disasters and disruptive events can have a broad range of impacts across an organisational network. Operations, processes, structures and employees can all be adversely affected and altered following an event. These impacts may also extend across the organisational network and supply chain and have dramatic implications for customers and other stakeholders. In severe instances, events may result in the loss of life or severe health implications. The subsequent
alterations to the organisational landscape caused by the impact of an event mean that ‘traditional’ organisational functions, routines, pathways and connections may be altered or damaged. As a result, linkages need to be re-established or new connections made. In order to facilitate an effective response, these connections form a critical junction within an organisation’s ability to interpret demands, access resource and expertise and transfer information.

The effective use of information is essential within supporting resilience within an organisation, both during the routine operation of organisational functions and within the coordination of response activities. Not only does effective information exchange and communication support critical thinking and understanding across organisational processes and decision making. But it provides linkages and alignment between organisational elements as well as resources. It is through these linkages that an organisation is able to link the efforts and attributes of organisational elements and resources to organisational objectives and critical success factors. Following the onset of an event, as a result of an increased exchange of information, organisational actors are then better positioned to account for the impact of an event and address the altered operating environment.

In order for an organisation to elicit an effective response to a disruption, regardless of cause, it is often necessary for the organisation to develop the necessary attributes prior to the onset of the event. These are termed adaptive capabilities, and relate to the capabilities required for the organisation to effectively adapt and overcome possible discontinuities. Following the impact of a disruptive event, the organisation is then able to draw on these capabilities. This is linked to the adaptive capacity as outlined by Gunderson (2000). A systems adaptive capacity relates to the ability of a system to evolve and transcend events in order to accommodate threats or changes. The adaptive capacity of a system is partly determined by the diversity within the system, as well as the networks that create flexibility and balance authority/power. As such, providing opportunities for employee development through training programmes and other initiatives, allows organisations to cultivate an extended range of future capabilities. This increases the amount of expertise the organisation is then
able to draw upon during periods of adversity and extends the range of possible outcomes during response activities.

In order for the organisation to take a proactive approach towards environmental fluctuations, an improved situational awareness of both internal and external influences is required. Through this the organisation is then able to continually adapt in the face of both potential opportunities and certain discontinuities through identifying potential implications and implementing appropriate mitigation procedures prior to an event’s occurrence. Thereby ensuring organisational objectives are continually met. Following a disruptive event, the organisation is then better positioned to deal with the full impact and demands of an event given an improved understanding of both internal and external variables as well as an awareness of both dependencies and areas of criticality.

Additionally, the warning signs of an impending threat or crisis may also not be perceived early enough in order to support a proactive response or at the right moment (Wooten and James, 2008). This delay in effectively interpreting the demands of the situation can give rise to organisational behaviour that could be perceived as dysfunctional or reactive (Lalonde, 2011). Alternatively, hasty or rushed reactions based upon incorrect assumptions or incomplete information can also lead to inadequate response measures (Perry and Lindell, 2003). Through emphasising the development of a continuous situational awareness, organisations are better positioned to acknowledge fluctuations and changes within their respective operating environments. Impending threats may then be viewed as potential opportunities towards the development of the organisation.

8.4.4. Situational Awareness

Situational awareness is related to the perception and understanding attributed to the surrounding environment. Within the developed generalised causal network (Figure 8-4), this is represented through the node Environmental Scanning/Monitoring (Node 10). Situational awareness involves understanding the current status of an incident as well as forecasting how an event could evolve and develop. This can provide an advanced warning or recognition of impending threats and allow organisational actors
to prepare and plan potential response and mitigation activities (Johnson et al., 2011). As a result, the linkage between Environmental Scanning/ Monitoring (Node (10)) and Detection (Node (3)), is critical within achieving proactive response to threats and disruptive events.

The concept was first developed to describe the processes of attention, perception and decision making within aviation (Endsley, 1995; Adams et al., 1995). Situational awareness is most commonly defined as the “perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future.” (Endsley, 1995). As such, situational awareness related to the ability to detect, integrate and interpret data gathered from the environment (Johnson et al., 2011). Through this, situational awareness strives to develop a holistic understanding of a situation and form the basis for effective decision making (Endsley, 1995). Although it is important to note that situational awareness is distinct from both the process of decision making and the performance of a system. As outlined by Endsley (1995), situational awareness can be expanded into three distinct levels. These range from the perception of the current situation to forecasting future trajectories (Johnson et al., 2011).

Through these levels, system actors are able to address not only initial threats, but also secondary or even tertiary hazards. A comprehensive approach towards situational awareness allows systems to develop a holistic understanding of their respective dynamic environments. This ability to foresee and monitor potential threats and complications further supports an effective response to complex situations (Johnson et al., 2011). Linking this awareness to organisational variables, such as areas of criticalities and dependencies, further reinforces a proactive approach towards resilience.

There are several factors that can influence and affect the situational awareness of a system (Endsley, 1995). System actors vary in their ability to acquire and develop situational awareness as a function of both their cognitive abilities and the inherent properties of the system itself. Situational awareness can subsequently be influenced by the design of the system, inherent abilities, previous experiences, individual
preconceptions and training. The degree to which the system is able to provide the required information and the format in which it is provided will also influence the level of situational awareness. The environment surrounding a system will also influence the level of situational awareness. Factors such as complexity, ambiguity, stress and workload will also impact the perception and interpretation of an environment. As outlined by Endsley (1995), situational awareness can be conceptualised at three levels. These include:

- Level 1: Perception of the elements in the environment
- Level 2: Comprehension of the current situation
- Level 3: Projection of future status

The first level of situational awareness relates to the perception of a systems operating environment. This requires an awareness of the status, attributes and dynamics of relevant elements within an environment (Endsley, 1995). These elements may be either internal or external to the organisational system. Level 1 involves an active process of scanning and gathering data from a system’s surroundings (Darwin and Melling, 2011). Level 2 situational awareness goes beyond an awareness and perception of a given environment or scenario and involves the development of an intrinsic understanding of system elements. It addresses how system actors combine, interpret, store and retain multiple pieces of information (Endsley and Garland, 2000). Through this a mental model of the system in relation to a situation or event is developed, in which observations are combined with knowledge and experience (Darwin and Melling, 2011). Level 3 situational awareness is the highest level and relates to forethought about future event. Projection relates to the ability to forecast (predict) the future actions of the elements in the environment (Darwin and Melling, 2011). This allows system actors to anticipate future events and system dynamics (Endsley and Garland, 2000). This requires both knowledge of the status and dynamics of the elements and a thorough comprehension of the situation (both level 1 and 2) (Endsley, 1995). Level 3 situational awareness thereby forms a critical junction within the decision making process (Darwin and Melling, 2011). However, it is crucial to identify limitations within this prediction given the uncertainty associated with forecast models.
8.4.5. Decision Making

Understanding the organisational strengths and available resources is crucial within developing an effective response strategy. This is reflected by the correlation between situational awareness and decision making linked to expertise and strengths. Utilising inherent strengths and effectively mobilising available resources is essential within an effective organisational response. During the active response of an organisation, the ability of the organisation to effectively interpret situational demands is critical within the development and coordination of response activities. Appropriate allocation of resource and support is vital within the support of response and recovery activities. However, strategy implementation can form the most challenging aspect of the strategy process (Mills et al., 1998). Following the evidence from the Bivariate correlation analysis, an improved situational awareness (RES2) and ability to effectively interpret demands (ORS2) is linked with the organisational capabilities related towards a strategic approach. Subsequently, through cultivating these capabilities, organisations can be better positioned to consistently achieve positive results through periods of adversity.

The analysis of the Organisational Resilience Survey and case study evidence also emphasises the importance of decision making within the response of an organisation. Decisions are about future states of affairs (Wilson et al., 2010) and relate to judgements about particular instances. Before a decision is made, often a stimulus is required (Mintzberg et al., 1976). Decision making thereby forms the process of analysing information and utilising knowledge in order to resolve problems and issues (Zhang et al., 2002). However, while problem solving is concerned with addressing and resolving issues towards achieving an objective, decision making is a much more comprehensive process and comprises of an act or choice requiring a judgement that is then translated into action (Wilson et al., 2010). During periods of stable operations, organisations are able to undertake this process following an in depth analysis and consideration of a full range of alternatives. However, following the impact of disruptive events, the constraints of the situation often stand to limit an organisation’s ability to do so. As such, decision making often relies on intuition and experience rather than on analysis (Bonn and Thiele, 2007). Instead, it is suggested that decision
making is supported within the framework provided by organisational values and strategic position. The analysis indicates that effective decision making within response activities is linked to the effective utilisation of organisational strengths and available resources.

As identified by Janssen et al (2010), many disaster and crisis management systems often lack the capability to cope with the associated complexity and uncertainty within disruptive events. The demands and requirements of a situation can often overwhelm the capability of individuals or organisational elements to form effective decisions. As a result, decisions are often based on incomplete or inconsistent information (Wilson et al, 2010). Following the occurrence of a disaster or crisis event, a complex task environment is created in which interdependent decision-making teams are required in order to ensure effective coordination during response activities. Relevant information pertinent to the event needs to be collected from multiple sources, verified for accuracy, and effectively distributed and shared, all within a short time frame. This means that decision making within crisis management operations requires the development of an inclusive process capable of addressing the demands and uncertainties of crisis events (Darling, 1994).

Decision making in complex environments is not a very well understood process (Srinivas and Sekar, 1997). Given the complexity of crisis situations, difficulty arises as decision makers may become overwhelmed by the vast amounts of information and considerations which they are required to absorb and process. As a result of this, decision makers are often forced into making ‘partially informed’ or ‘imperfect’ decisions which may not account for important or critical issues (Wilkenfield et al, 1995; Klibi et al, 2010). This is addressed by Cosgrave (1996) who suggests that there are three primary constraints within emergencies. These include time constraints, in which a distinction between time bound and critical or urgent decisions needs to be made. Constraints caused by the limited amount of information upon which decisions are often based (bounded rationality) and finally a decision load constraint, which relates to the amount of decisions which are required.
Perrow (1999) proposes that within complex and tightly coupled systems, in order to address threats and disruptive events a high level of centralisation is required within decision making functions. This is due to ‘low level’ decision makers having an insufficient understanding. Perrow (1999) outlines the importance of understanding the inter-relationship between actions and their consequences on other system elements within decision making. However, Heath (1998) suggests that the response of a system to disruptive or crisis events requires consultation and a decentralised approach to decision making. Through this decision makers are able to utilise the inherent skill and local knowledge of all involved respondents. As a result, it could be argued that the issue of centralised or decentralised decision making authority is dependent on the structure of the impacted system or network.

As identified by Comfort et al (2001), when complexity increases, possibly through a high impact or disruptive event, a system’s performance decreases. This is due to the system’s inability to effectively process the amount and range of information required to adequately establish coordination across the components of the response system. This is a result of the system requiring a significant increase in information exchange, communication and coordination in order to integrate the multiple levels of system operations and decisions caused by the increase in environmental and system complexity. In order to address this Tomasini and Wassenhove (2009) suggest that effective information management can aid in reducing the complexity brought on by uncertainty. As a result of this, in order to establish a strategy for reducing risk and adapting to disruptive events within uncertain environments it is proposed that a system should create a balance between anticipation (or preparedness) and resilience (Comfort et al, 2001).

The process of decision making is complex. The process is further complicated by the stress and pressure associated with disruptive events. In order to support the proactive response of an organisation to a threat or event, decision makers are required to not only effectively interpret the current demands of the situation, but understand the availability of resources and the expertise within an organisation or the wider system or network. This is reflected by the factor loadings of items associated with decision making within the extracted factors of the Organisational
resilience Survey. Aligning decisions with organisational strengths, available resources and support channels allows the organisation to take advantage of potential opportunities for response and recovery. This is hinged on effectively interpreting and utilising information from a wide variety of sources in order to support well informed decisions. Decision speed is also a critical variable of responding to an event, as an event may generate particular time constraints and demands.

8.4.6. Forecasting

Forecasting relates to the process of predicting, projecting or estimating future events or conditions which are typically outside of the direct control of an organisation but may impinge on critical managerial planning (Golden et al., 1994). Forecasting thereby forms an essential element within an organisation’s decision making and planning processes (Winklhofer et al. (1996); supporting the transition towards a systematic decision making process in order to address the increasing complexity of organisations and their environments. As such, accurate forecasting can shape the strategic direction of an organisation; providing critical information within operational (short-term), tactical (medium-term) and strategic (long-term) planning. Forecasting may also direct organisational capacity. However, the process of forecasting requires decision makers to form judgements which may introduce subjective biases into the decision making process. As a result, the forecasting process is based upon the collection and analysis of data from a variety of sources. Additionally, forecasting inaccuracies can result from information distortion from within an organisation and the wider organisational network or the supply chain (Chopra and Sodhi, 2004). This issue can be further aggravated by factors such as the bullwhip effect (Sheffi, 2005). This is seen by organisations further along the supply chain experiencing a greater level of distortion as fluctuations are amplified.

In relation to the management of disruptive events, forecasting can support a proactive approach towards addressing potential risks and threats. Forecasting may identify potential threats and opportunities within the organisational environment and help shape the direction of the organisation. Forecasting can also help quantify a potential threat, supporting the justification of a proposed adjustment or change.
Accurate forecasting and planning can also provide a useful tool within the establishing the impact of an event.

8.4.7. Organisational Behaviour, Values and Beliefs

The evidence of the case studies suggests that behaviour within an organisation is influenced by policies, procedures, shared values, aspects of organisational culture and the direct intervention of leadership or management. Behaviour is also influenced by the social and organisational context in which the behaviour occurs and the level of awareness of behavioural and cognitive patterns (Woods and Hollnagel, 2006). Creating a shared set of values and objectives thereby provides a united purpose and direction within the operation of organisational functions. Values have an intrinsic and important influence on organisational behaviour, extending through culture, operations, standards, conduct, beliefs, principles and organisational ethics. Values are stable beliefs that operate across multiple levels and outline certain modes of behaviour or ‘end-states’ that the organisation perceives as being desirable or necessary in order to achieve its intended function (Grojean et al., 2004). These values will be specific to a particular organisation. Organisational values can therefore shape and influence the behavioural choices made by organisational members. Individuals and organisational functions are motivated and encouraged to operate in a way that is consistent with the values set by the organisation (Grojean et al., 2004). Through developing a shared set of values within an organisation, individuals are able to find meaning within their work and routine operations; within a wider context, the organisation is then able to develop a committed workforce that is able to function and perform well through periods of change (Sullivan et al., 2001).

Subsequently, values influence the decision and actions within organisations. As such, organisational values form a primary driver for the motivation within an organisation and provide the standard against which decisions and actions are measured against and evaluated (Sullivan et al., 2001). As a key dimension of organisational resilience, Mallak (1998) highlighted the importance of goal directed solution seeking. This feature of resilience involves improvising solutions to problems through considering several alternatives and brings together the need for clear goals and direction to guide
creative processes within problem solving. In order to ensure consistent function and operation, developed solutions should not conflict with the core values of the organisation, as values drive all behaviours (Sullivan et al., 2001). Following the evidence of the extracted factors, it is indicated that decision making should be conducted within the framework provided by the accepted organisational values.

8.4.8. Organisational Leadership

Leaders play not only a vital role within providing direction within an organisation, but also within facilitating the processes that enable organisations to achieve their respective objects (Grojean et al., 2004). Placing and embedding leaders in the correct positions within an organisation is then crucial for success. Leadership forms a dynamic process within ensuring that an organisation's purpose is continually achieved. Leadership involves balancing a number of factors relating to strategy as well as inspiring and leading an organisation with a clear direction (Lynch, 2009). The influence of leadership may also extend across organisational boundaries (Wooten and James, 2008). Leaders play an important part within identifying and developing organisational values and serve as possible role models for those values, thereby setting the tone and standard for organisational members (Ulmer, 2001). This is reflected by Stoltz (2004), who underlines the importance of leadership in relation to resilience, stating that resilient leaders should provide the model for other organisational members to follow. Leaders may therefore define responsibilities, vision and goals within an organisation. However, the consolidation of these goals is achieved through the combined effort of others. This is reflected by Lynch (2009), identifying that the way in which an organisation evolves is a function of its leadership as much as its strategy. However, rather than a purely prescriptive role, effective leadership supports an organisation’s ability to develop a shared purpose as well as the facilitating the changes required to achieve it. It is therefore suggested that in order to maintain a resilient system it is necessary to develop multiple leadership roles across the organisation invested in different individuals, groups and organisational elements (Walker et al., 2006).
8.4.9. The Adaptive Cycle and Organisational Learning

Learning forms an important aspect of organisational resilience (Burnard and Bhamra, 2011). As noted by Miller (1996), the concept of organisational learning has resulted in a broad range of definitions and subsequent interpretations. These range from the view of learning as a change in behaviour in response to an event or stimulus, to others that view learning as the conscious acquisition of knowledge and insight through organisational members. Regardless, given the connotations of the concept, organisational learning is closely associated with improvements in performance (Tsang, 1997). In relation to resilience, learning provides the mechanisms through which events can be viewed as potential opportunities towards organisational development.

As outlined within the literature review within Chapter 2, dynamic systems will follow an adaptive cycle. The adaptive cycle may aid in establishing the theoretical connection and relationship between organisational resilience and organisational learning. During the release and reorganisation phases of the adaptive cycle, the system may introduce innovation through reconfiguring the accumulated capital into novel combinations to realise new opportunities (Holling, 2001). If this observation is held within organisations, then a conceptual link can be established between the phases of the adaptive cycle and organisational learning. As shown by Carrol et al. (2003), double loop learning within organisations involves integrating the governing variables of a system. As such, the double loop learning process may involve radical changes to the organisation, such as the complete revisions of systems and alterations in policies and strategies. The adaptive cycle may therefore offer a potential framework for the development of double loop learning within the resilience response of an organisation to perturbation.

Establishing suitable environmental feedback controls and the assessment of operating conditions allow for the possible development of an ‘embedded intelligence’ within organisational systems. Within socio-technical systems, organisational and environmental variables co-evolve around each other (Coiera 2006). Subsequently, without conceptualising and formalising these elements, key
factors, such as organisational learning, may be neglected. The capacity to learn from an event and develop organisational systems better prepared for future disruptions is an elementary component of resilience (Ponomarov and Holcomb, 2009). Specific logical and analytical skills that allow for a higher level of thinking to emerge from available information during a disruption is vital during an organisation’s response (Carrol et al., 2003). Learning outcomes are required to develop both new strategies and operations that will support organisational capabilities. Organisational learning provides a means for these capabilities to continually evolve and develop thereby enabling organisational resilience to also develop (Ponomarov and Holcomb, 2009).

Without the inclusion of this opportunity for development, an organisation may be limited to single loop learning, restricting the potential level of resiliency. Meaning that learning within the organisation will remain primarily focused on effectiveness (Garcia-Morales, 2009). This is due to emphasis being placed on the detection and correction of errors within a given set of parameters, through this only incremental change is possible (Carrol, 2003). In order to enable resilience within organisational systems the evidence from the case studies suggests that double loop learning is required. Double loop learning is a much greater cognitive process compared to that of single loop learning, and subsequently involves incorporating the governing system variables into the learning process (Carrol, 2003). As such, radical alterations to operating procedures and strategies can be developed. Double loop learning is particularly suited to turbulent environments, as it enables organisations to utilise a wide base of experience to increase response variability (Garcia-Morales, 2009). Through this organisations may be able develop improved situational understanding and new disruption mitigation strategies may emerge. Single loop learning in relation to the exposure of an organisation to disruptive events relates to feedback directly influencing potential future responses. This is reflected by organisational members gaining experience and knowledge in relation to the management of disruptive events. Double loop learnings relates to the same feedback and influence however adjustments or improvements are made to organisational planning and preparations. Double loop learning may also extend towards addressing vulnerabilities or
organisational inadequacies. As such, double loop learning develops robustness within organisational systems.

8.4.10. Organisational Adjustment

An organisation’s response to change can have a direct influence on the strategic position of the organisation (Tuominen et al, 2002). An adaptive designed system will attempt to adapt to changes in the environment to ensure continued function (Coiera, 2006). The adjustment of these systems in response to a disruption may be achieved primarily through two means. An embedded intelligence in a systems response through environmental feedback controls or through a systems ability to be successfully reconfigured to an appropriate mode of operation through the human assessment of environmental circumstances (Coiera, 2006). However both of these methods focus on reflexive responses to environmental change. To overcome this an understanding of the vulnerabilities of an organisation is required (McManus et al, 2007).

As shown by Sheffi (2007), high-impact/low-probability events require planning and response outside of the realm of daily activities. The limitations of traditional system responses is highlighted by the difficulty in interpreting low probability events during the decision making process (Camerer and Kunreuther, 1989). This is possibly through uncertainties being large and difficult to characterise (Sheffi, 2007); these high-impact events may therefore affect a system on a wider scale. Subsequently, as Walker et al (2002) participatory approach for resilience management in social-ecological systems suggests, individuals should learn to ‘live’ or ‘operate’ within systems instead of striving to control the system. The environmental conditions may also change faster than the forecasting model or environmental feedback controls can process information. Subsequently, to enable a proactive positive adjustment a broader range of information processing is required. Through this organisational systems can be developed to be adaptive to the requirements of the disruption mitigation process and also flexible in the ability to return to pre-disruption structure and performance. Thereby incorporating the fundamental definition and characteristics of resilience into organisational systems.
8.4.11. Dynamic Capabilities and Organisational Adaptation

Following the resource-based-view of an organisation, the concept of dynamic capabilities provides an insight into how organisations are able to adapt in response to changing environmental conditions in order to attain and sustain a competitive advantage (Wang and Ahmed, 2007). Within this view, emphasis is placed on the resources and capabilities of an organisation (Pettus et al., 2009). The concept of dynamic capabilities then extends this view, conceptualising an organisation’s ability to integrate, build and reconfigure these resources and capabilities in order to adapt or even capitalise on changes and opportunities (Berkhout et al., 2006; Wang and Ahmed, 2007). Through this, dynamic capabilities involve the organisational processes through which resources are used to create and provide growth and adaptation within changing environmental conditions (Teece et al., 1997, Pettus et al., 2009). However, as outlined by Zahra et al. (2006), it is important to note that developing dynamic capabilities does not necessarily lead to superior organisational performance. Instead, dynamic capabilities refer to the ability of an organisation to change and re-configure existing substantive capabilities.

In relation to adaptation, dynamic capabilities refer to the capacity of an organisation to renew competences towards effectively adapting to change. Organisations are therefore required to adapt, integrate and reconfigure internal and external organisational skills, resources and functional competences in order to satisfy the demands of a continually changing environment (Teece et al., 1997). Adaptation, whether to internal or external circumstances, thereby requires that an organisation effectively manage current resource bases, as well as develop the necessary flexibility in order to change the organisation’s resource position and respond effectively (Pettus et al., 2009).

Within this context, adaptation or organisational adaptability, is defined as the capability of an organisation to effectively adjust to changes within its respective operating environment (Stoica et al., 2003). This involves both forward thinking through anticipating future events, and the continual feedback and exchange of information across the organisation to support operations (McDonach and Yaneske, 2002). Within an organisation, this is supported through the use of forecasting and actively monitoring the operating environment and wider organisational network.
(environmental scanning) (Pettus et al, 2009). Adaptability, thereby relates to the ability of an organisation to identify and take advantage of emerging opportunities (Tuominen et al, 2002) as well as the ability to effectively predict and adapt to unexpected change (Takii, 2007).

This is particularly important within the context of organisational resilience, and the ability of an organisation to respond effectively to disruptive and crisis events. As within complex and turbulent environments, organisations are continually challenged to revise and adjust established routines of operation (Zahra et al, 2006). As a result, adaptability forms a critical element within the performance of an organisation during dynamic and unpredictable environmental conditions. As such, Tuominen et al (2002) argue that adaptability is a continuous construct that organisations must develop and maintain. As a result, developing dynamic capabilities provides an organisation with the means to achieve new and innovative forms of competitive advantage given dependencies and environmental demands (Teece et al, 1997).

8.5. Attributes of Resilient Organisations

Following the development of the generalised causal network (Figure 8-4) and the identified features of resilience within the response of an organisation, several characteristics of resilient organisations can be outlined. These features relate to the ability to adjust and respond effectively to both events and identified opportunities. Resilience requires flexibility and the ability to adapt to changing circumstances. The ability of an organisation to respond effectively to disruptive events or the adaptive capacity of an organisation, lies in the ability to effectively link elements and features of both ‘active’ and ‘passive’ resilience. While the ability of an organisation to take advantage of opportunities, relates primarily to a proactive approach within the management of risks and threats. As such, organisational resilience stems from a connection between the paradigms of engineering and ecological resilience as presented by Gunderson (2000) and Walker et al (2002). Following the evidence of both the organisational survey and case studies, the general features of a resilient organisation are identified. These features acknowledge the elements of both active and passive resilience. The identified features include:
- Resilient organisations develop embedded capabilities (*competencies*) towards addressing events and opportunities
- Resilient organisations invest time and effort within considering a range of possible events (including low-probability events) and scenarios
- Resilient organisation are able to develop unique solutions towards addressing threats and events
- Resilient organisation make decisions within the framework provided by the organisation’s values and beliefs
- Resilient organisation effectively recognise limitations within operations, planning and the organisation’s capacity of response
- Resilient organisations invest in developing human resources across the organisation
- Resilient organisations have established leadership and authority hierarchies
- Resilient organisations cultivate creativity and innovation within the organisation
- Resilient organisations form strategic partnerships within the operation of complex supply chains and organisational networks

**8.6. Conclusions and Implications**

Following the evidence and cross-case comparison between each of the four case study organisations a generalised causal network is developed. The presented model (Figure 8-4) highlights the decision making process within management of disruptive events and draws specific attention to the elements of resilience related to the response of an organisation. Following the development of the generalised causal network, the key features within the response and adjustment of an organisation are discussed. These features include: *Internal and External Awareness, Proactive and Reactive Responses, Escalation of Response, Containment of an Event, Establishing Linkages and Connection, Resolution and Stabilisation*, and finally *Recovery and Development*.

These features relate to the adaptive, proactive and reactive strategies of an organisation in response to perceived threats and disruptive events. Central within
each feature of the causal network is communication and the exchange of information between organisational elements. An external awareness and an understanding of organisational criticalities, dependencies and vulnerabilities are critical within developing robust preparations and planning (including forecasting). The ability of an organisation to effectively recognise change and threats is central within establishing a proactive response.

Following the response of an organisation, the ability to escalate response activities ensures that demands and implications of an event are met to the best ability of the organisation. The capacity of an organisation to escalate response activities stems from prior preparations and developed response strategies. Through this the organisation is able to provide containment and limit the potential impact and implications of an event. The effective resolution and stabilisation of the impact of an event is dependent on an organisation’s ability to effectively maintain criticalities, restore dependencies, understand organisational connectedness and manage susceptibilities.

8.7. Summary

This chapter begins with an overview of the evidence from the Organisational Resilience Survey. Presenting data related to the extracted factors for each of the four case study organisations. The chapter then details the development of a generalised causal network for the response of an organisation to crisis or disruptive events. The key elements of response are each discussed in turn. These features include: 1) internal and external awareness; 2) proactive and reactive response; 3) escalation of response activities; 4) containment of event impacts; 5) the need to establish organisational linkages; 5) event resolution; and 6) recovery and organisational development. Following the Grounded Theory approach, a literature review is then presented discussing the identified features within the wider context of academic literature and knowledge. From the synthesis of literature, the characteristics and features of a resilient organisation are presented.
Chapter 9 - Conclusions

9.1. Introduction

The following chapter presents the concluding discussions and summary of this research. Each of the proposed research objectives are addressed in turn, drawing together the results of both the organisational survey and case studies. Following this the contribution of the research to existing knowledge is discussed. Finally, the research limitations and areas of future work are outlined.

9.2. Achievement of Research Aims and Objectives

The focus of the research was to investigate and explore resilience at an organisational level. Specifically, the proposed aim of the research was to develop an understanding and theoretical foundation for the concept of resilience within the response of an organisation. This relates to the development of an organisation’s adaptive capacity and the effective response of an organisation to disruptive and crisis events. Through this aim, the research focuses on identifying the critical success factors and influencing factors within addressing organisational performance and competitiveness during periods of turbulence and adversity.

This was achieved through a Grounded Theory approach within the research design. The research involved the development of an organisational survey, conducted across Engineering and Technology organisations within the UK. This survey, supported by an initial literature review, identified twelve influencing factors related to resilience and the response of an organisation. Following this, four in-depth case studies were conducted across organisations with operations related to critical infrastructure and Healthcare within the UK.

Following a Grounded Theory approach, the research design followed a multiple case study approach utilising semi-structured interviews. The multiple case study research design was selected as it offers a more robust approach in comparison to single case studies (Yin, 2009). This approach also enhances the generalisation of results through allowing for comparisons to be made between organisations (Bryman, 1989). The
organisational case studies identified elements within the phases of ‘Readiness and Preparedness’, ‘Response and Adaption’, and ‘Recovery and Adjustment’. Focusing on the ‘Response and Adaption’ of an organisation, the research explored the dynamics and behaviour of an organisation following the impact of a disruptive or crisis event. Following a comparative analysis of case attributes a general causal network for the response and adjustment of an organisation was then developed. This causal network provides a framework and rationale to support the effective coordination and decision making within response activities; identifying the critical elements and influencing factors within the response of an organisation to both opportunities and threats.

As a result of this analysis a new way to view, interpret and understand organisational responses has emerged. Rather than a linear process, the response of an organisation forms a complex network of interactions and activities. The response of an organisation is viewed as a dynamic process linked to responsiveness, adaptability and competitiveness. This new approach is based on understanding the features of resilience within organisations and developing an organisation’s adaptive capacity through cultivating and embedding adaptive capabilities within organisational systems and networks. As a result, resilience is viewed as a strategic imperative within the functioning and operation of an organisation rather than a static property.

However, the uncertainty and complexity associated with disruptive events often stands to overwhelm or restrict the capacity of an organisation to respond effectively. This is reflected within the results of the organisational survey; as the complexity of an event increases, so does the impact across all organisational levels. As a result of this complexity, the control of information and decision making forms a critical element within the response of an organisation. In order to address this, the developed causal network identifies the key dependent and independent variables within the response and adjustment of an organisation. Using the developed causal network as a framework to structure response preparations and capabilities, organisational elements may be able to identify and refine important linkages and resources necessary within response activities.
9.2.1. Accomplishment of Objectives

9.2.1.1. Research Objective 1 (RO1)

To critically review literature and other secondary data sources related to resilience and other associated concepts.

The research objective RO1 relates to the extant body of knowledge related to resilience. This objective was completed through a comprehensive review of literature presented within Chapter 2. This review included a synthesis of literature from the areas of social and childhood psychology, ecology, organisational theory, systems engineering, supply chain management, strategic management and safety engineering. This review resulted in the development of four supportive epistemological propositions related to organisational resilience and a proposed working definition, presented within Section 2.9. Additionally, a conceptual framework related to the response of an organisation was developed, presented within Chapter 4 Section 4.2. These elements also supported the development of a robust research methodology and design. Following the outcomes of both the organisational survey and subsequent case studies, an additional review of pertinent literature is also presented within Chapter 8 Section 8.4. This review explores the identified features and concepts within the wider context of literature.

9.2.1.2. Research Objective 2 (RO2)

Investigate the implications of disruptive events on the performance of organisations. Identifying how organisations are able to effectively meet core business objectives during disruptions and periods of adversity.

Disruptive events carry a range of consequences and implications that may impact and restrict the performance and functioning of an organisation. Rather than focus on a specific type or category of event, the research addresses any disruption or change events that affect the performance or functioning of an organisation. Following the organisational case studies and analysis, presented within Chapter 6, three ‘Types’ of events were identified in relation to probability of occurrence and potential impact or severity. Following this classification, presented within Chapter 7 Section 7.3.3., the
Conclusions

response of an organisation to lower impact events typically relates to robustness, while the response to more severe events relates to elements of resilience. The determinants and implications of a severe event were also identified. Following the evidence of the organisational case studies, events directly impacting the priorities of an organisation, most notably employee health and safety, are considered severe events.

Furthermore, in order for an organisation to meet core business priorities and objectives, critical success factors within the response of an organisation must be achieved. Fundamentally, these factors relate to the priorities and responsibilities of an organisation. The ability of an organisation to achieve these factors is dependent on the organisation’s ability to develop and embed appropriate capabilities and competencies within organisational elements. These capabilities relate to Adaptive, Strategic, Operational and Developmental organisational capabilities. These are detailed within Chapter 7 and Appendix G. The organisation must also develop and provide access to appropriate resource when required during periods of adversity.

9.2.1.3. Research Objective 3 (RO3)

Identify the critical stages and elements within the response of an organisation to a disruptive or crisis event. Identifying the linkages and relationships between organisational variables and resilience.

Following the coding and development of the thematic matrixes for each of the case study organisations, individual causal networks were developed. These are presented within Chapter 6. Based on previously developed conceptual frameworks (Burnard and Bhamra, 2011) as presented within Chapter 4, these causal networks identify both the independent and dependent variables, as well as the relationships between them. Through this the critical stages within the response of each organisation are identified. The networks highlight both a proactive and reactive response to threats, risks and disruptive events.

Based on the evidence of the organisational case studies varying levels of response were identified. Based on the severity and magnitude of an event, an organisation
may escalate the response in order to meet the demands of the situation. Typically, as shown within the case studies, the levels of response and the boundaries between them are established within prior response preparations and protocols. Following the evidence of the case studies, four levels of response were identified, presented within Chapter 7 Section 7.3.4.

Following a cross-case comparison within Chapter 7, a cross-case causal network is developed and discussed. This model is then refined and a generalised causal network is then presented within Chapter 8 Section 8.3. Following the development of this causal network, the elements of response are then outlined and discussed in relation to extant literature. The presented causal network highlights the decision making process within the management of disruptive events and draws specific attention to the elements of resilience related to the response of an organisation.

9.2.1.4. Research Objective 4 (RO4)

*Investigate the organisational factors influencing resilience and an organisation’s ability to respond effectively to disruptive and crisis events. Identifying the influence and strategic implications of resilience on organisational responses.*

The factors influencing resilience and the response of an organisation are detailed within Chapter 7 and Chapter 8. From the evidence of both the organisational survey and the organisational case studies, resilience relates to the ability of an organisation to develop and maintain adaptive, proactive and reactive strategies within addressing both internal and external change. Through this organisations may not only be able to respond effectively to turbulence and uncertainty but also seek potential opportunities within disruptive events.

Following a Grounded Theory approach, a literature review exploring the identified features of resilience and the response of an organisation is presented within Chapter 8 Section 8.4. Organisational resilience provides a dynamic adjustment process within organisations in response to either internal or external changes or fluctuations. Following this, organisational resilience draws on the attributes of both *active* and *passive* resilience. Highlighting an organisation’s capacity to withstand or absorb disturbances (*passive resilience*) as well as a proactive engagement and adjustment of
a system in relation to change (active resilience). In relation to the response of an organisation, decision making forms the critical junction within an organisation’s ability to respond effectively to potential threats. Decision making involves analysing information and utilising knowledge and experience in order to resolve problems or issues. Through this, capabilities related to decision making rely on an embedded understanding of the organisation’s structure and value stream, as well as an ability to recognise impinging risk factors and influencing elements. Additionally, resilience highlights the need to develop capabilities towards enabling and supporting the response of an organisation prior to an event. Following the onset of a disruption or change event, organisational systems or elements are then able to draw on these capabilities and competencies when required.

Within Chapter 8, Section 8.5 outlines the attributes of a resilient organisation. These attributes relate to an understanding of operational and response limitations, the ability to maintain criticalities, the ability to effectively restore dependencies, an understanding of the connections between elements and resources, and the capacity to effectively manage or mitigate susceptibilities and vulnerabilities. Following the proposed working definition presented within Chapter 2 Section 2.9, the mechanisms of organisational resilience thereby strive to improve an organisation’s situational awareness, reduce organisational vulnerabilities to systemic risk environments and restore efficacy following the events of a disruption. As such, resilient organisations are able to develop embedded capabilities and competencies towards addressing events and opportunities. Additionally, resilient organisations develop robust communication networks and linkages between organisational elements. This is supported by an organisational wide investment in innovation and the development of employees.
9.3. Contribution to Knowledge

9.3.1. Research Contribution 1 (RC1)

*Contribution to the theoretical and empirical development of organisational resilience.*

The concept of resilience has increased in prominence over recent decades. Although several areas of resilience research have received significant attention, such as social psychology and ecology, the concept of organisational resilience has received relatively little empirical focus and independent attention (Sutcliffe and Vogus, 2003). As a result, the aim and objectives of this research focus on the theoretical and empirical development of resilience within organisations.

Resilience is the intrinsic ability of an element or system to maintain and regain stability following a disruption. Within the context of an organisation, the concept of resilience enables organisational survival and sustainability to be viewed as an inherent system property rather than an abstract goal. Resilience is thereby viewed as a dynamic process and emergent property that relates to the inherent and adaptive qualities that enable an organisation to take a proactive approach to threat and risk mitigation. Subsequently, the concept of resilience may offer a means to develop organisational systems capable of overcoming and transcending turbulent operating conditions through adjusting to immediate risk and preparing for future uncertainty.

Through the developed research design and methodology, the research is focused on developing a more complete understanding and typology of organisational resilience. Where previous studies have focused primarily on the resilience of individuals within organisations, the research strives to develop a more holistic perspective of organisational resilience. Utilising evidence from both an organisational survey and focused organisational case studies, the research presents evidence focused on exploring the dynamics of resilience within organisations. Through this, the research identifies several features of organisational resilience related to organisational responses, situational awareness, decision making, organisational behaviour, organisational management and leadership, organisational learning and organisational adjustment.
9.3.2. Research Contribution 2 (RC2)

*Contribution to the understanding of organisational responses to disruptive or crisis events.*

Focusing on organisational responses to adversity and disruptive events, the research addresses how organisations are able to effectively utilise inherent capabilities and strengths in order to take a proactive approach to overcoming a disruptive event. As a result, the research contributes to the developing theories and typologies of organisational resilience. The research provides further credence to the proposition that resilience is more than an abstract concept for the adaption of an organisation to an environment. Resilience supports an organisation’s ability to develop and maintain adaptive, proactive and reactive strategies within addressing both internal and external change.

Developing from the previously published work of several authors including Staw et al (1981), Barnett and Pratt (2000), Sutcliffe and Vogus (2003) and Powley (2009), the research focuses on the response of an organisation to disruptive and crisis events. This culminates in the development of a causal network related to the response of an organisation. This causal network seeks to address the features of disruptions, risk, uncertainty and contingency within organisations, and draws specific attention to the features of detection, activation, response, containment and recovery. Through this, the developed causal network stands to not only unify several trends of literature, but also provide a means to classify key components of organisational resilience in relation to organisational responses.

9.3.3. Research Contribution 3 (RC3)

*Contribution to the understanding of communication and decision making during periods of adversity and crisis*

Following the development of the generalised causal network within Chapter 8 Section 8.3, the elements within the response of an organisation are identified. These elements include an internal and external awareness, the characterisation of an event, escalation of response activities, containment of event impacts, establishing
organisational linkages and connections, event resolution and stabilisation and finally organisational recovery and development. Central within each of these elements is communication and decision making.

During a response to disruptive or crisis events, organisational actors must maintain criticalities, restore dependencies, understand organisational connectedness (both internal and external), as well as manage and mitigate susceptibilities. Without effective information exchange and communication during these activities, the difficulties faced by organisational elements and functions may be further compounded and opportunities for successful recovery and development restricted. As a result, following the evidence of the research, communication and decision making forms a critical junction within the successful response of an organisation. As such, the developed causal networks highlight the key areas of concern in relation to decision making during the response of an organisation. In addition, the research identifies the critical success factors of an effective response.

9.3.4. Research Contribution 4 (RC4)

Contribution to the understanding of organisational adaption and the development of an organisation’s adaptive capacity.

The research identifies the processes through which an organisation is able to adjust and alter functioning in response to potential threats, opportunities or the associated impacts of an event. As such, the research emphasises the need to develop adaptive, proactive and reactive strategies within the response of an organisation to perceived threats and disruptive events. The identified elements of resilience thereby support the features of organisational adaption and the development of an organisation’s adaptive capacity. Following the analysis of the organisational case studies, the adaptive capacity of an organisation relates to the ability to prepare for periods of adversity (proactive response) and then respond effectively following the impact of an event (reactive response); cultivating elements of both Active and Passive resilience. The improvement and development of an organisation’s adaptive capacity, improves the ability of an organisational system to effectively manage the impacts of an event and alter approaches and functioning when necessary. The adaptive capacity of an
organisation is supported through the development of adaptive, strategic, operational and organisational development capabilities within organisational systems. These capabilities provide both the tangible and intangible resources that enable and support an organisation’s ability to effectively develop, coordinate and deploy response activities.

9.4. Research Limitations

Although the research achieved the intended objectives, there were several recognised limitations. Due to funding and time restrictions the research, including both survey and case study elements, could only be conducted over a relatively small population size. Confidentiality restrictions also further prevented the participation of several organisations within the research. Although focused within Engineering and Technology organisations, the opportunity for generalisation to larger groups is thereby restricted. As a result, the wider application of the research findings may be restricted to those organisations directly involved. However, through following a Grounded Theory approach, the results contribute to the developing theory and typology of organisational resilience.

In relation to the Organisational Resilience Survey, the small sample size limits the analyses possible. Although the sample size was large enough for an exploratory factor analysis and bivariate correlation analysis, a robust multiple regression analysis was not possible. Although data saturation was reached within the research, several additional avenues and trends were identified. This includes features such as Organisational Culture and Supply Chain Management. However, these features were insufficiently presented to incorporate within the findings.

Within the developed causal networks, the relationships between identified variables or nodes are outlined. These relationships describe the ways in which components and variables interact and link together. Through this, causal networks provide an insight into the causality between factors and variables related to the response of an organisation. However, the linkages between certain variables could not be fully explored within the constraints of the project. As a result, certain relationships highlight an association or connection between variables rather than a specific cause-
effect relationship. Although the addition of a fourth case study validated the connections between many of the identified linkages and variables, the connection between the variables of Organisational Development and Environmental Scanning/Monitoring requires further investigation. This association relates to the way in which identified improvements or organisational adjustments are instilled within an organisation. As such, the linkage between the two variables represents the process of change management and organisational learning following the response or adjustment of an organisation.

9.5. Future Work

Although the research design incorporated several measures to ensure rigor, validity and reliability, the generalisation of case study results is often debated. Although a multiple case study approach was followed, with the exception of one organisation (Company 4), participating case study organisations were involved within sectors related to critical infrastructure within the UK. As a result, the developed research constructs may vary across different industries and countries. In order to address this, a large scale organisational survey could be used to investigate the identified factors across different organisations (including SMEs) and industries.

The developed causal network remains theoretical until fully tested. As such, future research efforts should focus on the validation of this model. Following the resilience perspective outlined within the research, it is recommended that researchers should concentrate attention on both the strategic implications of resilience in relation to the performance of an organisation as well as the mechanisms that support the adaption of an organisation during periods of adversity. Through this, researchers and practitioners can begin to address the complexity associated within disruptive events and support the development of organisational capabilities towards the response to major disruptions. Particularly, future research may address the development of dynamic capabilities in relation to resilience and the adaptive capacity of an organisation. Additionally, the development of a longitudinal research study may provide significant insight into the operational strategies and influencing factors that facilitate and maintain the long-term performance of an organisation.
Following the evidence of the Organisational Resilience Survey and the developed organisational case studies, the development of the human resource is emphasised as an important aspect of organisational resilience. Luthans et al (2006) identify resilience as a component of psychological capital and acknowledge its importance within human resource development. Mallak (1998) and Horne and Orr (1998), also recognise the connection between resilience and an individual’s characteristics. The authors also extend this through stating that resilience within organisations develops from the resilience of organisational members (Mallak, 1998), however resilience at the individual level does not guarantee resilience at the organisational level (Horne and Orr, 1998). Powley (2009) develops this further through defining resilience as a socially constructed concept. However, an empirical connection between individual level resilience and organisational level resilience is yet to be unequivocally established. Thereby, an investigation into the potential pathways of individual resilience and psychological capital within organisations may outline several insights into the development of organisational capabilities through human resource development.

Additionally, the development of a performance measurement system (Neely et al, 1995; Neely et al, 2000) related to resilience may support the development of an organisational system’s adaptive capacity. Dalziell and McManus (2004) begin to establish a foundation for the development of organisational metrics to assess the elements of resilience. Establishing a robust metric would allow for the quantitative assessment of an organisation’s potential ability to overcome adversity. However, due to the multifaceted nature of resilience, a single metric may not be suitable. Due to the potential human and psychological linkages within resilience a single assessment may not be appropriate or may yield an incomplete view. Instead several metrics relating to the operationalisation of resilience concepts is required. Developing an assessment of elements such as adaptive capacity, resistance, stability and vulnerability may highlight areas of strength and weakness within an organisational system. Suitable metrics may also aid in identifying an organisation’s core competencies.
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### Table 0-1 - Perspectives, Concepts and Methodologies within Resilience Literature

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## Appendix B

**Template for Case Study Protocol**

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**Details**

- Understanding the background information related to the organisation
- Outline the organisational strengths related to resilience
- Outlining how the organisation identifies inherent strengths (available resources)
- Assess the organisation's capabilities in relation to resilience
- Outline the organisation's goal in relation to resilience

**Outcomes**

- Interview
- Press Releases
- Annual Reports
- Internal Process Audits
- Organisational Capability Audit

**Data Source**

- Interview
- Organisational Chart
- Press Releases
- Annual Reports
- Internal Process Audits
- Organisational Capability Audit
## Appendix B

### Readiness and Preparedness

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<td>- Staff &amp; Resource Development</td>
<td>- Effects on Organisation</td>
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### Details

- Identify how the organisation positions itself against risk and uncertainty
- Understand the preparations currently in place
- Position of the organisation in regards to Contingency Planning
- What benefits has the organisation realised through contingency planning
- Identify any shortcomings in relation to contingency planning

### Outcomes

- Identify the threats and risks posed to the continuity of the organisation
- Outline the characteristics of LHP and HILP
- Identify previous disruptions and the effect on the organisation
- Establish areas of future uncertainty
- Identify the forces that limit or restrict the organisation in relation to resilience

### Data Source

- Interview
- Internal Process Documents
- Press Releases
- Annual Reports
- Internal Process Documents

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## Appendix B

### Response and Adaption

#### Threat Detection
- Recognising a Threat
- Initial Reaction to Threat/Event
- Situational Assessment
- Feedback

#### Response Activation
- Recognising a Disruption
- Environmental Scanning
- Situational Mechanism

#### Organisational Responses
- Action Formation Mechanism
- Transformational Mechanism
- Response Preparations
- Information Seeking
- Action Formation Mechanism

### Outline how the organisation monitors its environment
- Identify which organisational capabilities influence the organisation during this phase
- Establish how response preparations are put in place
- Identify how information is processed and exchanged
- Outline the action taken once a threat is recognised
- Identify how the organisation effectively responds to a disruption or threat

### Identifying the organisational capabilities and resources that support an effective response
- How does an organisation react to external threats?
- Identifying the organisational capabilities and resources that support an effective response
- Understanding how the organisation assesses the demands of an event
- Identifying how the organisation responds

### Outcomes

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### Fundamentals Stages & Processes
- Identification of Response
- Utilising Organisational Resources and Understanding Demands
- Degree of Response (Severity)
- Types of Response
- Feasibility of Response

### Understanding the requirements of an effective response
- Identifying the key stages and features of the organisation outcomes
- Identifying how the organisation integrates preparation to response
- Identifying the required requirements of an effective response

### Organisational Responses
- Implementing Organisational Resources
- Identifying Organisational Resources and Resources that Support an Effective Response
- Understanding How the Organisation Responds
- Feasibility of Response
- Degree of Response (Severity)
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**Data Source**
- Interview
- Organisational Documents
- Internal Process

**Recovery and Adjustment**
- Interview
- Organisational Documents
- Internal Process

**Section**
- Interview
- Organisational Documents
- Internal Process

**Recovery**
- Interview
- Organisational Documents
- Internal Process

**Appendix B**
## Dynamics of Resilience

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### Details

- Identify how the organisation ensures key business objectives are met during a disruption.
- Identify the enabling condition of resilience (7S).
- Identify how organisational capabilities are utilised effectively.
- Outline the determinants of proactive behaviour.

### Outcomes

- Identify the critical success factors of an effective response procedure.
- Outline how organisational strengths can align with critical success factors of resilience.

### Data Source

- Interview
- Press Releases
- Annual Reports
- Internal Process Documents
## Dynamics of Resilience

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### Outcomes

- Interview
- Interview
- Internal Process
- Interview

### Data Source

- Interview
<table>
<thead>
<tr>
<th>Coding Process</th>
<th>Coding Phase</th>
<th>Description</th>
</tr>
</thead>
</table>
| Establish Conceptual and Theoretical Foundation | Preparation | - Literature review  
- Development of epistemological propositions  
- Development of conceptual framework  
- Development of working definition of organisational resilience  
- Develop case study protocol (interviews) |
| Data Collection | Preparation | - Identify relevant participants  
- Conduct interviews  
- Collect relevant documentation and supporting evidence |
| Transcribe Interviews | Preparation | - Transcribe interview recordings  
- Transcribe interview notes |
| Initial Coding | Open Coding | - Establish coding process and database  
- Identify main themes within transcript  
- Review interview notes and memos |
| Line-by-Line Analysis | Open Coding | - Identify key terms and phrases within transcripts  
- Identify and refine terms and phrases  
- Establish concepts |
| Coding Database | Open Coding | - Insert identified concepts into coding database  
- Ensure traceability and logical chain of evidence |
| Establish Categories | Open Coding | - Characterise identified concepts through initial groups relative to the components of the case study protocol  
- Create groupings or clusters of concepts |
| Classification of Concepts | Open Coding | - Reduce and refine clusters  
- Establish themes within identified clusters  
- Identify initial linkages and connections between concepts |
| Establish Dimension Range | Axial Coding | - Identify node groups  
- Identify context and causal conditions  
- Compare node groups; establish relationships between node groups |
| Establish Nodes and Sub-Nodes | Axial Coding | - Identify central phenomenon, idea, event, or incident within clusters and node groups  
- Identify sub-nodes (intervening conditions) |
| Integration of Nodes | Selective Coding | - Extracted relevant nodes in relation to the research aims and objectives  
- Establish conditional propositions and relationships between nodes |
| Establish Core Categories | Selective Coding | - Refine relationships between node groups  
- Review identified relationships between nodes  
- Validate identified relationships against collected data  
- Identity a central theme or term (core category) that |
| Appendix B |
|-----------------|-----------------|
| **Plot Connections** | **Selective Coding** |
| - Plot linkages and connections between extracted nodes | - Identify direction of linkages |

| **Structure Emerging Network** | **Selective Coding** |
| - Arrange network around identified core category | - Illustrate linkages and connections between nodes |
| - Refine structure of network | - Compare emerging network against collected data |

| **Validate Causal Network** | **Selective Coding** |
| - Review and adjust network | - Compare causal network against identified theoretical and conceptual foundations |
| - Review causal network with participating organisation |
Appendix C

Organisational Resilience

Resilience relates to an organisation’s ability to adapt, bounce back and recover from challenges and disruptive events. Natural disasters, economic instability, supply disruptions, equipment failures and terrorism all represent a potential threat to organisations. In order to overcome these events organisations are required to reduce vulnerabilities, effectively restore function following a disruption and develop the ability to identify and take advantage of potential opportunities. Through this organisations will be better prepared for future uncertainties.

The Survey

The aim of this survey is to identify and collect general information relating to the response of your organisation to a disruption or crisis. The survey aims to establish the features of organisational resilience and identify the influence of certain variables. The survey, in part, correlates to a capability audit in which organisational strengths can be identified.

How to Complete the Survey

All responses will remain anonymous. Any information that is provided within the survey will be treated as strictly confidential and will not be disclosed to any third parties. Responding individuals will not be identified.

To complete the survey please select the most appropriate response for each question from the options provided. If a question is not applicable please move onto the following question.

<table>
<thead>
<tr>
<th>Example Questions</th>
<th>Strongly Disagree</th>
<th>Tend to Disagree</th>
<th>Neutral</th>
<th>Tend to Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eg1. The organisation has a clear mission statement</td>
<td>1</td>
<td>2</td>
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<tr>
<td>Eg2. Individuals are given the necessary support required</td>
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<td>2</td>
<td>3</td>
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<td>5</td>
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</table>

Please feel free to leave any comments that you might have. Any information that you feel is relevant to the research that is not covered within the survey, would be greatly appreciated. Any questions or comments regarding the survey please contact Kevin Burnard:
Part A – Organisational Variables

**Initial Opinion**

Following the description of resilience provided within the introduction, for each of the following statements please indicate the extent to which you agree or disagree on the scale provided.

<table>
<thead>
<tr>
<th>Organisational Variable</th>
<th>Strongly Disagree</th>
<th>Tend to Disagree</th>
<th>Neutral</th>
<th>Tend to Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Our organisation is resilient.</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>2. There is an organisation wide sense of susceptibility to unexpected events.</td>
<td>1</td>
<td>2</td>
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<tr>
<td>3. Employees are accountable for reliability.</td>
<td>1</td>
<td>2</td>
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<tr>
<td>4. Leaders pay as much attention to managing unexpected events as they do to achieving formal organisational objectives.</td>
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<td>2</td>
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<tr>
<td>5. People at all organisational levels value quality.</td>
<td>1</td>
<td>2</td>
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<tr>
<td>6. Time is spent identifying the potential implications of future activities and actions.</td>
<td>1</td>
<td>2</td>
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<tr>
<td>7. The organisation pays close attention to when and why employees, customers and other related parties become dissatisfied.</td>
<td>1</td>
<td>2</td>
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<td>5</td>
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<td>8. There is widespread agreement about what the organisation does not want to go wrong.</td>
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<td>2</td>
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<tr>
<td>9. There is widespread agreement about how things could go wrong within the organisation.</td>
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<td>10. The organisation has the ability to change.</td>
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<td>11. The organisation effectively uses forecasting.</td>
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<td>12. Adequate resources are provided for training purposes.</td>
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<tr>
<td>13. Employees have the skills and experience required to perform their role.</td>
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<td>2</td>
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<tr>
<td>14. The organisation is concerned with developing employee skills and knowledge.</td>
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<td>15. The organisation encourages opportunities for employee development.</td>
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<tr>
<td>16. Employees have the ability to use their knowledge in new and novel ways.</td>
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<td>17. The organisation effectively develops employee’s</td>
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Appendix C

18. Employees sometimes use informal contacts to solve problems.

19. Within the organisation, people learn from their mistakes.

20. Employees are able to rely upon each other.

Importance of Organisational Variables and Capabilities

The following section addresses the capabilities of the organisation and identifies its inherent strengths. For each of the following capabilities, please indicate the extent to which you agree or disagree on the scale provided.

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<th>Tend to Agree</th>
<th>Strongly Agree</th>
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<td>21. ‘Performance Accountability’</td>
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<tr>
<td>We are good at obtaining high performance from employees</td>
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<td>22. ‘Adaption’</td>
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<tr>
<td>We are able to adapt and change if necessary</td>
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<td>23. ‘Awareness’</td>
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<tr>
<td>We are good at recognising demands and opportunities</td>
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<td>24. ‘Change’</td>
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<tr>
<td>We are good at recognising the need to change</td>
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<td>25. ‘Collaboration’</td>
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<tr>
<td>We are good at working across boundaries to ensure efficiency and leverage</td>
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<td>26. ‘Communication’</td>
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<tr>
<td>We are good at effectively exchanging information</td>
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<td>27. ‘Community’</td>
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<td>We have a shared vision of the organisations purpose and values</td>
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<td>28. ‘Connection’</td>
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<tr>
<td>We are good at establishing and maintaining linkages and alignment throughout the organisation</td>
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<td>29. ‘Coordination’</td>
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<tr>
<td>We are good at linking our efforts together to achieve effective results</td>
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<td>30. ‘Creating Ideas’</td>
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<tr>
<td>We are good at generating ideas with impact</td>
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### Appendix C

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<th>Strongly Agree</th>
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<td><strong>31. ‘Customer Connectivity’</strong></td>
<td>1 2 3 4 5</td>
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<tr>
<td>We are good at building enduring relationships of trust with targeted customers</td>
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<td><strong>32. ‘Efficiency’</strong></td>
<td>1 2 3 4 5</td>
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<td>We have the ability to accomplish a job effectively</td>
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<td><strong>33. ‘Empowerment’</strong></td>
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<td>We give individuals the ability and support to make decisions</td>
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<td><strong>34. ‘Financial’</strong></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>We are good at managing costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>35. ‘Flexibility’</strong></td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We are able to alter how we operate when it is warranted</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>36. ‘Focus’</strong></td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>We have a shared mindset and coherent brand identity</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>37. ‘Ingenuity’</strong></td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>We are good at developing creative and innovative solutions with available resources</td>
<td></td>
<td></td>
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<tr>
<td><strong>38. ‘Innovation’</strong></td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>We are good at doing something new in both content and process</td>
<td></td>
<td></td>
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<tr>
<td><strong>39. ‘Leadership’</strong></td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>We are good at placing effective leaders in the right positions</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>40. ‘Learning’</strong></td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We develop from our experiences</td>
<td></td>
<td></td>
<td></td>
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<td><strong>41. ‘Perception’</strong></td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>We perceive experiences constructively, identifying areas of opportunity and development</td>
<td></td>
<td></td>
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<td></td>
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<td><strong>42. ‘Planning’</strong></td>
<td>1 2 3 4 5</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>We are good at developing effective plans</td>
<td></td>
<td></td>
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<td><strong>43. ‘Power Structure’</strong></td>
<td>1 2 3 4 5</td>
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<tr>
<td>We have a clear understanding of the organisational structure and the responsibilities of employees</td>
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<td><strong>44. ‘Prediction’</strong></td>
<td>1 2 3 4 5</td>
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<tr>
<td>We effectively utilise forecasting</td>
<td></td>
<td></td>
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<td></td>
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<td><strong>45. ‘Proactive’</strong></td>
<td>1 2 3 4 5</td>
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<td>We have an active approach towards problem solving</td>
<td></td>
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</table>
46. ‘Speed’
We are good at making important changes rapidly

1 2 3 4 5

47. ‘Strategic Unity and Consensus’
We are good at communicating and sharing a strategic point of view

1 2 3 4 5

48. ‘Support’
We have access to adequate external resources

1 2 3 4 5

49. ‘Talent’
We have the competencies and commitment to meet the demands of a situation

1 2 3 4 5

Part B – Disruptive Events and their Impact

1) Occurrence of Disruption
A major disruption is an event that threatens or affects the operation or survival of an organisation. As such, it can be characterised as an event that alters the ‘normal functioning’ of an organisation.

Has your organisation experienced a major disruption* or change event in the past (Approximately)?
*If multiple disruptions have occurred, please select the most recent disruption.

☐ 6 months ☐ 3 years +
☐ 6 - 12 months ☐ 5 years +
☐ 1 - 2 years ☐ None
☐ 2 - 3 years

2) Characterising a Disruption
How would you characterise this disruption? (Tick all that apply)

☐ No Disruption ☐ Loss of Key Skills
☐ Customer Health/ Product Safety Incident ☐ Loss of Staff
☐ Damage or Failure of Product/ Service ☐ Machine/ Equipment Failure
☐ Damage to IT ☐ Regulatory Upheaval
☐ Damage to Machine/ Equipment ☐ Supply Chain Disruption
☐ Damage to Telecommunications ☐ Terrorist Related Damage
☐ Employee Health and Safety Incident ☐ Utility Outage
☐ Environmental Incident ☐ Other (Please Specify)
☐ Extreme Weather
☐ Financial
☐ Fire
☐ Industrial Action
☐ Inventory Issues
☐ Loss of Access to Site
Impact of the Disruption

From the scale provided, please rate the impact of the disruption to the operation of the following organisational levels. The scale ranges from 1 = no impact to 9 = severe implications and disruption

<table>
<thead>
<tr>
<th>Organisational Level</th>
<th>None</th>
<th>Minor</th>
<th>Moderate</th>
<th>Severe</th>
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<tbody>
<tr>
<td>3. Individual or personal Level</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<tr>
<td>4. Departmental Level</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. Managerial Level</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. Senior Management Level</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. Organisational Level</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. Industry Level</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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</table>

Part C – Preparations and Response

Response of the Organisation

Relative to the response of your organisation to a disruption, for each of the following statements please indicate the extent to which you agree or disagree on the scale provided:

<table>
<thead>
<tr>
<th>Variables</th>
<th>Strongly Disagree</th>
<th>Tend to Disagree</th>
<th>Neutral</th>
<th>Tend to Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Adequate emergency planning and procedures are in place</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. Emergency planning is used effectively</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. We are passive in our behaviour towards overcoming a disruption</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. We understand our organisational vulnerabilities</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. We challenge existing standards and procedures</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. There is close co-operation between individuals, groups and departments</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. We conserve available resources</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. We create favourable working conditions</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
9. There is a culture of Continuous Improvement (CI)  & 1 2 3 4 5
10. Decisions are made quickly & 1 2 3 4 5
11. Decisions are often made with a lack of evaluation & 1 2 3 4 5
12. We develop new knowledge and understandings & 1 2 3 4 5
13. Effective decisions are made & 1 2 3 4 5
14. We are able to effectively interpret the demands of a situation & 1 2 3 4 5
15. We identify opportunities & 1 2 3 4 5
16. We are effective at managing risk & 1 2 3 4 5
17. We are able to develop unique solutions to problems & 1 2 3 4 5
18. We are good at creating alternative ideas & 1 2 3 4 5
19. There is an increased exchange of information & 1 2 3 4 5
20. Individuals are given the authority to make decisions & 1 2 3 4 5
21. Individuals with the necessary expertise are used & 1 2 3 4 5
22. We are effective at looking for information & 1 2 3 4 5
23. The majority of decisions are made by senior management & 1 2 3 4 5
24. We utilise information from a variety of sources & 1 2 3 4 5
25. There is a short term focus on immediate benefits & 1 2 3 4 5
26. We effectively utilise organisational strengths & 1 2 3 4 5
27. We effectively utilise available resources & 1 2 3 4 5
28. There is a high degree of collaboration between departments & 1 2 3 4 5

29) Final Comments
Do you consider your organisation resilient towards major disruptions?

Please feel free to leave any comments that you might have. Any information that you feel is relevant to the research that is not covered within the survey, would be greatly appreciated.
## Appendix D

### Descriptive Statistics for Organisational Resilience Scale

<table>
<thead>
<tr>
<th>Scale Item</th>
<th>Mean</th>
<th>Median</th>
<th>Std. Deviation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organisation is resilient</td>
<td>3.7692</td>
<td>4.0000</td>
<td>1.14760</td>
<td>4.00</td>
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<tr>
<td>Sense of susceptibility</td>
<td>3.3590</td>
<td>3.0000</td>
<td>0.96902</td>
<td>3.00</td>
</tr>
<tr>
<td>Employee accountable for reliability</td>
<td>3.8547</td>
<td>4.0000</td>
<td>0.72236</td>
<td>3.00</td>
</tr>
<tr>
<td>Managing the unexpected</td>
<td>3.1709</td>
<td>3.0000</td>
<td>1.13176</td>
<td>4.00</td>
</tr>
<tr>
<td>Employees value quality</td>
<td>4.1966</td>
<td>4.0000</td>
<td>0.64647</td>
<td>2.00</td>
</tr>
<tr>
<td>Effectively use forecasting</td>
<td>3.1111</td>
<td>3.0000</td>
<td>1.17281</td>
<td>4.00</td>
</tr>
<tr>
<td>Resources for training</td>
<td>3.5299</td>
<td>4.0000</td>
<td>1.08733</td>
<td>4.00</td>
</tr>
<tr>
<td>Employees have skills to perform</td>
<td>4.1197</td>
<td>4.0000</td>
<td>0.78961</td>
<td>3.00</td>
</tr>
<tr>
<td>Developing employee knowledge</td>
<td>4.0342</td>
<td>4.0000</td>
<td>0.84007</td>
<td>3.00</td>
</tr>
<tr>
<td>Opportunities for employee development</td>
<td>4.0684</td>
<td>4.0000</td>
<td>0.79575</td>
<td>3.00</td>
</tr>
<tr>
<td>Use knowledge in novel ways</td>
<td>3.6838</td>
<td>4.0000</td>
<td>0.90639</td>
<td>3.00</td>
</tr>
<tr>
<td>Develop employee competencies</td>
<td>3.7179</td>
<td>4.0000</td>
<td>0.96353</td>
<td>3.00</td>
</tr>
<tr>
<td>Use informal contacts to solve problems</td>
<td>3.8291</td>
<td>4.0000</td>
<td>0.94038</td>
<td>4.00</td>
</tr>
<tr>
<td>Employees learn from mistakes</td>
<td>3.8547</td>
<td>4.0000</td>
<td>0.79073</td>
<td>3.00</td>
</tr>
<tr>
<td>Employee rely on each other</td>
<td>4.0085</td>
<td>4.0000</td>
<td>0.80404</td>
<td>3.00</td>
</tr>
<tr>
<td>Identifying potential implications</td>
<td>3.2735</td>
<td>4.0000</td>
<td>1.05556</td>
<td>4.00</td>
</tr>
<tr>
<td>Attention is paid when parties become dissatisfied</td>
<td>3.4957</td>
<td>4.0000</td>
<td>1.07177</td>
<td>3.00</td>
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<tr>
<td>Agreement about what the organisations doesn't want to go wrong</td>
<td>3.8205</td>
<td>4.0000</td>
<td>0.83682</td>
<td>3.00</td>
</tr>
<tr>
<td>Agreement about how things could go wrong</td>
<td>3.4615</td>
<td>4.0000</td>
<td>0.84627</td>
<td>3.00</td>
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<tr>
<td>Organisations ability to change</td>
<td>3.9573</td>
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</table>

### Descriptive Statistics for Organisational Response Scale

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<th>Mean</th>
<th>Median</th>
<th>Std. Deviation</th>
<th>Range</th>
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</thead>
<tbody>
<tr>
<td>Adequate emergency planning</td>
<td>4</td>
<td>4</td>
<td>1.18176</td>
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</tr>
<tr>
<td>Emergency planning used effectively</td>
<td>3.6496</td>
<td>4</td>
<td>1.19854</td>
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<tr>
<td>Passive in behaviour</td>
<td>3.2991</td>
<td>3</td>
<td>1.16903</td>
<td>4</td>
</tr>
<tr>
<td>Understand organisational vulnerabilities</td>
<td>3.4786</td>
<td>4</td>
<td>0.96131</td>
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<tr>
<td>Challenge existing standards</td>
<td>3.547</td>
<td>4</td>
<td>0.84584</td>
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<tr>
<td>Cooperation between members</td>
<td>3.8462</td>
<td>4</td>
<td>0.80532</td>
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<tr>
<td>Conserve available resources</td>
<td>3.5641</td>
<td>4</td>
<td>0.93204</td>
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<tr>
<td>Create favourable working conditions</td>
<td>3.6154</td>
<td>4</td>
<td>0.98126</td>
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<tr>
<td>Continuous Improvement culture</td>
<td>4.0598</td>
<td>4</td>
<td>0.79101</td>
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<tr>
<td>Decisions made quickly</td>
<td>3.188</td>
<td>3</td>
<td>0.88999</td>
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### Descriptive Statistics for Organisational Capabilities Scale

<table>
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<th>Mean</th>
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<th>Std. Deviation</th>
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<tr>
<td>Performance Accountability</td>
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<tr>
<td>Adaption</td>
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<tr>
<td>Awareness</td>
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<td>Change</td>
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<td>Collaboration</td>
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<td>Communication</td>
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<td>Community</td>
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<td>Creating Ideas</td>
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<td>Customer Connectivity</td>
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## Appendix E

<table>
<thead>
<tr>
<th>Readiness and Preparation</th>
<th>Company 1 – ABB</th>
<th>Company 2 – E.ON</th>
<th>Company 3 – UAM</th>
<th>Company 4 – 3M Healthcare</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Limit opportunity for event escalation</td>
<td>- Effectively recognise change</td>
<td>- Established criticalities and dependencies</td>
<td>- Understand the organisational value chain</td>
<td></td>
</tr>
<tr>
<td>- Consider both high and low probability events</td>
<td>- Monitor environment</td>
<td>- Continual monitoring of operations</td>
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<td>- Focus on developing front end planning</td>
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## Appendix E

| Recovery and Adjustment | - Identify learnings and improvements  
  - Exchange experiences across organisational group (Forums)  
  - Develop and improve processes and procedures  
  - Align organisational elements across network | - Implement processes and controls  
  - Identify learnings and improvements  
  - Address operational constraints  
  - Embed change within organisational elements | - Response linked to regulations  
  - Identify learnings and improvements  
  - Established process to capture improvements | - Identify root cause  
  - Established investigation procedure  
  - Identify learnings and improvements  
  - Communicate experiences  
  - Identify areas of vulnerability |
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<td>Establishing clear and effective communication and group structure</td>
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<td>Establishing incident response and time parameters on critical processes</td>
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<td>Establishing the strategic importance of the ecosystem</td>
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<td>Establishing the strategic importance of the ecosystem</td>
</tr>
<tr>
<td>Company 1 – ABB</td>
<td>Company 4 – 3M Healthcare</td>
<td></td>
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<tr>
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</tr>
<tr>
<td><strong>Disruptive Events</strong></td>
<td><strong>Activation</strong></td>
<td></td>
</tr>
<tr>
<td>- Impact on share price</td>
<td>- Access necessary expertise</td>
<td></td>
</tr>
<tr>
<td>- Impact image of ABB</td>
<td>- Quality assess</td>
<td></td>
</tr>
<tr>
<td>- Serious or multiple loss of life</td>
<td>- external 3M divisions</td>
<td></td>
</tr>
<tr>
<td>- Altered organisational processes</td>
<td>- Access resource from</td>
<td></td>
</tr>
<tr>
<td>- Altered organisational controls</td>
<td>- Establish monitoring program</td>
<td></td>
</tr>
<tr>
<td>- Altered management structure</td>
<td>- Quarantine damaged products</td>
<td></td>
</tr>
<tr>
<td>- Future liabilities linked to events</td>
<td>- Communicate event</td>
<td></td>
</tr>
</tbody>
</table>

**Appendix F**
<table>
<thead>
<tr>
<th>Established means of characterising an event and the severity</th>
<th>Established means of characterising an event and the severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severity determines the level of individual involved within response</td>
<td>Severity determines the level of individual involved within response</td>
</tr>
<tr>
<td>Understand the level of risk the organisation is able to tolerate</td>
<td>Understand the level of risk the organisation is able to tolerate</td>
</tr>
<tr>
<td>Established business impact analysis</td>
<td>Established business impact analysis</td>
</tr>
<tr>
<td>Impact of external events can have direct impact on business strategy and direction</td>
<td>Impact of external events can have direct impact on business strategy and direction</td>
</tr>
<tr>
<td>Events in Japan highlight importance of addressing low probability events</td>
<td>Events in Japan highlight importance of addressing low probability events</td>
</tr>
<tr>
<td>Understand wider implications of event (environmental, reputational etc)</td>
<td>Understand wider implications of event (environmental, reputational etc)</td>
</tr>
<tr>
<td>Understanding the impact of potential disruption or event</td>
<td>Understanding the impact of potential disruption or event</td>
</tr>
<tr>
<td>Organisation facing a number of risks and issues</td>
<td>Organisation facing a number of risks and issues</td>
</tr>
<tr>
<td>Large scale events outside of normal business consideration</td>
<td>Large scale events outside of normal business consideration</td>
</tr>
<tr>
<td>Significant long-term implications</td>
<td>Significant long-term implications</td>
</tr>
<tr>
<td>Large scale nuclear events</td>
<td>Large scale nuclear events</td>
</tr>
<tr>
<td>Time delay in establishing full impact of organisation's suppliers</td>
<td>Time delay in establishing full impact of organisation's suppliers</td>
</tr>
<tr>
<td>Implications of external events in industry</td>
<td>Implications of external events in industry</td>
</tr>
<tr>
<td>Events have global impact on nuclear industry</td>
<td>Events have global impact on nuclear industry</td>
</tr>
<tr>
<td>Political influence on event</td>
<td>Political influence on event</td>
</tr>
<tr>
<td>Challenges to stock price</td>
<td>Challenges to stock price</td>
</tr>
<tr>
<td>Development plans changed</td>
<td>Development plans changed</td>
</tr>
<tr>
<td>Fukuishima events affected business</td>
<td>Fukuishima events affected business</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Company 3 – UAM</th>
<th>Company 2 – E.ON</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
### Knowledge and Experience

- ABB focus on core values
- Ability to lead and manage a change in the organisation
- Identifying competencies and areas of expertise
- Experience and exposure to severe crisis
- Lessons are documented and disseminated across group
- Identity and implementation best practices
- Ensuring guidelines for businesses are aligned and accessible
- Past experienced has resulted in the development of support
- Continuous learning within the organisation
- ABB has a good understanding and connection to legislation
- Size of organisation offers a diverse and strong pool of

### Preparation

- Scenario planning used to validate country crisis plan
- Use of scenario simulation sessions
- Establishment procedures for known threats
- Well established communication network
- Each country is responsible for developing their own unique
- Crisis training provided

### Company 1 – ABB

### Company 4 – 3M Healthcare

- Risk of having entrenched views
- Loss of key skills
- External factor – Regulatory change
- External factors – Change in suppliers
- External factors – Change in direction
- External – May cause organisational change
- Previous events provide a reference point for

- Assess scale of event
- Clearly identify the impact and details of the event
- Physically assess impact of event
- Develop response plan
- Evacuate people out of the facility
- Develop a stepwise approach
- Identify available resources
- Prioritise impact of event
- Assess scale of event
- Evacuate people out of the facility
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- Prioritise impact of event
- Assess scale of event
### Company 1
- Understanding organisational strengths
- Don't address issues in isolation - Penalty
- Procedure of each country
- Vertical to understand the response
- Share learning across industry
- Infrastructure
- Connection to National Response authorities and operators
- Close involvement with regulators and partners
- Regular management reviews
- Communication and alignment
- Line could start adapting and operate
- Developing and understanding of events
- Developing and understanding of operations
- Review meetings with suppliers and customers
- Develop understanding of operations
- Use of scenario simulation sessions
- Utilisation of a robust system to capture
- Use of lean and Six Sigma tools
- Regular risk process (internal and external)
- Quality assurance and compliance
- Regulatory framework
- Emergency planning initiatives from industry
- Consistent monitoring of regulations
- Review of events that effect industry
- Involvement with advisory committee

### Company 2
- Electronic management system to document
- Structured approach to managing information
- Establish connection to external bodies and authorities
- The tipping point for a business going into a crisis is the way in which communication is managed
- Resilience requires the development of a broad understanding
- Understanding from senior management
- Understanding critical operations
- Developing a wider business resilience strategy
- Efficiency in operations
- Use of standards as a framework
- Quality assurance
- Align to recognised standard
- Services
- Develop responsive plans in line with emergency

### Company 3
- E.ON
- Understanding from sector management
- Understanding critical operations
- Align to recognised standard
- Quality assurance
- Use of standards as a framework
- Efficiency in operations
- Developing a wider business resilience strategy
- Emergency planning initiatives from industry
- Consistent monitoring of regulations
- Review of events that effect industry
- Involvement with advisory committee
- Use of scenario simulation sessions
- Utilisation of a robust system to capture
- Use of lean and Six Sigma tools
- Regular risk process (internal and external)
- Quality assurance and compliance
- Regulatory framework
- Emergency planning initiatives from industry
- Consistent monitoring of regulations
- Review of events that effect industry
- Involvement with advisory committee
Appendix F

Company 4 – 3M Healthcare
Response dependent on individuals
Direction through individuals
Senior management responsible to
developing and coordinating response
plans
Based on knowledge and experience
Use of management team
Leadership on site
Safety is a priority through all planning
Even within unprecedented situations
is paramount
EH&S
expertise within the
Understand
-organisation
Ensuring the right connection are in
place
resource when required
in event
pullto
Able toprior
Black belt training Adaptable skills
Established attributes for leadership
Structured approach to employee
development
Clear guidelines for progress and
improvement
Ensure accurate information about all
sites
Experienced management team
Provide experience of addressing an
event

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Company 1 – ABB
ABB Group Provide
Guidelines
Centralised operations
with Regional Approach
Changing Organisational
Culture
Clear Responsibilities and
Accountability
Diverse Operations and
Portfolio
Established connections
to external support
Established
Organisational Structure
and Hierarchy
Established strategic
imperatives
Experienced Senior
Management Team
External Focus
Commonality (One ABB)

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Company 2 – E.ON

Resilience lead by senior managers
Resilience requires an holistic approach
Established connection to national safety
infrastructure and agencies
Linking resilience with strategic priorities
Clearly established and recognised strengths within
the organisation
Understand risk
Need to develop robust fit for purpose controls and
processes
Clear organisational objectives and goals

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Organisational Dynamics and Behaviour


<table>
<thead>
<tr>
<th>Company 1 – ABB</th>
<th>Organisational Development and Growth</th>
<th>Identifying Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Growth through Acquisitions</td>
<td>Acquisitions provide access to markets</td>
</tr>
<tr>
<td></td>
<td>Establishment of Six Sigma culture</td>
<td>Learn from experience (Organisational Development)</td>
</tr>
<tr>
<td></td>
<td>Continuous Improvement</td>
<td>Continually seeking improvement (Organisational Development)</td>
</tr>
<tr>
<td></td>
<td>Leadership Development</td>
<td>Practically managing events offer organisational developmental opportunities</td>
</tr>
<tr>
<td></td>
<td>Effective Supply Chain</td>
<td>Incrementally identifying responsibilities</td>
</tr>
<tr>
<td></td>
<td>Management</td>
<td>Need to develop robust communication system</td>
</tr>
<tr>
<td></td>
<td>Planning</td>
<td>Need to establish visibility of incident</td>
</tr>
<tr>
<td></td>
<td>Leadership Development</td>
<td>Need to establish visibility of incident</td>
</tr>
<tr>
<td></td>
<td>Openness to Change</td>
<td>Practically managing events offer organisational developmental opportunities</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Company 2 – UAM</th>
<th>Identifying Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global 3M network</td>
<td>People are the key asset</td>
</tr>
<tr>
<td></td>
<td>Connection to Parent Companies</td>
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<tr>
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<td>Commonality and Branding</td>
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<td>Contract between Divisions</td>
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<td>Contract Security</td>
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<tr>
<td></td>
<td>Identified Dependencies</td>
</tr>
<tr>
<td></td>
<td>Identified limitations and constraints</td>
</tr>
<tr>
<td></td>
<td>Establishing Customer Support and Coordination with Customers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Company 3 – UAM</th>
<th>Organisational Growth and Development</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Identifying Opportunities</td>
</tr>
<tr>
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<td>Growth through Acquisitions</td>
</tr>
<tr>
<td></td>
<td>Establishment of Six Sigma culture</td>
</tr>
<tr>
<td></td>
<td>Continuous Improvement</td>
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<td></td>
<td>Leadership Development</td>
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<td></td>
<td>Effective Supply Chain</td>
</tr>
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<td>Management</td>
</tr>
<tr>
<td></td>
<td>Planning</td>
</tr>
<tr>
<td></td>
<td>Leadership Development</td>
</tr>
<tr>
<td></td>
<td>Openness to Change</td>
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</table>

<table>
<thead>
<tr>
<th>Company 4 – 3M Healthcare</th>
<th>Organisational Development and Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Identifying Opportunities</td>
</tr>
<tr>
<td></td>
<td>Growth through Acquisitions</td>
</tr>
<tr>
<td></td>
<td>Establishment of Six Sigma culture</td>
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<td></td>
<td>Continuous Improvement</td>
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<td></td>
<td>Leadership Development</td>
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<tr>
<td></td>
<td>Effective Supply Chain</td>
</tr>
<tr>
<td></td>
<td>Management</td>
</tr>
<tr>
<td></td>
<td>Planning</td>
</tr>
<tr>
<td></td>
<td>Leadership Development</td>
</tr>
<tr>
<td></td>
<td>Openness to Change</td>
</tr>
<tr>
<td>Understanding</td>
<td>Share information between business units</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------------------------------</td>
</tr>
</tbody>
</table>
| Manage expectations and develop capabilities | •
| Maintain awareness of operational resilience | •
| Continuously develop operational capabilities | •
| Broaden portfolio | •
| Reduce internal costs | •
| Take advantage of market fluctuations | •
| Capturing Innovation and Opportunity | •

<table>
<thead>
<tr>
<th>NEED TO ESTABLISH CLEAR STRATEGIC PRIORITIES</th>
<th>NEED TO ESTABLISH CLEAR STRATEGIC PRIORITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Establish strategic objectives</td>
<td>• Establish strategic objectives</td>
</tr>
<tr>
<td>• Strategic focus is a bottom up approach</td>
<td>• Strategic focus is a bottom up approach</td>
</tr>
<tr>
<td>• Establish hierarchical risk review process</td>
<td>• Establish hierarchical risk review process</td>
</tr>
<tr>
<td>• Focus on developing globally</td>
<td>• Focus on developing globally</td>
</tr>
<tr>
<td>• Identifying business risk within opportunity</td>
<td>• Identifying business risk within opportunity</td>
</tr>
<tr>
<td>• Strategy development following disruption</td>
<td>• Strategy development following disruption</td>
</tr>
<tr>
<td>• Learning from external events</td>
<td>• Learning from external events</td>
</tr>
<tr>
<td>• Investment in R&amp;D</td>
<td>• Investment in R&amp;D</td>
</tr>
<tr>
<td>• Investment in new technology</td>
<td>• Investment in new technology</td>
</tr>
<tr>
<td>• Use of innovation to address environmental issue</td>
<td>• Use of innovation to address environmental issue</td>
</tr>
<tr>
<td>• Establish value added</td>
<td>• Establish value added</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMPANY 3 – UAM</th>
<th>COMPANY 2 – E.ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Differentiate from competitors</td>
<td>•</td>
</tr>
<tr>
<td>• Change and develop existing methods and processes</td>
<td>•</td>
</tr>
<tr>
<td>• Challenge existing methods and processes</td>
<td>•</td>
</tr>
<tr>
<td>• UAM has to build connections and relationships</td>
<td>•</td>
</tr>
<tr>
<td>• Mandate awareness of external drivers</td>
<td>•</td>
</tr>
<tr>
<td>• Focus on developing globally</td>
<td>•</td>
</tr>
<tr>
<td>• Establish hierarchical risk review process</td>
<td>•</td>
</tr>
<tr>
<td>• Identify business risk within opportunity</td>
<td>•</td>
</tr>
<tr>
<td>• Strategy development following disruption</td>
<td>•</td>
</tr>
</tbody>
</table>

Appendix F
<table>
<thead>
<tr>
<th>Innovation without constraints</th>
<th>System Development towards more robust range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organisation cultures diverse skills</td>
<td>Established Training and Development</td>
</tr>
<tr>
<td>Change driven by learning and evolution</td>
<td>Seek stability within changes</td>
</tr>
</tbody>
</table>

- Encouraged to change processes
- Ideas for improvement captured
- Seek different perspectives
- Internal opportunities – New Direction
- Internal opportunities – Product
- Internal opportunities – Customer
- Identify improvements through audits and training

**Company 4 – 3M Healthcare**
## Appendix G

### Adaptive Capabilities

#### Table 0-1 - Organisational Capability Table - Flexibility

<table>
<thead>
<tr>
<th>Capability</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexibility</td>
<td>- Find alternative supply and rearrange to complete contract</td>
</tr>
<tr>
<td></td>
<td>- Flexible organisational systems and operations</td>
</tr>
<tr>
<td></td>
<td>- Ability and proclivity of employees to work under pressure</td>
</tr>
<tr>
<td></td>
<td>- Welcome challenges</td>
</tr>
<tr>
<td></td>
<td>- Develop strategic view of the organisation</td>
</tr>
<tr>
<td></td>
<td>- Flexible work arrangement</td>
</tr>
<tr>
<td></td>
<td>- Capability to operate virtually</td>
</tr>
<tr>
<td></td>
<td>- Seek alternative means of operation</td>
</tr>
<tr>
<td></td>
<td>- Adaptability within organisational members</td>
</tr>
</tbody>
</table>

#### Table 0-2 - Organisational Capability Table - Resourcefulness

<table>
<thead>
<tr>
<th>Capability</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resourcefulness</td>
<td>- Provide support</td>
</tr>
<tr>
<td></td>
<td>- Emphasis on innovation and creativity</td>
</tr>
<tr>
<td></td>
<td>- Develop a compromise</td>
</tr>
<tr>
<td></td>
<td>- Understand criticality</td>
</tr>
<tr>
<td></td>
<td>- Awareness of functional roles</td>
</tr>
<tr>
<td></td>
<td>- Variety of means to capture information</td>
</tr>
</tbody>
</table>

#### Table 0-3 - Organisational Capability Table - Creativity

<table>
<thead>
<tr>
<th>Capability</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creativity</td>
<td>- Create novel solutions</td>
</tr>
<tr>
<td></td>
<td>- Emphasis on innovation</td>
</tr>
<tr>
<td></td>
<td>- Develop multiple solutions</td>
</tr>
<tr>
<td></td>
<td>- Multiple interpretations</td>
</tr>
<tr>
<td></td>
<td>- Facilitate development of ideas and solutions</td>
</tr>
</tbody>
</table>
Appendix G

<table>
<thead>
<tr>
<th>Capability</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Develop creative solutions to contract terms</td>
<td></td>
</tr>
<tr>
<td>- Openly discuss alternative operational methods</td>
<td></td>
</tr>
<tr>
<td>- High calibre of staff (Experienced staff)</td>
<td></td>
</tr>
</tbody>
</table>

**Strategic Capabilities**

**Table 0-4 - Organisational Capability Table - Robustness**

<table>
<thead>
<tr>
<th>Capability</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robustness</td>
<td>- Follow site contingency procedures</td>
</tr>
<tr>
<td></td>
<td>- Identify employee strengths</td>
</tr>
<tr>
<td></td>
<td>- Organisations operate through people</td>
</tr>
<tr>
<td></td>
<td>- Security within operations</td>
</tr>
<tr>
<td></td>
<td>- Maintaining operational and industry knowledge</td>
</tr>
<tr>
<td></td>
<td>- Depth of supply chain</td>
</tr>
<tr>
<td></td>
<td>- Supported by processes instead of being governed by them</td>
</tr>
<tr>
<td></td>
<td>- Ability to absorb impact financially</td>
</tr>
<tr>
<td></td>
<td>- Robust physical response</td>
</tr>
<tr>
<td></td>
<td>- Development of rigorous procedures</td>
</tr>
<tr>
<td></td>
<td>- Industry wide preparations</td>
</tr>
<tr>
<td></td>
<td>- Understanding areas of limitation</td>
</tr>
<tr>
<td></td>
<td>- Clear and effective communication channels</td>
</tr>
</tbody>
</table>

**Table 0-5 - Organisational Capability Table - Leadership**

<table>
<thead>
<tr>
<th>Capability</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership</td>
<td>- Empower employees</td>
</tr>
<tr>
<td></td>
<td>- Establish clear direction (goals, objectives, priorities)</td>
</tr>
<tr>
<td></td>
<td>- Lead through example</td>
</tr>
<tr>
<td></td>
<td>- Effective communication</td>
</tr>
<tr>
<td></td>
<td>- Strategic view of organisation and operations</td>
</tr>
<tr>
<td></td>
<td>- Leadership commitment</td>
</tr>
<tr>
<td></td>
<td>- Close involvement</td>
</tr>
<tr>
<td></td>
<td>- Establish event management team</td>
</tr>
</tbody>
</table>
Appendix G

<table>
<thead>
<tr>
<th>Capability</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Motivate employees</td>
<td></td>
</tr>
<tr>
<td>- Knowledge and experience</td>
<td></td>
</tr>
<tr>
<td>- Ability to coordinate team and response activities</td>
<td></td>
</tr>
<tr>
<td>- Organisational understanding</td>
<td></td>
</tr>
<tr>
<td>- Authority to act</td>
<td></td>
</tr>
<tr>
<td>- Seek opportunities for development</td>
<td></td>
</tr>
<tr>
<td>- Provide support</td>
<td></td>
</tr>
</tbody>
</table>

Table 0-6 - Organisational Capability Table - Decision Making

<table>
<thead>
<tr>
<th>Capability</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decision Making</td>
<td></td>
</tr>
<tr>
<td>- Utilise expertise and knowledge</td>
<td></td>
</tr>
<tr>
<td>- Organisational understanding</td>
<td></td>
</tr>
<tr>
<td>- Understand value stream within organisation</td>
<td></td>
</tr>
<tr>
<td>- Understand the nature of risk</td>
<td></td>
</tr>
<tr>
<td>- Effective communication within both internal and external stakeholders</td>
<td></td>
</tr>
<tr>
<td>- Ability to recognise opportunities</td>
<td></td>
</tr>
<tr>
<td>- Understand criticality</td>
<td></td>
</tr>
<tr>
<td>- Enhanced situational understanding</td>
<td></td>
</tr>
<tr>
<td>- Access to information</td>
<td></td>
</tr>
<tr>
<td>- Ability to transfer information</td>
<td></td>
</tr>
<tr>
<td>- Willingness to act decisively</td>
<td></td>
</tr>
<tr>
<td>- Ability to communicate effectively</td>
<td></td>
</tr>
<tr>
<td>- Defer decision authority</td>
<td></td>
</tr>
<tr>
<td>- Ability to make quick decisions</td>
<td></td>
</tr>
</tbody>
</table>

Table 0-7 - Organisational Capability Table - Situational Awareness

<table>
<thead>
<tr>
<th>Capability</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Situational Awareness</td>
<td></td>
</tr>
<tr>
<td>- Internal and external awareness</td>
<td></td>
</tr>
<tr>
<td>- Developed through a continuous process</td>
<td></td>
</tr>
<tr>
<td>- Organisational understanding</td>
<td></td>
</tr>
<tr>
<td>- Understand value stream within organisation</td>
<td></td>
</tr>
</tbody>
</table>
Environmental/Market understanding
- Environmental scanning
- Established linkages between organisational elements
- Awareness of changes in operating environment
- Connection to customers

---

### Operational Capabilities

#### Table 0-8 - Organisational Capability Table - Efficiency

<table>
<thead>
<tr>
<th>Capability</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency</td>
<td>- Focus on reducing waste</td>
</tr>
<tr>
<td></td>
<td>- Clear reporting lines</td>
</tr>
<tr>
<td></td>
<td>- Clear authority structure</td>
</tr>
<tr>
<td></td>
<td>- Continually streamline operations</td>
</tr>
<tr>
<td></td>
<td>- Continually developing operations</td>
</tr>
<tr>
<td></td>
<td>- Emphasis placed on improvements</td>
</tr>
</tbody>
</table>

#### Table 0-9 - Organisational Capability Table - Diversity

<table>
<thead>
<tr>
<th>Capability</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diversity</td>
<td>- Broad portfolio of suppliers</td>
</tr>
<tr>
<td></td>
<td>- Diverse range of operations</td>
</tr>
<tr>
<td></td>
<td>- Diverse portfolio</td>
</tr>
<tr>
<td></td>
<td>- Backup distribution lines</td>
</tr>
<tr>
<td></td>
<td>- Diversity of employees</td>
</tr>
<tr>
<td></td>
<td>- Broad range of employee skills</td>
</tr>
</tbody>
</table>

#### Table 0-10 - Organisational Capability Table - Operational Capacity

<table>
<thead>
<tr>
<th>Capability</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational Capacity (Equipment)</td>
<td>- Good availability of equipment</td>
</tr>
<tr>
<td></td>
<td>- Innovative equipment</td>
</tr>
<tr>
<td></td>
<td>- High capacity</td>
</tr>
</tbody>
</table>
### Environmental sustainability
- Constant development of ideas
- Constantly developing equipment capabilities
- Use equipment to offer advantage to customers
- Attention to detail
- Safety consideration in the design of equipment
- Develop/modify equipment to provide advantage

### Table 0-11 - Organisational Capability Table - Redundancy

<table>
<thead>
<tr>
<th>Capability</th>
<th>Features</th>
</tr>
</thead>
</table>
| Redundancy | - Global platform through diverse facility locations  
- Insurance  
- Multiple supply sources  
- Multiple approaches, pathways and connections available  
- Variety of accounts around the globe  
- Inventory available  
- IT infrastructure is backed up on external server  
- Virtual role system  
- Diversity of operational activities |

### Table 0-12 - Organisational Capability Table - Rapidity

<table>
<thead>
<tr>
<th>Capability</th>
<th>Features</th>
</tr>
</thead>
</table>
| Rapidity   | - Actively solve problems  
- Effective exchange of information  
- Changes/adjustments made quickly  
- Assets are in different locations around the world  
- Ability to mobilise quickly through access to resources  
- Streamlining of processes |

### Organisational Development Capabilities
### Table 0-13 - Organisational Capability Table - Employee Development

<table>
<thead>
<tr>
<th>Capability</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employee Development</td>
<td>- Employee Development Board to develop competencies</td>
</tr>
<tr>
<td></td>
<td>- Skills register to identify expertise</td>
</tr>
<tr>
<td></td>
<td>- Understand capabilities of individual employees</td>
</tr>
<tr>
<td></td>
<td>- Supportive succession planning</td>
</tr>
<tr>
<td></td>
<td>- Involvement in diverse activities</td>
</tr>
<tr>
<td></td>
<td>- Expose employees to different roles</td>
</tr>
<tr>
<td></td>
<td>- Transfer skills and experience</td>
</tr>
<tr>
<td></td>
<td>- Opportunity to introduce new ideas</td>
</tr>
<tr>
<td></td>
<td>- Take advantage of opportunities outside of skill base</td>
</tr>
<tr>
<td></td>
<td>- Employees able to develop in areas of interest</td>
</tr>
</tbody>
</table>

### Table 0-14 - Organisational Capability Table - Strength of Staff

<table>
<thead>
<tr>
<th>Capability</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength of Staff</td>
<td>- Identify key responsibilities of employees</td>
</tr>
<tr>
<td></td>
<td>- Small team with close connection between members</td>
</tr>
<tr>
<td></td>
<td>- Business operates through people</td>
</tr>
<tr>
<td></td>
<td>- Strength of the organisation is the ability of the people</td>
</tr>
<tr>
<td></td>
<td>- Employee care about the success of the business</td>
</tr>
<tr>
<td></td>
<td>- Job satisfaction</td>
</tr>
<tr>
<td></td>
<td>- Employees eager to develop and grow business</td>
</tr>
<tr>
<td></td>
<td>- Balance social and work life</td>
</tr>
<tr>
<td></td>
<td>- Professional and well trained staff</td>
</tr>
<tr>
<td></td>
<td>- Knowledgeable and experienced staff</td>
</tr>
<tr>
<td></td>
<td>- Business experience within industry</td>
</tr>
<tr>
<td></td>
<td>- Clear understanding of staff authority levels</td>
</tr>
<tr>
<td></td>
<td>- Desire to resolve situation with a positive outcome</td>
</tr>
<tr>
<td></td>
<td>- Individuals eager to resolve issues</td>
</tr>
<tr>
<td></td>
<td>- Integrate new staff well</td>
</tr>
</tbody>
</table>
### Table 6.15 - Organisational Capability Table - Innovation

<table>
<thead>
<tr>
<th>Capability</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovation</td>
<td>- Focus on developing new technologies</td>
</tr>
<tr>
<td></td>
<td>- Open environment to discuss ideas</td>
</tr>
<tr>
<td></td>
<td>- Explore possible solutions</td>
</tr>
<tr>
<td></td>
<td>- Challenge expectations</td>
</tr>
<tr>
<td></td>
<td>- Encourage alternative perspectives</td>
</tr>
<tr>
<td></td>
<td>- Access to adequate resource</td>
</tr>
<tr>
<td></td>
<td>- Ability to capture ideas</td>
</tr>
</tbody>
</table>