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FORMATION OF PROJECT MANAGERS

by

TALAL ABBAS ADHAM, BSc, MSc.

A Doctoral Thesis
Submitted in partial fulfilment of the requirements
for the award of
Doctor of Philosophy
of the Loughborough University of Technology

December 1992

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FORMATION OF PROJECT MANAGERS

ABSTRACT

The construction industry is a fundamental, integral part of economic development. It is organised around individual projects. The effectiveness of the industry is largely determined by the collective performance of projects and the effectiveness of the project manager.

This thesis investigates the following issues:

1. the major characteristics of construction projects and the variables affecting the construction industry;
2. the education, training and experience of construction project managers;
3. major skills and knowledge required for the construction project managers;
4. comparisons of the general education policies in other countries;
5. performance in construction; and
6. the factors affecting the successful completion of construction projects.

The investigation of the education, training and experience of project managers, plus the major skills and knowledge required for the project managers was carried out by mailed questionnaires, followed by face to face interviews. This was organised with the co-operation of the European Construction Institute, which represents major international contractors. The number of completed questionnaires received was 120 out of 170 mailed questionnaires. This is a response rate of 70.5%.

The responding project managers were clearly successful and working for successful companies.

The aims of this survey were to investigate the following issues:

- educational backgrounds of the project managers;
- training achievements;
- the effectiveness of major sources contributing to the knowledge and skills;
- major knowledge and skills required for the construction project manager's post.

The majority of these project managers are engineering graduates. They are of very strong technical background, but of shallow or very shallow managerial background. The top priority of the required knowledge and skills was given to management related subjects. The importance of technical knowledge is not diminished by the attendant need for management, legal and other personal skills.
An investigation by case studies was carried out on six major European projects in order to identify the factors affecting the successful completion of construction projects and achieving a clearer picture of the required skills and knowledge for effective project managers.

This thesis identifies the following:

- the education background of project managers;
- the effectiveness of the major sources of knowledge in contributing to skills and knowledge of the project managers;
- the top 20 skills required for the job of the project manager;
- the required actions by all the parties concerned to enhance the effectiveness of construction project managers;
- the link between the required skills and the factors affecting the successful completion of projects.

In general this thesis contributes to the policies for developing effective construction project managers.
DECLARATION

No portion of the research referred to in this thesis has been submitted in support of an application for another degree or qualification at this or any other university or the C.N.A.A.
DEDICATION

This thesis is dedicated to my father, Abbas Adham, for his great support and encouragement. This man is a great father and a sincere friend.
ACKNOWLEDGEMENTS

My sincere thanks go to Professor Ronald McCaffer for his invaluable support, guidance and encouragement without which this thesis would not have been completed.

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My thanks are due to all lecturers, members of staff and research assistants of the Civil Engineering Department at Loughborough University of Technology. I am also grateful to the European Construction Institute and its Board of Advisors and staff for the support offered. My thanks are also due to all the successful project managers who participated in the survey.

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I am also grateful to Samira, my wife, for her encouragement. She has suffered during the time spent in completing this thesis.

Finally, this thesis is also dedicated to Abbas, my son. I hope he will take pride in its completion and do a better one in the near future.
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CHAPTER 1
INTRODUCTION AND GUIDE TO THE THESIS

1. Background to the Research

The construction industry is a fundamental, integral part of economic development. It is organised around individual projects. The effectiveness of the industry is largely determined by the collective performance of projects and the effectiveness of the project manager.

Previously, construction managers were predominantly ambitious, daring, hardworking craftsmen who progressed through the trades, and the knowledge was gained by apprenticeship and hands-on experience.

Very little is known about project managers in the construction industry, their educational background, course contents, further educational qualifications, the importance of the major sources of knowledge contributing to their knowledge and skills and the relevancy of skills to their jobs. If a profile about their formation was achieved, in a scientific manner, then we will be in a better position to draw the main lines in the process of the formation of successful project managers.

This thesis deals with contractors' project managers. These are the project managers working for the contracting companies and are responsible for the project completion on behalf of the contractor.

The construction industry is affected by many variables. The changing nature of these variables has contributed to the complexity of this industry.

Construction projects are characterised by different characteristics. Accordingly these characteristics have contributed to the complexity of the construction projects.

This thesis investigates the following issues:
- the major characteristics of construction projects, the variables affecting the construction industry and the successful completion of construction projects;
- the education, training and experience of construction project managers;
• major skills and knowledge required for the construction project managers;
• comparisons of the general educational policies in France, Germany, United States of America, Japan and the United Kingdom;
• performance in construction and the relationships between the factors affecting the performance and the skills and knowledge required for the construction project managers;
• the factors contributing to recently completed six major European projects and the association between these factors and the skills and knowledge required for the construction project managers;
• the views of the leaders from the UK’s construction industry.

2. Objectives of the Research

The main objective of this research is the effective formation of construction project managers. In order to achieve this, the following sub-objectives were used:

1. to describe the characteristics of construction projects, project phases, variables in construction project management, and the successful completion of projects;

2. to draw a profile on the academic educational backgrounds, course contents, further education qualifications, training achievements, major sources contributing to the knowledge and skills and experience of the project managers;

3. identifying the relevancy of the major knowledge and skills required for the construction project managers;

4. discussing the process of the formation of construction project managers in the United Kingdom;

5. collecting the views of the leaders in the construction industry;

6. discussing engineering education in France, Germany, USA and Japan, and comparing that to the UK;

7. discussing the performance in construction; and
8. discussing the factors contributing to the successful completion of recently completed six major European projects.

3. Reasons for the Objectives

The reasons for the objectives are as follows:

1. Construction Project Management
Highlighting the characteristics, phases and variables of the construction projects in order to achieve a better understanding of the complexity involved. Hence, we will be in a better situation to appreciate the effects of these issues on the formation of project managers in the construction industry. Furthermore, these investigations will clarify many of the issues to be adopted in the course of this research.

2. Education, Training and Experience
It is important to investigate the educational backgrounds and the contents of the basic academic qualifications of the construction project managers in order to determine what elements of their formation, their undergraduate degree, their postgraduate degree, formal training, and on-the-job experience have contributed to their skills and to their knowledge.

3. Major Knowledge and Skills
The identification of the major knowledge and skills required for the construction project managers is of very great importance to the effective formation process. It sets the foundation of what knowledge and skills are relevant to the construction project managers jobs. Hence, we will be in a better position to provide the required knowledge and skills for the future project managers. Also we will be able to review the contents of the educational and training curriculums in the light of the identified knowledge and skills.

4. Formation of Construction Project Managers
The formation of construction project managers in the UK is aimed at investigating the educational system in general and the undergraduate and postgraduate engineering education policies in particular. It is also
aimed at highlighting the major issues regarding the education, training and the professional status of engineering graduates in the United Kingdom. This will provide us with the characteristics, dilemmas and critics of the implemented educational system.

5.  *The views of the leaders*
Views of the industry's leaders are of paramount importance. These views will help in clarifying the needs of the employers in the construction industry and will highlight their expectations of the engineering graduates produced by the concerned educational establishments. Furthermore, the views of the leaders from the construction industry will be a good ground for testing the validity of the research findings.

6.  *Engineering Education in France, Germany, USA and Japan*
The process of exchanging ideas and learning from others is one of the best means of evaluating the effectiveness and the successfulness of the implemented system. On this background it was essential to study the policies used in other leading nations such as France, Germany, United States of America and Japan. Then we can compare this to the policies implemented in the United Kingdom. Hence, we can highlight the changes that might bring improvements to the existing system. And/or evaluate the effectiveness of our policies in the light of the investigated areas.

7.  *Performance in Construction*
The effectiveness of the construction industry is largely determined by the collective performance of projects and the effectiveness of the project managers.

The above statement raises the following major issues:

- the role of the project manager in performance;
- the effective use of resources;
- factors influencing performance; and
- the links between the knowledge and skills required by the project managers and the performance factors.
Therefore, it is important to investigate these issues to identify the relationship between the performance factors and the skills of the construction project managers. Hence, the existence of such a relationship will provide supporting evidence and validate the importance of the skills and knowledge required by the construction project managers.

8. *The factors contributing to the successful completion of 6 major projects.*

This is another attempt to verify and investigate the association between the skills and knowledge required for the construction project managers and the factors that have contributed to the successful completion of recently completed six major European projects. The successful completion of these major European projects was the main theme of the second European Conference organised by the European Construction Institute. The researcher was given the opportunity to attend this conference by the European Construction Institute. This has provided the opportunity to discuss the key factors, contributing to the successful completion of these projects, with the delegates who delivered the papers.

4. **Methodology**

To achieve the objectives, this research comprises the following:
- literature review;
- survey of construction project managers;
- case studies; and
- interviews.

The four items listed above are interlinked together and have contributed to the achievement of the objectives of this research.

Figure 1.1 shows the relationship between the methodology used in this thesis.

The following is a brief discussion of these items.
- **Literature Review**
The literature review sets the foundation of the research work. It has provided the background required to carry out most of the work throughout this thesis.

Also, it has clarified many of the major issues regarding the construction industry. The literature review has provided the skills and knowledge to design the questionnaire. Accordingly, the findings have contributed to the process of assembling the questionnaire, the comparative study of the educational policies and the case studies of the six major European projects.

- **Survey of construction project managers**
One of the main objectives of this survey is to investigate the education, training and experience of construction project managers. It also investigates the knowledge and skills required for the project manager's job and the effectiveness of the major sources of knowledge in contributing this knowledge and skills. Extensive literature review was carried out to determine the past research work in this field. The methods and tactics to enhance the response rate, the statistical analysis procedures and the reporting methods. Interviews with academic, institutional and professional personnel have provided many crucial feedbacks and comments.

Given the amount of data required, the diversity of this type of study, and the anticipated large number of responses, a mailed questionnaire was used to conduct this survey.

- **Case Studies**
The use of case studies in the analysis of recently completed six major European projects has highlighted the key factors contributing to the successful completion of these projects. Accordingly, the findings will be used in investigating the association between the success factors and the knowledge and skills required for the construction project managers. Hence, we will be able to verify the need for such skills and knowledge.
Fig. 1.1 The Methodology
Literature review will also be needed to assemble the structure of such a study and to set the basis of analysis.

Interviews with the people presenting the papers of these projects at the conference have also clarified some of the missing points and ensured consistency.

- **Interviews**

From the previous discussions we have seen the important role of the interviews in conducting this research work.

Interviews with some of the leaders from the construction industry were also used in investigating and discussing the criteria of employers towards the education, training and experience of the construction project managers.

## 5. Major Achievements

We have been able to investigate the education, training and experience of 110 of today's successful project managers. It has been established that the conventional pattern is to take engineering graduates and graft on management, human relations and leadership skills at a later stage of their careers to produce our project managers. Nevertheless, project managers do require a mix of skills and knowledge to cover such aspects such as management, finance, legal, communication, etc. Academic course contents are technically based with very little space for other highly needed subjects. It has been found that 49 out of 110 of today's successful project managers have had their basic education considerably extended.

On-the-job experience was found to be the most important source contributing to the knowledge and skills. The research established the top 20 skills required for the project managers. The top 5 skills were:

1. Leadership skills;
2. Planning and scheduling;
3. Delegation;
4 - Chairing meetings;
5 - Negotiation techniques.

The research also identifies the effectiveness of the major sources of knowledge in contributing to these skills and knowledge.

The need for technical knowledge is not diminished throughout the project manager's career life.

Training in management and business studies has been found to be the highest achieved type of training by the project managers.

Future training in languages was the highest type of training required by the project managers.

As compared to the world's leading nations, the education system in the United Kingdom requires fundamental changes at all its levels. The role of the professional engineering institutions must be reviewed in order to secure the freedom of the engineering educational establishments. Engineering curriculums must be designed to fulfill the employer's requirements not the stipulations of the guidelines issued by the professional institutions.

Employers must review their training policies to ensure that their future project managers are well trained and equipped. The concerned authorities must issue new regulations to secure that employees are given the best available chance for further education and training.

6. **Guide to the Thesis**

This part comprises a guide to the thesis. Figure 1.1 at the end of this chapter illustrates the layout of the thesis.

The thesis is divided into 8 chapters as follows:

- Chapter 1 Introduction and Guide to the Thesis;
- Chapter 2 Construction project management;
- Chapter 3 Survey of construction project managers;
Chapter 4  Formation of construction project managers;
Chapter 5  Engineering education in France, Germany, USA and Japan, "A comparative study";
Chapter 6  Performance in construction;
Chapter 7  In search of excellence; and
Chapter 8  Conclusions, recommendations and further research.

The following is a brief guide to the contents of these chapters.

Chapter 1. Introduction and Guide to thesis

This chapter spells out the background to the research and the major issues to be investigated. It contains the objectives of the research and the reasons for these objectives. It discusses the methodology used in conducting the research. It also summarises the major achievements of the research. Finally, it contains the guide to the research.

Chapter 2. Construction Project Management

The second chapter describes the major characteristics, variables and issues contributing to successful project management. It discusses the following issues:

- characteristics of construction projects;
- project phases;
- variables in construction project management; and
- successful completion of projects.

This chapter is aimed at highlighting the issues that are affecting the construction industry in general and the formation of construction project managers in particular.

Chapter 3  Survey of Construction Project Managers

The third chapter reports the findings of the survey of the project managers. It investigates the education, training and experience of construction project managers. It also investigates the relevancy of 56 skills and knowledge listed at the skills portfolio in the questionnaire form. Accordingly, it identifies the
top 20 highest rated skills. Furthermore, it lists the top 20 skills required by the project managers at three different age levels.

The survey investigates more than 300 variables, and because of this large amount of variables, this chapter is divided into four main parts as follows:

1. Background to the survey;
2. Descriptive analysis of the survey;
3. Association of factors;
4. Summary and conclusions.

Chapter 4. Formation of Construction Project Managers

This chapter highlights the major issues related to the effective formation of construction project managers. Also, it investigates the major aspects of the project manager's job and the relationships between these aspects and the knowledge and skills required for the post of project manager. The chapter investigates the education and training of engineers in the United Kingdom at different levels. It also contains the views of some of the leaders from the construction industry interviewed on a face to face basis.

Chapter 5 Engineering Education in France, Germany, USA and Japan "A Comparative Study"

This chapter investigates the engineering educational policies in France, Germany, USA and Japan and compares these policies to the policy of the United Kingdom. The following issues are investigated:

- school education;
- admission requirements;
- undergraduate engineering education;
- management education and training.

The chapter highlights the practices of these developed nations and compares them to the British system. Conclusions are drawn on the basis of the findings of this study. The chapter also summarises the major key issues for all the five countries in tabulated form.
Chapter 6. Performance in Construction

Chapter 6 investigates the following issues:
- performance and productivity;
- the role of the project manager in performance measurement;
- effective use of resources and performance;
- factors influencing performance;
- the need for change in the UK construction industry;
- a UK construction site report;
- the links between skills and performance factors.

This chapter is aimed at establishing the links between the skills and knowledge required for the project manager and the project manager's role in performance.

Chapter 7 In Search of Excellence

This chapter comprises a further investigation of the factors contributing to the successful completion of recently completed six major European projects. It highlights the key factors that have contributed to the successful completion of these projects. Also it discusses the association between the factors and the knowledge and skills required for the construction project managers. A table is used to highlight the major messages provided by the presentations of these major European projects.

Chapter 8 Conclusions, Recommendations and Further Research

Chapter 8 comprises the major conclusions and recommendations derived from the research. It also includes the recommendation for further research.
Chapter 1
• Construction industry is organised around individual projects. The effectiveness of the industry is largely determined by the collective performance of projects and the effectiveness of the project manager.
• Objectives
• Reasons for objectives
• Guide to the thesis

Chapter 2 Construction project management
• Characteristics of projects
• Project phases
• Variables in construction management
• Successful completion of projects

Chapter 3 Survey of construction project managers
• Educational background
• Training achievements
• Major sources of knowledge
• Experience
• Skills and knowledge required for construction project managers

Chapter 4 Formation of construction project managers
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Fig. 1.2 Thesis Layout
CHAPTER 2

CONSTRUCTION PROJECT MANAGEMENT

1. Introduction

Construction projects are complex, involve much time, capital and the use of other resources. The development of a project consists of several phases requiring a diverse range of specialised services. Accordingly, the construction industry is characterised by many characteristics subject to many variables.

The objective of this chapter is to describe the major characteristics, variables and issues contributing to successful construction project management.

In order to achieve this objective, the following issues are discussed:

- characteristics of construction projects;
- project phases;
- variables in construction projects management;
- successful completion of projects.

These issues are discussed to draw a clear picture of the construction industry as a whole. Hence, we will be in a better situation to appreciate the effects of these issues on the industry in general and on the successful education, training and experience of the project managers in specific.

The project managers in the construction industry work for different types of employers. Generally speaking, these employers can be divided as follows:

- Contractors;
- Consultants; and
- Clients.

Regardless of the different types of organizations and employers, these issues have great effects and influences on the following:
the general education and training policies adopted by all the concerned parties;
- the organizational strategies, structure and policies;
- the contractual relationships amongst the concerned parties;
- regulations and legislation stipulated by concerned governments and/or public authorities;
- the basis of cooperation among all the concerned parties in order to counteract the effects of these variables and to develop a better strategy to enhance the successfulness of the industry as a whole.

These are but a few of the effects. Nevertheless, the main objective is to achieve success. Accordingly this chapter is devoted to investigating these issues.

2. Characteristics of Construction Projects

Avots(5) has elaborated on the importance of project characteristics. According to his research, one of the reasons for project failure is that management techniques applied to the project may not always suit the project's requirements or project characteristics.

To some degree each construction project is unique, and no two jobs are ever quite alike(3).

Construction projects are typified by a set of characteristics. These characteristics are as follows:

(i) A variety of firms and individuals are often needed to work together to create new construction products(5).

(ii) Generally each product is custom-made to an individual specification(3).

(iii) Construction projects often involve impressive capital investment(6).

(iv) They normally require a relatively long time from conception to completion(3).
The long life utilisation span will affect the decision procedures regarding durability, maintenance and other relevant issues\(^{(7)}\).

The construction phase is often conducted on a site remote from the contractor's head office\(^{(9)}\).

Construction projects are affected by many external factors such as the ground conditions, weather influences and uncertainty in predicting the performance of personnel and plant\(^{(5)}\).

Although major technological advances have been achieved in other industries, the construction industry is still recognisably similar to that of the pre-ware with increased mechanisation\(^{(7)}\).

Although all businesses have associated risks, the construction industry seems to have more than it's fair share\(^{(7)}\).

National industrial accident statistics place the construction industry among those industries with the highest accident rates and indicate that these rates are tending to rise rather than fall\(^{(8)}\).

As a consequence of these characteristics, the industry organizes its work as a series of individual projects. In other words, the construction industry is organized around individual projects.

3. **Project Phases**

Projects proceed through a sequence of phases. Phases are distinguished from each other by the type of tasks characteristics of each phase and frequently by formal decision points at which it is determined if the project has been sufficiently successful in the earlier phases to continue on into the next\(^{(1)}\).

Different authors identify from three to six separate phases, and according to Adams\(^{(2)}\) there is no agreement on terminology. Nevertheless, general agreement does exist to indicate that each project phase involves different management considerations and presents different tasks to be performed\(^{(3)}\).

In this thesis we are concerned with the formation of project managers. Therefore we are not going to investigate the concepts of defining these
phases in depth. These phases might overlap. Hence we will discuss the phases briefly to highlight the general working nature of the construction projects.

Accordingly, we will choose four stages to describe the project phases. This decision is made to highlight the distinct phases of a project on the basis of the ownership of the project and the functions involved throughout the final handover stage from the contractor to the client.

Projects generally involve four phases as follows:

- Conceptual;
- Design;
- Construction;
- Commissioning.

- Conceptual Phase
  The definition of the works is basically the responsibility of the owner, although a professional assistant may be called in to provide advice. General guidelines are normally drawn and the main aim is to identify the client's needs and requirements clearly and explicitly.

- Design Phase
  This phase involves the engineering and architectural design of the entire project. It often overlaps with the construction phase. Drawings and specifications documents are prepared by the consultant or designer. Many issues are associated with this stage, but the major one is the constructability of the design.

- Construction Phase
  Construction phase is the process of physically bringing the project into reality. This involves providing the required human resources, equipment, materials, and supervision to accomplish the work.

- Commissioning Phase
  At this phase the completed product is handed over to the owner. Termination phase involves many crucial issues. Considerable efforts are exercised by all the parties to secure smooth handover procedure.
4. Operating Conditions of the Construction Industry

In a report published by the International Labour Organisation (8) it was stated that the operating conditions of the construction industry are determined by:

- government policy;
- the structure and organisation of the industry;
- methods of organising and financing construction activities;
- plant and equipment availability consistent with the levels of technology appropriate to national circumstances;
- material supplies, with particular reference to the relationship between local production and imports; and
- the level of knowledge and skill possessed by the managers and workers of the industry.

5. Variables in the Construction Projects

Projects are affected by many sets of variables. Over the years many authors have tackled the identification of these variables by grouping them under two main categories. The two groups are:

- External variables; and
- Internal variables.

But as it was mentioned earlier, as the construction industry is organised around individual projects, it would be better to group these variables into three major groups as follows:

5.1 Environment variables;
5.2 Organization variables;
5.3 Project variables.

The relationship between these variables is complex and interactive. The environment variables will influence the organization variables and, consequently, the organization variables will influence the project variables. In other words this relationship, depending on the outcome of the project, might affect the direction of flow from the inner core towards the outside.
The environment variables will dominate the initial process of setting up the working atmosphere of the organization. The organization variables, accordingly, will affect the process of executing the individual projects. The projects variables, to some degree, will affect the organization policies and strategies within the environmental boundaries. Consequently, on a long term basis some of the environmental and organizational variables will be influenced and be indirectly changed. This process is endless and iterative. But some of the variables are unpredictable, especially on the outer shells (such as the organization of the environment) and hence these variables will have a greater influence on the inner shells. The arguments are endless. Therefore, I have decided to discuss these variables in the given order with greater emphasis on the inner variables as possible. These are the variables that could be, to some degree, under control or at least could be dealt with more easily. Figure 2.1 depicts these variables.

5.1 Environment variables

Environment variables are the outside variables that affect the construction industry. In general they are:
- social;
- economical;
- technological; and
- political.
Fig. 2.1 Variables in Construction
These four major groups affect the organizations as well as the projects. They have a major influence on the construction industry and many other industries. In fact, they represent the whole world around all the human beings’ activities.

These four environmental components will affect particular industries in different ways\(^{(12)}\). But the fact remains, in my view, that these variables have the greatest influence on the construction industry.

5.1.1 Social variables

The social variables involve the following major variables:

- demographic trends;
- individual needs;
- cultural differences.

Understanding the social variables is an extremely important issue to be undertaken by the organization and the people in charge of the project.

- **Demographic trends**
  Shifts in demographic characteristics of the population affect organizations in terms of the nature of the work force and the profile of customers. Organizations are faced with the need to alter their strategies in order to attract or cater for these groups of population. Failure to address this trend will cause lots of deficiency in the understanding of many characteristics relevant to the population, markets, and the availability of the human resources in general.

- **Individual needs**
  Maslow's needs hierarchy suggests that individuals in organizations are motivated to perform by a desire to satisfy a set of internal needs\(^{(12)}\). Changes in demographic trends will be felt by organizations as individuals begin to express the desire to satisfy different needs through the job\(^{(12)}\). Fulfilling the individual requirements will contribute to a greater motivation of the recruited work force. Therefore,
understanding the basic theories of individual needs is of great importance to the successfulness of the organizations.

- Cultural differences
Culture relates to a society's economic, social, political, educational and legal attitudes and beliefs(12). Significant research effort has been devoted to cross-cultural studies in an attempt to investigate the behavioural and performance characteristics of employees. Considerable considerations must be exercised by organizations in order to evaluate these cultural differences. This is of great importance for those organizations considering overseas involvement.

- Economical variables
The economic environment involves the state of the economy, as well as clients, contractors, suppliers and competitors. Economic factors dominate the environmental variables. They interact with most of the variables. Changes in economic circumstances affect many other environmental variables. For example, economic circumstances may affect the government policies in many different situations. All major project activities raise the need for considerations to economic trends.

- Technological variables
The rate of the technological development has been accelerating in the last four decades. Developments in the technological environment are the fastest to unfold and can have the most impact on the organizations in extending or constraining their growth. Technological variables can be grouped under two components as follows:

- the process of innovation; and
- the process of technology transfer.

The process of innovation refers to the efforts in the basic sciences to develop new technologies, methods, processes and products(13). The process of technology transfer involves taking the new technology to the market. It is the transfer of science to useful products and applications(14).
• Political variables

Organizations operate within and through various political systems. The interaction between the organization and the political environment is one of mutual influence\(^\text{(12)}\). Most large projects raise political issues of some sort and hence require regulatory, public and financial support. These political issues must be considered at the outset of the project in order to secure successful implementation process.

5.1.2 Organization variables

Many authors have investigated a large number of organizational variables and the effects of these variables on the organizations. The following organizational variables were cited in the literature review:

- organization climate;
- size;
- structure;
- conflict; and
- job satisfaction.

These variables are chosen on the basis of their great importance on the organization. The list is not exhaustive but shows the major organizational variables.

• Climate

Organizational climate is a description of the organization as a whole\(^\text{(15)}\). Litwin and Stringer defined organizational climate as "a set of measurable properties of the work environment perceived directly or indirectly by the people who live and work in this environment and assumed to influence their motivation and behaviour"\(^\text{(16)}\).

These authors went on to suggest that both performance and satisfaction are affected by climate.

• Size

Organization size has been shown to have a strong effect on perceived organizational climate in several manufacturing organizations\(^\text{(2)}\). Research has generally shown the existence of
positive relationships between size and organizational formalization\(^{(17)}\). Adams and Barndt\(^{(2)}\) have stated that increased size may also permit economies through greater functional specialization. They added that as a consequence the larger project organization may tend to be more functionally structured or mechanistic in nature.

Generally speaking, organization size is an important variable in the construction industry. It will play an important role in the construction process, and accordingly will affect the organization strategies and policies.

- **Structure**
Organizational structure has been changing throughout the human history. Environmental variables have played an important role in this process. Proper organizational structure will enhance the performance of the organization and will allow the other organizational aspects to function properly. Walker\(^{(18)}\) rightly argued that this is not to say that, if an organization is inappropriately designed, it will not perform adequately, as people have the ability to construct informal organization structures that circumvent the formal structure often to the benefit of performance. Therefore, major project organizations may display a mixture of formal and informal practices which will have a major influence on the project execution at all its phases. Nevertheless, the level of bureaucracy must be kept at the minimal level if we are looking for a prosperous construction industry.

- **Conflict**
The essence of project management is that it is interfunctional and is frequently in conflict with the normal organizational structure, leading to natural conflicts system\(^{(19)}\). The ability of the project manager to foster useful conflict, or to convert disruptive to useful conflict, can often determine his degree of success in achieving the project's goals\(^{(20)}\). Therefore, it is essential for the managers in the construction industry to
maintain a reasonable degree of harmony among the organizational elements contributing to the project.

- **Job satisfaction**
  Payne et al\(^{(15)}\) have described job satisfaction as an individual's effective response to his job. The relationship of job satisfaction to performance is by no means settled\(^{(2)}\). But the overriding message is that job satisfaction is one of the major variables contributing to high productivity. Money incentives are not the only means of job satisfaction. Other means must be used in order to achieve job satisfaction, such as job enrichment, job enlargement and job simplification\(^{(21)}\).

5.1.3 **Project variables**
Different project variables will considerably affect the management processes of construction projects. These variables are:

- function;
- quality
- complexity;
- size;
- urgency;
- funding;
- resources; and
- repetition.

These variables play an important role in setting up the management strategy for the projects.

All the project's parties, such as the client, consultant, and the contractor, must consider all these variables in order to achieve a successful completion of the project. The importance of these variables is linked to the project's phases and thus their effect will change throughout the project's life.

- **Function**
  The usual way of describing a product is in terms of its dominant function\(^{(9)}\). Thus we speak of roads, bridges, power stations and many
other functions. Understanding the function is essential in order to take the necessary actions for the fulfilment of the project.

- **Quality**
Achievement through people requires complete commitment by all the concerned parties, be they owner, designer, contractor or supplier\(^{10}\).

Function and quality define the objectives of the projects which relate directly to their physical end products\(^9\).

- **Complexity**
Projects differ in terms of the number of different actions needed to produce the end product. The number of different actions determines the complexity of the project\(^9\). Many factors are considered in order to determine the degree of complexity for a project. But the main factors are:
  - remoteness of site;
  - technology involved;
  - design completeness; and
  - availability of required resources.

- **Size**
There are different methods of measuring the size of the project. These methods are:
  - in terms of total value of the project;
  - in terms of units, such as linear metres of pipeworks;
  - in terms of the primary function, such as production quantity.

Bennett\(^9\) has indicated that size is usually measured in terms of value and argued that this leads to inconsistencies. He indicated that a small, complex, high quality project will be classified as the same size as a large, simple, low quality project simply because their costs happen to be similar.

This argument leads to indicate that there is no linear relationship between the complexity and the size of an individual project.
Accordingly, each of these two variables should be taken into consideration separately.

- **Urgency**
  Urgency is initially defined by the client's objectives and the speed of constructing his project. It is based on the idea of the relationship of speed and economy. Bennett(9) has explained that for any project there is a normal speed and level of costs. He stated the local construction industry, in the absence of pressures to perform differently, will approach projects in a manner largely shaped by habit and convention.

  In reality, a thorough investigation must be undertaken by the client or his consultant in order to decide upon the optimum level of speed. Other parties, such as the designer or the contractor may have to face this need of urgency in a different concept. Some activities may raise this need due to improper planning and hence they are urged to deal with the situation accordingly.

- **Funding**
  A new project has no information on which to base judgements about its likely future financial performance. As a result, financiers will judge the merits of the project after undertaking a thorough analysis of the business plan and assessment of the track records of the management and contractors(22).

  The structure and form of finance is governed, to a large extent, by the nature of the project. Thus, this will impose constraints on all the phases of the project from conception to completion. Managers in the construction industry must be aware of the nature of these constraints and an early participation within the project phases is essential.

- **Resources**
  Availability of the required resources for a project is one of the major problems in the construction industry. Project variables in general will help, to some extent, to identify required resources. The major resources are grouped as follows:

  - human resources;
- equipment and plant;
- information technology tools;
- computer hardware and software; and
- materials.

These resources are normally converted to cost figures using estimated man-hour rates, purchase costs for equipment and material and unit rates.

- **Repetition**
  Repeated work for an individual or organization will improve performance. When the work of an organization provides consistent repeating patterns of reasonably similar work for a series of teams, productivity increases\(^{(9)}\). Although this is a valid argument, the construction industry is faced with many external factors, such as weather and ground conditions, and hence this will obstruct the prediction of productivity to some extent.

Bennett\(^{(9)}\) has cited a major United Nations (1965) study of the effect of repetition on building operations and processes on site. This study found that the productivity benefits translate into lower costs. Therefore managers of the construction industry are faced with this variable and hence must evaluate the benefits of such repetitive activities in order to reduce costs. But due to the nature of construction projects there are many obstacles to be dealt with in order to overcome them. Accordingly, proper evaluation is required by all parties in order to make the optimum solution.

6. **Success of Construction Projects**

Defining project success is a complex task. It could be defined to include all project phases and beyond to include operation, maintenance and replacement. Therefore, this chapter will discuss success within the previously mentioned project phases.
6.1 **Definition of success**

Successful project management is basically defined as having achieved project objectives:

- on schedule;
- within budget;
- at the desired performance level; and
- whilst utilising the assigned resources effectively and efficiently.

Kerzner\(^{23}\) has explained that this was the definition that has pertained for the last 20 years or so. He has provided a *modified definition of project success* to include completion:

- within the allocated time period;
- within the budget cost;
- at the proper performance or specification level;
- also accepted by the customer/user;
- within minimum or mutually-agreed upon scope changes;
- without disturbing the main work flow of the organization;
- without changing the corporate culture; and
- while adhering to the ever-changing input factors:
  - legal,
  - social,
  - political,
  - economical,
  - technological.

Therefore, we can conclude that success means different things to the different organizations and people associated with a project.

6.2 **Organizations, individuals and success**

Organizations associated with a project are diverse. They are generally grouped as follows:

- clients;
- financiers/investors;
• consultants;
• contractors/sub-contractors;
• suppliers;
• public authorities;
• operators/maintenance organizations;
• users.

Each of the above organizations will have their different set of success criteria. A client may consider success in terms of optimum costs; an investor in terms of meeting the marketing strategies; a contractor in terms of profitability; a public authority in terms of meeting environmental regulations, and so on.

On the other hand, individuals within these organizations will have different sets of success criteria. An architect may consider success in terms of aesthetic appearance; an engineer in terms of technical competence; an accountant in terms of money spent, and so on.

6.3 Project success criteria

The success of a construction project is measured in terms of an output : input ratio(9). Bennett(9) has also argued that since money is the only practical common measure for all the outputs and inputs of construction projects, it follows that their success in practice is most comprehensively measured in terms of the value : cost ratio. He concludes that the only objective practical criterion for the success of construction projects is the value : cost ratio and therefore construction project managers should, at the very least, use this ratio in making their own judgements about projects.

Bennett's arguments were, to some extent, misleading and narrow. Actually, he tried to avoid the real problems facing the construction industry in evaluating success of projects.

Baker et al(24) asks, on one hand, why are some projects perceived as failures when they have met all the objective standards of success:

- completed on time;
- completed within budget;
- all technical specifications met.

On the other hand, why are some projects perceived as successful when they have failed to meet two important objective standards associated with success:
- not completed on time;
- not completed within budget.

In a research study conducted by Baker et al (24) on some 650 projects, the following definition of success was given:

"If the project meets the technical performance specifications and/or mission to be performed, and if there is a high level of satisfaction concerning the project outcome among:
- key people in the parent organization;
- key people in the client organization;
- key people on the project team; and
- key users or clientele of the project effort.

the project is considered an overall success". (24)

Baker et al have also stated that perceptions play a strong role in this definition. Therefore the definition is more appropriately termed "perceived success of a project".

Freeman and Beale (25) have identified seven main criteria used for measuring the success of projects from 14 reviewed papers. Table 2.1 lists and describes these criteria and shows the frequency with which each was nominated in the fourteen papers.

We have to establish a clear and realistic set of success criteria prior to starting to evaluate project success. Many of the construction activities are difficult to quantify and measure. Therefore, managers of construction are faced with a complex task. They have to evaluate success by using the appropriate tools whenever possible. Research into this field is necessary in order to evaluate the appropriate methods for evaluating success and achievements.
Table 2.1 Project Success Criteria

<table>
<thead>
<tr>
<th>Success Criteria</th>
<th>Description</th>
<th>Frequency of mention</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Technical performance</td>
<td>To what extent the technical requirements specified at the commencement of the execution phase were achieved.</td>
<td>93%</td>
</tr>
<tr>
<td>2. Efficiency of project execution</td>
<td>The degree to which targets of time and cost were met.</td>
<td>93%</td>
</tr>
<tr>
<td>3. Managerial and organizational implications</td>
<td>A measure of client, parent and user satisfaction, incorporating the degree to which the project was carried out without disturbing corporate culture or values.</td>
<td>43%</td>
</tr>
<tr>
<td>4. Personal growth</td>
<td>The satisfaction of the project team, particularly in terms of interest, challenge and professional development</td>
<td></td>
</tr>
<tr>
<td>5. Project termination</td>
<td>The completeness of the termination, the absence of post-project problems, and the quality of post-audit analysis.</td>
<td>14%</td>
</tr>
<tr>
<td>6. Technical innovativeness</td>
<td>The success in identifying technical problems during the project and solving them.</td>
<td>14%</td>
</tr>
<tr>
<td>7. Manufacturability and business performance</td>
<td>The ease with which the product resulting from the project can be manufactured, and its commercial performance.</td>
<td>43%</td>
</tr>
</tbody>
</table>

Source: Freeman and Beale(25)
6.4 Key factors for success

From the literature review of different sources (2, 4, 5, 6, 8, 22, 23, 24, 25, 29) the following are some of the frequently cited key factors contributing to the successful completion of construction projects:

1. Scope
2. Funding
3. Contract
4. Design and engineering
5. Estimating
6. Planning and Scheduling
7. Procurement
8. Sub-contracting
9. Controlling
10. Communication

The items listed above are not in any order but they are listed to highlight their contribution to the successful completion of construction projects. These factors are briefly discussed as follows:

1. Scope
   It is important that both client and contractor have a common understanding of the contract definition. This instruction is the mechanism for ensuring all parties involved are aware of the exact needs of the project (26).

2. Funding
   Lack of adequate funding for a project throughout all its phases is one of the major factors contributing to the project failure. The financing of a project has been defined as "the arrangement of adequate funds over time to finance the development and operation of a clearly defined project" (22). The main elements of the funding requirement are:
   - Construction finance, to pay for capital expenditure;
   - Contingency finance, to pay for cost overruns and delays;
Working capital finance, to invest in stock and fund operating costs during the early phase of operations\(^{(22)}\).

3. Contract

Forms of contract are required to formalise the complex arrangements and relationships that are likely to be encountered in the construction of all major projects\(^{(27)}\). The contracting philosophy chosen by the client will determine the handling procedures of all the construction activities. The client decision will depend on the level of involvement and control he wishes to have. In deciding on the contract the client will have to consider the following factors:

- time;
- variations;
- quality;
- price;
- risk;
- complexity.

Many forms of contract are used in the construction industry. The main factors to be considered in the choice of the form of contract can be summarised as:

- suitability for the particular project;
- the purpose of the contract;
- the proven track record of the document;
- familiarity of use within the industry.

The changing environment of projects has created a demand for complex contract policies. Fast-track contracts is a result of the client’s demand to get his project in the minimal time and therefore there is an overlap of different activities in order to fulfil this demand.

Partnering is another result of the complicated environment. Generally, partnering is an alternative management process that seeks to produce organizational change to resolve the traditional
problems between the client and the contractor\(^{(28)}\). The objective of the partnering process is to design for each project an effective problem-solving team representing the client and the contractor. Thus creating a better environment with one set of goals and objectives.

4. *Design and Engineering*

As mentioned earlier, the design and engineering is one of the important project phases. It involves the architectural and engineering design of the entire project. In broad terms, it is culminated with the preparation of final working drawings and specifications for the project. In practice, the design often overlaps with the construction phase.

Constructability of the design is of paramount importance for the success of a project. This is a result of the adequate construction experience of the design team.

The technological developments have introduced many computer softwares which have made design process easier. But, the need for practical experience on construction is not?

5. *Estimating*

Estimating is a very broad term. It can be used to cover many activities such as

- the initial total cost of all the project phases for the client;
- the design activities and the anticipated cost of construction and commissioning of a project;
- the estimation of the bidding price by the contractor and/or the sub-contractor;
- the estimation of resources, materials, and activities required for the project.

These are some of the aspects broadly covered under the estimation term.
Past experience, market competition, and use of computer aided estimation software are some of the factors contributing to the accuracy of estimation in the construction industry.

6. **Planning and Scheduling**

Planning, in general, can be described as the function of selecting the organization objectives and establishing the policies, procedures and programs necessary for achieving them\(^{(23)}\). Planning in a project environment can be described as establishing a predetermined course of action within a forecasted environment\(^{(23)}\). Therefore, the project's requirement set the major milestones for the project. The large number of construction activities raises the need for a tool that will enable managers in construction to manipulate these activities in a simple and understandable fashion\(^{(30)}\). The Critical Path Method (CPM) is one of the tools used in the project planning. It is a three-phase procedure consisting of planning, scheduling, and time monitoring\(^{(3)}\).

7. **Procurement**

The primary objective of good procurement practice is to provide end users with what they need, when they need it, at the lowest cost\(^{(29)}\). The success or failure of a project is closely linked to the procurement strategy\(^{(29)}\). Material costs often account for more than half the total cost of a project whilst the failure to obtain materials on time is possibly the most frequent cause of programme slippage\(^{(30)}\).

One of the earliest tasks for procurement is the preparation of a procedure and control document which will take into account the client and contractor's own procedures together with any specific requirement for the project. Careful attention must be exercised in the evaluation and selection of suppliers in order to secure successful project execution.

8. **Sub-contracting**

The complexity of client's demands, together with the increasing complexity of building, civil and industrial
engineering, and other variables, has over the years resulted in specialisation within the construction industry\(^{(18)}\). This specialisation has resulted in a growing number of subcontractors. The extent to which a general contractor will sub-contract work depends greatly on the nature of the project and the contractor's own organisation\(^{(3)}\). Qualified sub-contractors are usually able to perform their construction speciality more quickly and at lesser cost than the general contractor\(^{(3)}\). Some of the large contractors may give the work to their specialised divisions or sub-divisions. Proper management strategy is essential to secure proper handling of the sub-contracted jobs in order to secure successful completion of the projects.

9. **Controlling**

Project control provides the information that is necessary for reporting on the project status both internally and to the client. The principal project controls are estimating, scheduling, cost and change control\(^{(31)}\).

Control is necessary at all the project phases. Effective project control has been defined\(^{(32)}\) as the process that does the following:

- forecasts and evaluates potential hazards prior to occurrence so that preventive action can be taken;

- reviews trends or actual situations to analyze their impact and, if possible, proposes action to alleviate the situation;

- provides constant surveillance of project conditions to effectively and economically create a "no surprise" condition, apart from "force majeure" situations.

10. **Communication**

Communication provides information which is nothing less than the lifeblood of project organization\(^{(9)}\). Proper communications are vital to the success of the project\(^{(23)}\). The communications process is also a source for control. Proper
strategy and channels for communication must be agreed upon at the early start of a project and updated throughout all the project phases.

7. Conclusion

1. Construction projects are complex undertakings throughout all their phases. All the concerned parties must take these phases into consideration. Clear and appropriate definitions of all the key points in the project phases are essential in order to secure success.

2. Characteristics of the construction projects have contributed to the complexity of the construction industry.

3. Many variables affect the construction projects and therefore managers have to face these variables and evaluate the likely outcomes according to the uncertainty involved.

4. Great attention must be given to the success factors in order to achieve the successful completion of projects.

5. Managers in the construction industry must have the appropriate knowledge, skills and qualifications in order to overcome the obstacles created by the project phases, the construction project's characteristics, and variables.

6. The changing nature of the variables implies that the industry requirements will change accordingly. Hence, continuous evaluation of the likely effects of these variables is required by all the concerned parties. Accordingly, the skills and knowledge needed for the people involved must be developed and updated regularly in order to be adequately equipped with the necessary knowledge and skills. Hence, they are capable to fulfill their roles.
REFERENCES - CHAPTER 2


CHAPTER 3

SURVEY OF CONSTRUCTION PROJECT MANAGERS

One of the main objectives of this study is to investigate education, training and experience of construction project managers. This chapter tries also to investigate the knowledge and skills required for this post and the contribution of major sources towards these skills and knowledge.

The chapter is divided into four main parts as follows:

Part 1 - Background to the survey

Part 2 - Descriptive analysis of the survey

Part 3 - Associations of factors

Part 4 - Summary and Conclusions

The reason for this is the large amount of data involved and the desire to present it in a structured way.

PART 1

1. Background to the Survey

In broad terms there is a broad consensus on the knowledge and skills required by project managers in the construction industry. Thus, there is a broad consensus on the content of postgraduate construction management degree courses, as well as the formation of construction project managers.

These include the principles and concepts underpinning construction methods, operations, management, procurement and commissioning, and try to develop:

- human relations skills;
- the ability to think and reason logically;
- the ability to make sound decisions and to implement them;
• the ability to communicate clearly and concisely;
• the stature to provide leadership to construction personnel and to command the respect of other professionals.

In order to refine some of these accepted truths we have, in conjunction with the European Construction Institute, been surveying 170 successful project managers to determine:

- the skills and knowledge that they regarded as important;
- the elements of their formation;
- their undergraduate education;
- their postgraduate education;
- formal training;
- on-the-job experience.

We also tried to determine how the above mentioned sources have contributed to the knowledge and skills of project managers.

2. Planning the Survey

The planning of the survey was carried out in four stages as follows:

Literature review;
Interviews;
Survey method;
Population for the survey.

Literature review

Extensive literature review determined:

• The past research work in the field of education, training and experience of project managers and other professions such as engineering and management education. This was important in order to appreciate the general approach used to investigate the education, training and experience issues. Appendix I lists some of these sources covered by the literature review.
The methods and tactics used in order to enhance the response rate.

The handling of data and analysis procedures used to report the findings.

This field of research is very diverse and there are many associated aspects to be covered. Thus, many relevant issues are to be investigated and therefore any researcher in this field is forced to handle a lengthy and complex survey.

**Interviews**

The second stage of planning the survey was concerned with getting further feedback from academia and professions. Interviews were conducted with many academic, institutional and professional personnel. The following is a list of the key people interviewed at this stage:

1. Professor S H Wearne, UMIST.
2. Mr J Thomas, Loughborough University of Technology.
3. Dr Peter Morris, Bovis International and Association of Project Managers.
4. Mr Eric Gabriel, Vice President of Association of Project Managers.
5. Mr Ron Burbridge, Chairman of European Construction Institute, Loughborough University of Technology.

Many other professional and academic staff were also interviewed.

The contributions gained from the interviews were priceless and helped in building a clear picture of the situation. These contributions are grouped and listed as follows:

- Information on the latest studies in this field and the sources to be referred to for retrieving them.

- The important aspects regarding the education and training of participants.
The role of some professional institutions (i.e. Institution of Civil Engineers (ICE), as compared to others (i.e. American Society of Civil Engineers (ASCE)). The role of ASCE is zero and could not be compared with the ICE.

- The licensing of engineers in the United States of America, Canada and Australia compared to that in the United Kingdom.

- Information on how data has to be collected on different aspects such as education, training and experience.

- Discussion on the variables affecting the performance of the project manager.

- Management education for engineering undergraduates and the growing demand in recent times.

- Policies adopted by employers towards training their employees and how these policies are going to affect the effectiveness of the anticipated project managers.

- Methods and techniques used for measuring the success of the projects as well as the project managers.

The encouragement received from all the interviewees was also valuable and effective to boost my morale and motivated me toward getting this survey underway. It is important to highlight the interest shown by all the people interviewed to see a successful outcome and contributions for all the concerned parties.

Survey Method

Mailed questionnaire was used to conduct this survey, to be followed by face to face interviews if needed. This was the decision made given the amount of data to be collected, the diversity of such a type of survey and the anticipated large number of responses in order to have a valid response rate.
Population and Sample of the Survey

In collaboration with the European Construction Institute a standard letter (see Appendix 2) was sent to the Board of Advisors of the European Construction Institute, requesting them to recommend five project managers' names who would be willing to respond to a questionnaire investigating the education, training and experience of managers of major projects in the construction industry. Confidentiality was strongly assured and all information provided will be used to assemble statistics; no reference will be made to individuals.

Out of 57 letters sent 40 positive responses were received giving a response rate of 70 percent. The number of the nominated project managers ranges from one to seven, but the majority of responses have given three to five names. The total number of project managers nominated was 170.

The number of negative responses received was eight. Some of these stated that they are not able to nominate any names because they are very busy and therefore they could not provide any names and some stated that such a request was against the policies of allowing their employees to participate in any kind of survey. Nevertheless, this will show the type of management style used in the construction industry. One of the worrying aspects is if this is the case with about 14 percent of organisations, who are members of the European Construction Institute, what is the real percentage of organisations adopting such strict policies towards contributing to the development of the construction industry. Employers in the construction industry must recognise the benefits to be obtained from such research in order to bring the required changes into their existing policies. On the other hand, this shows the difficulty faced by the educational institutions if they decide to conduct a study such like this to investigate the attainments of their graduates.

3. Questionnaire of Project Managers

3.1 Design of the questionnaire

In order to utilize the comprehensive data entry service offered by the Computer Centre at Loughborough University of Technology, many meetings were arranged with Mrs Gwenda Scott, the supervisor of the Data Preparation Department. These meetings were quite effective in setting out a simplified and structured form of the questionnaire beside
making it easier for the data entry procedure. Accuracy is assured by the verification carried out by the staff. Verifying input effectively means typing the text or numbers twice(8). The high response rate achieved and the comments received from the respondents are evidence of the successful design of the form used in the survey.

3.2 Contents of the Questionnaire

The contents of the questionnaire are grouped as follows: (See Appendix 3 for a copy of the form used).

- General;
- Educational Background;
- Training;
- Experience;
- Skills Portfolio;
- Willingness for further participation;
- General Comments.

The following is a brief description of the questionnaire's contents.

- **General**
The general part of the questionnaire is aimed at collecting the following information:

  - Name and age;
  - Title of the job and years on this job;
  - Employer’s name and years with this employer;
  - Number of people in the whole organisation and in the division or branch.

This part is essential to have a clear picture of the sample's specific details. It will be used for further statistical analysis to investigate the relationships and associations with many factors incorporated in the questionnaire if needed.

- **Educational Background**
This part of the questionnaire investigates the following issues:
- The title, date and major subject of the basic academic degree;
- The contents of the basic academic degree;
- Further educational qualifications (such as Diploma or Postgraduate study etc...).

Given the anticipated diverse educational background of the respondents, this part was aimed to collect information on the educational background of the participants, the contents of their degree courses, and the further educational qualifications they have obtained.

The data to be collected from this part will contribute positively to our understanding of sample general educational aspects.

* Training
The training part was divided into three main divisions as follows:

- The importance of major training sources.
- Training courses.
- Training opportunity.

The three major divisions are described briefly as follows:

* The importance of major training sources:
Six major training sources were listed. These are:

- Academic training courses.
- On-the-job experience.
- Off-the-job training courses.
- Self learning courses.
- Lectures or Seminars.
- Secondment to other departments.

An extra space was given to be filled in by the participant. The participant is asked to indicate the importance of these training sources as contributors to skills and knowledge, by using a rating scale of 1 to 9 (1 indicating very low importance and 9 indicating very high importance).
* Training courses
A list of general training courses were given as follows:

- Advanced technology in participant's own field.
- Training in new technology.
- Management and human resources.
- Business studies.
- Marketing and Sales.
- Languages.

An extra space was also given. The participant was asked to indicate the type of training he obtained or was willing to take by circling the relevant number under the given three columns, which are:

- Full time training
- Part time training
- In the future.

These questions were included to obtain a clear picture about the project manager's training history in a structured way.

* Training opportunity
The participant was asked to indicate the degree of satisfaction with the opportunities for further training available to him, by circling the relevant number of the given scale.

* Experience
Five questions were asked in order to investigate the following issues:

- Total number of projects the participant was associated with before becoming a project manager.

- Number of projects for which the participant has been directly responsible as a project manager.

- Number of projects the participant is currently responsible for.

- Overseas working experience.
Approximate number of posts held during the participant’s career.

Skills Portfolio
This is the major part of the questionnaire. An extensive portfolio of skills was designed to cover diverse areas of knowledge that might be needed for the job of a project manager.

The portfolio is divided into seven major parts as follows:

1. Technical Skills (15 listed skills).
2. Managerial Skills (11 listed skills).
3. Financial (7 listed skills).
4. Computers (9 listed skills).
5. Legal (6 listed skills).
6. Communication (4 listed skills).
7. General (4 listed skills).

The total number of listed skills was 56. Extra spaces were given for other skills to be added by the participant if needed. (Please refer to pages 3-5 of Appendix 3 for full details of the listed skills).

The participant was asked to circle a number under Column A indicating how relevant is the given skill to his job as a project manager. Numbers were arranged in descending order from 5 to 1, 5 indicating high degree of relevancy and 1 indicating low degree of relevancy.

Under Column B the participant was asked to rate the effectiveness of three given sources in contributing to his knowledge for each particular skill using a rating scale of 1 to 9, 9 indicating high degree of effectiveness and 1 indicating very low degree of effectiveness.

The three given sources were:

- Academic courses.
- Formal training.
- Job experience.

- **Willingness for further participation to be interviewed**
The participant is asked if he is willing to be interviewed and to give his telephone number in the space provided.

- **Copy of the report**
The participant was asked to indicate his willingness to get a copy of the survey report by ticking a box and writing his address.

- **General comments**
A large space was allocated on the last page of the questionnaire form to get the participant's comments. A full report of these comments raised by the respondents will follow later.

4. **Pilot Studies of the questionnaire**

In order to study the clarity of questions and the relevance of questions in the questionnaire, two pilot studies were carried out as follows:
- Academic study;
- Professional study.

**Academic study**
The first study was undertaken by distributing five forms of the questionnaire to three lecturers and two doctoral research students.

All the three lecturers were associated with construction management field, two of them from the Civil Engineering Department at Loughborough University of Technology and one from the School of Civil Engineering at Teesside University. The doctoral research students were from the Civil Engineering Department at Loughborough University of Technology.

**Professional study**
Five copies of the questionnaire were completed by part-time postgraduate students studying for an MSc in Project Management at Teesside University.

All comments raised by the participants were discussed personally with them and the agreed amendments were included, and the final draft of the
questionnaire form was made accordingly. The comments raised by the participants are listed as follows:

- Very well designed questionnaire.
- Percentages of contribution are very difficult to be calculated. Consistent rating scales were used throughout the questionnaire form.
- Wording of some questions is vague. Changes were made and participants were consulted to review the questions and check the new wording.
- Few of the listed skills were thought to be very broad. Changes were conducted accordingly.

5. The Covering Letter

A covering letter was drafted. The aims of the letter were to:

- Personalise each individual form to the anticipated participant.
- Explain the general aims of the study.
- Provide further clarification of the contents of the questionnaire.
- Encourage the respondent to fill in the questionnaire by giving the average time required to fill the form given the length and complexity of the questionnaire.
- Assure confidentiality.
- Give a direct telephone number to respond to any difficulty faced by the participant.

An answer machine was in operation while the telephone was unattended in order to follow up any enquiry. This proved to be efficient to respond to all enquiries received during the survey although they did not exceed five calls.

A copy of this letter is included in Appendix 4.
6. Postage

170 questionnaires were posted on 15 February 1992. The personalised covering letter and self addressed envelopes were attached to almost all of them except fifteen forms. These fifteen forms were posted to the administration of three employers as requested, in order to be distributed by them.

27 questionnaires were posted overseas as follows:

8 to the United States of America;
1 to Hong Kong;
5 to Belgium;
5 to Ireland; and
9 to The Netherlands.

The remaining 143 questionnaires were posted to participants in the United Kingdom.

7. Initial Response

The initial response rate was unexpectedly high. The total number of responses at 14 March 1992 was 108. This is 63.5%. Three of the questionnaires were returned uncompleted, two of them were returned with apologies from the respondents stating that they were unable to fill the questionnaires because of lack of time and one was returned because of an unknown address. Therefore the initial response rate was adjusted to be 105 completed questionnaires, making a percentage of 61.8%. The overseas responses were 9 out of 27 posted questionnaires. That is 33%.

8. Follow Up of the Survey

Although the response rate was high it was decided to follow up the participants. A letter was prepared and sent to the people who did not respond. A copy of this letter is included in Appendix 5.
9. Final Response

After the follow up, the response rate started to pick up very slowly. On 15 April the total number of questionnaires received was 110 completed questionnaires. This is about 64.7 percent.

Given the large amount of data received, it was decided to make this the cut point to start the analysis.

The final number of the received questionnaires continued to rise until it reached 120 completed questionnaires. That is about 70 percent. Although it was very late to include them in the analysis, the comments raised in these late responses will be reported later under the relevant section.

10. Computer Software

In order to start the analysis of data the Data Preparation Department in the Computer Centre at Loughborough University of Technology was consulted regarding the statistical package to be used.

Given the large number of variables incorporated in the questionnaire, SPSS-X statistical package was recommended.

The advantages that SPSS-X statistical package has over some other general statistics programs(1) are that it has:

- a high quality of printed output with good notation;
- the ability to select subsets of data for independent analysis;
- the ability to handle nested or hierarchical data structures;
- a powerful range of transformation functions and conditional operations;
- a thorough set of reference material;
- facilities for holding over many variables at once.

This package is installed on the Hewlet-Packard on the mainframe at the Computer Centre of Loughborough University of Technology.
11. Data Coding and Entry

The received questionnaires were coded according to the special format agreed with the Data Preparation Department. This procedure is done to ensure correct entry of responses by the Computer Centre's staff.

Data entry were carried out on small batches of ten questionnaires on average.

Data files were collected through the system network and stored on the main data file ready for statistical analysis.

12. Command Files

SPSS-X is principally a batch programme\(^{(1)}\). By this I mean that SPSS-X instructions are assembled prior to execution.

All entries in the data file must be identified according to the record and column number for all the cases to be processed. Then, all these variables are to be labelled and all the associated values must be identified. These two steps are called variable labels and value labels respectively.

Due to the large number of variables in the questionnaire (more than 300 variables) many command files were used. The allocated memory has to be expanded by the Computer Centre in order to take the large number of print-out.
PART 2

Descriptive Analysis of the Survey

Under this section the results of the analysis is reported according to the order of the questions in the questionnaire.

1. Age Distribution

The minimum recorded age of the sample is 30 years and the maximum is 63 years.

The respondents were grouped under three groups as shown in Table 3.1. This grouping is made in order to be used for further analysis at the second section of the analysis.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young (30-40 yrs)</td>
<td>23</td>
<td>20.9</td>
</tr>
<tr>
<td>Middle (41-50 yrs)</td>
<td>50</td>
<td>45.5</td>
</tr>
<tr>
<td>Mature (51-63 yrs)</td>
<td>37</td>
<td>33.6</td>
</tr>
<tr>
<td></td>
<td>110</td>
<td>100.0</td>
</tr>
</tbody>
</table>

From Table 3.1, 20.9 percent of the sample are in the age group of 30-40 years, 45.5 percent are in the age group of 41-50 years, and 33.6 percent are in the mature group of 51-63 years. This distribution is nearly normal with about 79 percent of the sample from the middle and mature age groups.

2. Job Titles

Forty different job titles were given in the questionnaires. Table 3.2 lists the most popular job titles used and their distribution to the age of the respondents.
Table 3.2 Distribution of Titles by Age of Respondent

<table>
<thead>
<tr>
<th>Job Title</th>
<th>Total Number of respondents</th>
<th>Young 30-40</th>
<th>Middle 41-50</th>
<th>Mature 51-63</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Project Manager</td>
<td>47</td>
<td>15</td>
<td>19</td>
<td>13</td>
</tr>
<tr>
<td>2. Senior Project Manager</td>
<td>9</td>
<td>0</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>3. Project Director</td>
<td>9</td>
<td>0</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. Senior Manager-Projects</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>5. General Manager</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>6. Project General Manager</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>7. Site Project Manager</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>8. Site Manager</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>9. Manager-Operational Projects</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
<td>17</td>
<td>32</td>
<td>31</td>
</tr>
</tbody>
</table>

From Table 3.2 we can see that the Project Manager title is the most popular one. It is evident that this title will remain a very popular title throughout the project manager's career.

At the mature age group the situation might be slightly different and more senior job titles are used.

The other job titles used were very diversified and Table 3.3 lists all job titles used and the corresponding age of the participant.

It should be noticed that although the seniority of the respondents increases with age, it is still a valid argument that the title of 'Project Manager' is the overriding title and this may remain the title for the whole career. In some cases an organizational 'senior' title may be used to highlight the seniority of the project manager.
3. **Years on the Job**

This question was aimed at investigating the time spent by respondents on the present job in order to get an understanding of how long a person might be on his job. Table 3.4 shows the breakdown of years spent at present job by the respondents.

### Table 3.4 Years Spent on the Present Job

<table>
<thead>
<tr>
<th>Years on this job</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 3 years</td>
<td>58</td>
<td>52.7</td>
</tr>
<tr>
<td>4 - 6 years</td>
<td>25</td>
<td>22.7</td>
</tr>
<tr>
<td>7 - 9 years</td>
<td>10</td>
<td>9.1</td>
</tr>
<tr>
<td>10 - 15 years</td>
<td>8</td>
<td>7.3</td>
</tr>
<tr>
<td>16 and more years</td>
<td>9</td>
<td>8.2</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>110</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>
We notice from the above table that more than 50% of the respondents have spent 1 to 3 years on their present jobs. On the other hand about 50% of the respondents have been on their job for more than 4 years. The longer time spent on the job might indicate that the job of a project manager is a life-time job. This is not to say it is the end of the respondent’s career but it shows the seniority of this job as a whole, given the role played by the occupant and the seniority of his post in the organisational hierarchy.

4. **Years with this Employer**

In order to get a clear picture about the relationship between the employers and their employees, the participants were asked about the number of years spent with their present employer.

Table 3.5 shows the time spent by the respondents with their present employers.

<table>
<thead>
<tr>
<th>Years with Employer</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 5</td>
<td>22</td>
<td>20.0</td>
</tr>
<tr>
<td>6 - 10</td>
<td>14</td>
<td>12.7</td>
</tr>
<tr>
<td>11 - 20</td>
<td>38</td>
<td>34.6</td>
</tr>
<tr>
<td>More than 21</td>
<td>36</td>
<td>32.7</td>
</tr>
<tr>
<td>Total:</td>
<td>110</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The most important observation is that many of the respondents have spent all their entire career life with the same employer. This is another indication about the successful project managers participating in this survey which in return will have positive contributions to our survey.

This long career with the same employer reflects the importance of such a job for the employer's consideration as well as the importance of this job as a key job in the organisation as a whole.
5. **Size of Organisation**

Participants were asked to give the approximate number of employees in the organisation as a whole. This was done in order to find the sizes of organisations. Organisations were divided into 3 groups as follows:

- Small, less than 2000
- Medium, 2001 to 5000
- Large, more than 5000.

This grouping was done for the sake of the statistical analysis and has nothing to do with the capabilities of the participating organisations.

Table 3.6 shows the breakdown of the organisations by their size.

<table>
<thead>
<tr>
<th>Size of Organisation</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small (up to 2000)</td>
<td>46</td>
<td>41.8</td>
</tr>
<tr>
<td>Medium (2001 - 5000)</td>
<td>28</td>
<td>25.5</td>
</tr>
<tr>
<td>Large (More than 5000)</td>
<td>36</td>
<td>32.8</td>
</tr>
</tbody>
</table>

From another computer analysis, I found that 77% of the organisations have more than 1000 employees. This observation shows the size of organisations who are members of the European Construction Institute. Therefore, we can conclude that this represents the major parties of the construction industry.

6. **Basic Academic Degree**

The educational base of the participants is shown in Table 3.7.

<table>
<thead>
<tr>
<th>Degree</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Degree (BSc Engineering + HNC and HND)</td>
<td>96</td>
<td>87.3</td>
</tr>
<tr>
<td>Diploma (Technical)</td>
<td>4</td>
<td>3.6</td>
</tr>
<tr>
<td>Management Degree (B.A.)</td>
<td>7</td>
<td>6.4</td>
</tr>
<tr>
<td>No qualification</td>
<td>3</td>
<td>2.7</td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>100.0</td>
</tr>
</tbody>
</table>
From Table 3.7 the percentage of project managers with a technical degree is 90.9%.

The 7 project managers with management degrees raise a fundamental question that is being asked more and more.

The conventional wisdom is to take the graduate with an engineering degree and graft on management, human relations and leadership skills to produce our project managers.

7. Course Contents
The aim of this question was to investigate the education background of the participants. The following major contents were included:

- Technical content;
- Science subjects content;
- Management content;
- Accounting and Finance;
- Computers.

Participants were asked to make sure that the total percentage must add up to 100 percent in order to ensure accurate total percentage as much as possible.

Technical Contents
The distribution of the technical course contents is shown in Table 3.8.

<table>
<thead>
<tr>
<th>Range</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 5%</td>
<td>10</td>
<td>9.1</td>
</tr>
<tr>
<td>6 to 15%</td>
<td>5</td>
<td>4.5</td>
</tr>
<tr>
<td>16 to 30%</td>
<td>7</td>
<td>6.4</td>
</tr>
<tr>
<td>31 to 50%</td>
<td>29</td>
<td>26.4</td>
</tr>
<tr>
<td>More than 50%</td>
<td>59</td>
<td>53.6</td>
</tr>
<tr>
<td>Total:</td>
<td>110</td>
<td>100.0</td>
</tr>
</tbody>
</table>
From this table it is clear that 88% of our project managers have had technical course contents of more than 30%. More than 50% of the respondents have had even higher technical background. This is explained partly by their technical academic qualifications and partly by the high technical course contents incorporated in most curriculum used by the majority of the educational institutions.

Science subjects contents
Table 3.9 shows the breakdown of the science subject contents.

**Table 3.9 Science Subject Course Contents**

<table>
<thead>
<tr>
<th>Range</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 5%</td>
<td>30</td>
<td>27.3</td>
</tr>
<tr>
<td>6 to 15%</td>
<td>19</td>
<td>17.3</td>
</tr>
<tr>
<td>16 to 30%</td>
<td>32</td>
<td>29.1</td>
</tr>
<tr>
<td>31 to 50%</td>
<td>19</td>
<td>17.3</td>
</tr>
<tr>
<td>More than 50%</td>
<td>10</td>
<td>9.1</td>
</tr>
<tr>
<td>Total:</td>
<td>110</td>
<td>100.0</td>
</tr>
</tbody>
</table>

There is clear evidence from Table 3.9 that the science subjects course contents is different from the technical course contents. About 81 percent of the project managers have had less than 30% of science subjects.

Management Contents
The breakdown of management subjects course contents is shown in Table 3.10.
Table 3.10 Management Course Contents

<table>
<thead>
<tr>
<th>Range</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 5%</td>
<td>65</td>
<td>59.1</td>
</tr>
<tr>
<td>6 -15%</td>
<td>33</td>
<td>30.0</td>
</tr>
<tr>
<td>16 to 30%</td>
<td>7</td>
<td>6.4</td>
</tr>
<tr>
<td>31 to 50%</td>
<td>5</td>
<td>4.5</td>
</tr>
<tr>
<td>More than 50%</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total:</td>
<td>110</td>
<td>100.0</td>
</tr>
</tbody>
</table>

There is clear evidence from Table 3.10 that on one hand about 60% of our project managers have had very low management subject course contents of nearly 5 percent. On the other hand 98% of the whole project managers have had 15 percent or less of management education.

From what was mentioned earlier about the educational background of our sample, it is clear that those 7 project manages with management academic degrees did not even exceed the 50 percent range of their management subjects course contents. This also reflects that even those management based institutions are not biased towards single field such as pure management courses.

Also this could lead us to conclude that the management based educational institutions have a wider base for their educational curriculum by incorporating other subjects besides pure management courses.

Unfortunately, this does not seem the case for the educational institutions responsible for the education of the dominating majority of project managers of whom their academic background is engineering.

Accounting and Finance
The course contents of accounting and finance subjects are shown in Table 3.11.
Table 3.11 Accounting and Finance Course Contents

<table>
<thead>
<tr>
<th>Range</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 5%</td>
<td>93</td>
<td>84.5</td>
</tr>
<tr>
<td>6 to 15%</td>
<td>15</td>
<td>13.6</td>
</tr>
<tr>
<td>16 to 30%</td>
<td>1</td>
<td>0.9</td>
</tr>
<tr>
<td>31 to 50%</td>
<td>1</td>
<td>0.9</td>
</tr>
<tr>
<td>More than 50%</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>110</td>
<td>100.0</td>
</tr>
</tbody>
</table>

It is evident from Table 3.11 that accounting and finance is superficially covered. 84.5 percent of our project managers have had a course content of 5 percent or less in their educational curriculum. My overall impression is that this is even worse than the management course contents. More than 84 percent of our project managers have had less than 5% of accounting and finance subjects in their curriculum.

The overall impression is that construction project managers are of strong technical and scientific background but of shallow or even very shallow managerial, legal, financial and accounting background.

This case might be argued from different points of view as follows:

1. Some might think that the job of a project manager is highly technical and, therefore, does not require that deep managerial, financial and accounting knowledge. The reality is that this job requires a mix of different skills and knowledge. Candidates likely to occupy this job are those of engineering background. The most important question is "Are those engineers well prepared for this?" The answer is definitely 'No' as we have seen from the previous results.

2. The engineering educational institutions are well aware of the need for management, finance and accounting knowledge for their graduates, but they are expecting that these graduates will
follow structured educational and training programmes through their future careers to fulfill this need.

3. Although the educational institutions are aware of the need for management and finance subjects, they are constrained by the limited time stipulated for awarding the academic degree. Therefore they tend to reduce the curriculum course contents. Management and finance subjects have the priority to be reduced or eliminated if needed.

4. Employers are expecting well educated graduates with diversified base of knowledge to ensure successful recruitments and effective running of tasks in hand.

5. Costs of further education and training are escalating and employers are constrained to their budget on educating and training their employees.

6. The job of a project manager is highly demanding and this may result in a very restricted time schedule for the employer and the employees. Therefore, successful further education and training programmes are not expected.

The arguments are endless, but the overriding message, as it will be shown later in the analysis, is that the need for management, finance and accounting is indispensable for project managers if not for the majority of engineering graduates.

McCaffer(2) has indicated that the latest guidelines for undergraduate courses, issued by the Institution of Civil Engineers, only allow management studies, without defining what they mean, as part of the 'not easily quantified subjects'. He also added that law and economics are classed as subject which MIGHT be included. The quote below is taken from Professor McCaffer's lecture(2).

"If graduate engineers do not understand the part that civil engineering plays in an economic system it will come as an almighty shock - as it
Thompson(3) has also elaborated in this issue by saying "The belief that engineers are primarily concerned with technical matters and that financial, contractual and human issues can be left to other people appears to prevail in the civil engineering profession".

Clements(4) has indicated that the emphasis is technical and very little time is given to managerial and communication skills. He reports that only 40% of graduates cover any management topics at university and this is often as little as six lectures.

The reported result of our survey is in line with what was raised earlier as well as other similar studies conducted by Faulkner and Weame(5).

I would like to point out that although what was mentioned earlier was directed towards the education of civil engineers, it is also valid for all other engineering professions.

**Computers**

The computer subjects course contents is shown in Table 3.12

<table>
<thead>
<tr>
<th>Range</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 5%</td>
<td>94</td>
<td>85.5</td>
</tr>
<tr>
<td>6 to 15%</td>
<td>14</td>
<td>12.7</td>
</tr>
<tr>
<td>16 to 30%</td>
<td>2</td>
<td>1.8</td>
</tr>
<tr>
<td>31 to 50%</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>More than 50%</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>110</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

We can see that the majority of project managers in our survey have had low computer subjects. 85.5 percent of the sample had up to 5 percent. That is because most of them have their degrees prior to the
eighties. The situation after the great computer development in the early eighties changed dramatically. Advancements in the computer hardware and software have helped to reduce the cost of computer hardware as well as software. Many educational institutions have made available to their students most of the required computer facilities.

Computer education has become incorporated in many technical and scientific subjects. Nevertheless, the understanding of the basic theory and practice is indispensable. This makes the computer a tool rather than a specialization.

Computers are obviously advancing at an unprecedented rate and that will contribute to the education of the students in many different ways such as:

1. Reduce the time allocated to teach many different subjects such as mathematics and other technical subjects. Hence it will allow more time for the inclusion of other important subjects such as management, finance, accounting and law, etc.

2. Reduce the time spent by students in solving many assigned problems and, therefore, make time available for further theoretical and practical education.

3. It could be used as a teaching tool and could, therefore, help the instructors to take care of many students at the same time.

4. It could evaluate and monitor the students progress throughout their teaching sessions.

These are some of the benefits of the computer as a teaching tool. But the most important step is the adequate planning and implementation of such programmes in order to improve the education process.

Computers are becoming a must in our life. Therefore why should it be given late at the undergraduate level. It might be wise to start computer education at an earlier level so that a large number of young members of society will benefit from it.
8. *Further Educational Qualifications*

One of the most interesting observations was that 49 out of 110 participating project managers had obtained further educational qualifications. That is about 45 percent of the total number of project managers in the survey. The qualifications obtained were:

- 16 MSc's
- 2 PhD's
- 2 Postgraduate study incomplete
- 7 Diplomas
- 9 MBA's
- 8 Qualifications in Business Administration
- 5 Other educational qualification

We regard this as particularly encouraging that 49 out of 110 of today's successful project managers have had their basic education considerably extended.

I believe we have it now well established that further educational qualifications beyond the basic degree are of value to the individual and to the employer. Nevertheless, given the size of employers in our study, a question might be raised. That is:

>'If this is the situation with considerably large employers in our sample, will it be in line with the majority of, relatively, smaller employers?'

I doubt that the finding will be positive given the high cost of such further education, the time off the job to do such a degree and the early relationship between the employers and their employees. If that is the case it is definitely going to have its drawback on the employers, employees and the industry in general. Furthermore, as it was shown earlier that the job of a project manager is a life-time career, employers must revise their long term personnel strategies in order to prepare for successful education and training policies if they are willing to survive in the present market circumstances.
9. **The Importance of Major Training Sources**

A list of major training sources was given and participants were asked to indicate the importance of these sources as contributors to their skills and knowledge by using a rating scale of 1 to 9 for each source, 9 indicating very high importance and 1 indicating very low importance. Table 3.13 shows the given sources, the breakdown of responses and the ranking of these sources.

**Table 3.13 The Importance of Major Training Sources**

<table>
<thead>
<tr>
<th>Training Sources</th>
<th>Rating of Importance</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Training Courses</td>
<td>6 4 11 15 33 8 13 7 11</td>
<td>3</td>
</tr>
<tr>
<td>On the job experience</td>
<td>74 23 10 2 0 0 0 0 0 1</td>
<td>1</td>
</tr>
<tr>
<td>Off the job experience</td>
<td>2 4 14 22 28 18 8 4 9 2</td>
<td>2</td>
</tr>
<tr>
<td>Self learning courses</td>
<td>1 1 5 8 21 14 15 16 29 6</td>
<td>6</td>
</tr>
<tr>
<td>Lectures or Seminars</td>
<td>1 1 6 4 25 21 21 18 13 5</td>
<td>5</td>
</tr>
<tr>
<td>Secondment to other departments</td>
<td>3 7 16 20 14 11 6 7 25 4</td>
<td>4</td>
</tr>
</tbody>
</table>

The ranking of these sources was found by adding the ratings of the first five columns of the table. The difference between academic training courses and off-the-job training courses was very little.

From the previous findings the following observations are worth making:

- If 'on-the-job' experience is the best means of acquiring knowledge and skills, how can we combine this with our academic courses? The answer to this question lies with the educational institutions and their preparedness to cooperate with the employers of their graduates. In an increasing customer oriented market, some of the educational institutions(6) have been engaged in new ventures. These are simply undergraduate
courses sponsored by companies from the industry. All students are engaged by companies, the course project work is taken in conjunction with the companies and the industrial placements are taken with the companies.

These are serious efforts to balance technical education and professional training in the companies to produce better balanced graduates. This is also a step forward to fulfill the client's requirements. This strategy, although at the beginning, will lead to strong links between the educational institutions and the industry.

- It is also a serious effort to develop the interplay between time spent in industry and time spent in the classroom, to the benefit of both.

- The most worrying aspect is how low self learning courses are rated. If education had unlocked an enquiring mind then the self learning would have been rated higher.

- Participants have contributed to an open question in the questionnaire by giving other sources of knowledge and skill. The sources and the associated rates found are as follows:

<table>
<thead>
<tr>
<th>Ratings</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tailor-made company training schemes</td>
<td>8</td>
</tr>
<tr>
<td>Working for a contractor</td>
<td>7</td>
</tr>
<tr>
<td>Mentoring/Coaching</td>
<td>9</td>
</tr>
<tr>
<td>A variety of posts</td>
<td>8</td>
</tr>
<tr>
<td>Other jobs in different fields</td>
<td>7</td>
</tr>
<tr>
<td>Experience</td>
<td>8</td>
</tr>
<tr>
<td>Association with professional personnel</td>
<td>8</td>
</tr>
<tr>
<td>Private study, e.g. computer literacy</td>
<td>7</td>
</tr>
<tr>
<td>Mistakes</td>
<td>4</td>
</tr>
</tbody>
</table>

These sources are reported as mentioned in the received questionnaires.
Training Courses

The purpose of this question was to get a clear picture of the participants training records and their future training requirements. Table 3.14 lists the general training courses included in the questionnaire and the percentage of those participants who attended such courses and/or willing to attend in the future.

Table 3.14 Training Achievements

<table>
<thead>
<tr>
<th>Training Courses</th>
<th>Full time training *</th>
<th>Part time training *</th>
<th>Willing to take training in the future **</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced technology in own field</td>
<td>42.7</td>
<td>27.3</td>
<td>10.9</td>
</tr>
<tr>
<td>Training in new technology</td>
<td>23.6</td>
<td>43.6</td>
<td>8.2</td>
</tr>
<tr>
<td>Management and human resources</td>
<td>77.3</td>
<td>36.4</td>
<td>14.5</td>
</tr>
<tr>
<td>Business studies</td>
<td>50.0</td>
<td>25.5</td>
<td>18.2</td>
</tr>
<tr>
<td>Marketing and Sales</td>
<td>23.6</td>
<td>12.7</td>
<td>9.1</td>
</tr>
<tr>
<td>Languages</td>
<td>11.8</td>
<td>19.1</td>
<td>18.2</td>
</tr>
</tbody>
</table>

* Percentage of the total participants who have had at least one training course.

** Percentage of the total participants who are willing to take a training course in the future.

This table raises the following issues:

- **Full-time training**
  - More than three quarters of our project managers have had at least one full-time training course in management and human resources and this is by far the highest in all other fields of training courses listed. This is another strong evidence of the great need for management and human resources. This
argument is also valid for business studies as half the project managers have attended full-time training in this field.

- It is worth noticing that despite the strong technical background, participants have attended full-time training courses of advanced technology in their own field. That is because of the accelerating rate of technological advancements. But it also shows that the need for technical knowledge is not diminished.

- There is an indication of the growing awareness towards new technology and sales and marketing.

- Although the languages have received a low percentage (11.8%), but this is a reflection of the changes under the European Economic Council and the Unified Europe. This is not to say that participants from the United Kingdom are keen on languages but the opposite is true. Other European countries are much keener on foreign languages, especially English. On the other hand, the English language is the most widely used all over the world. But to compete in new markets this policy must be reviewed.

- **Part-time Training**

Part-time training in new technology has been the highest in the part-time training obtained by the participating project managers. 43.6 percent of our project managers have had at least one part-time training course in new technology. This shows the need for updating the technical knowledge of the project managers. Also it indicates that the need for technical knowledge is not diminished.

- **Management and human resources training** although came second, still indicates the need of such courses for project managers. This reflects the need for management knowledge and skills for the project managers.
- Part-time language education is more popular than full-time. This is because of the time restrictions for the employer and the employee.

- **Future Training**

- Less willingness in technological training is evident.

- Business studies and languages are required more than other fields.

It is an important fact that this sample of project managers represents those employed by large organisations. Therefore, the question to be asked is 'If this is the situation of project managers employed by considerably large organisations, can we expect that other project managers employed by the smaller organisations will have similar training records?' Further investigations are required in order to achieve an acceptable answer to this question.

11. **Satisfaction with Training Opportunities**

Respondents were asked to indicate their satisfaction with the training opportunities available to them. The responses are as follows:

<table>
<thead>
<tr>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very satisfied</td>
</tr>
<tr>
<td>Satisfied</td>
</tr>
<tr>
<td>Fairly satisfied</td>
</tr>
<tr>
<td>Not satisfied</td>
</tr>
<tr>
<td>- because their are no courses available</td>
</tr>
<tr>
<td>- because they cannot get time off to attend</td>
</tr>
</tbody>
</table>

On one hand this is not a satisfactory response, partly because of the large size of organisations under study and partly because of the fairly satisfied project managers. On the other hand the bias on this kind of question is likely to be high because of its sensitivity and the tendency not to give a correct answer for such a direct question.
12. **Experience**

This part of the questionnaire is divided into the following sections:

- total number of projects before becoming a project manager;
- number of projects the project manager has been directly responsible for;
- number of projects the project manager is currently responsible for;
- overseas working experience;
- number of posts held during the project manager's career;

The responses to the above sections are as follows:

- **Number of projects before becoming a project manager**
  
  This was aimed at investigating the level when a project manager starts being responsible for and in command of the project or projects at hand. Responses are grouped for the statistical purposes and they are shown below with the corresponding percentage of responses.

<table>
<thead>
<tr>
<th>Range</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 10 projects</td>
<td>63.6</td>
</tr>
<tr>
<td>11 to 20 projects</td>
<td>25.5</td>
</tr>
<tr>
<td>21 to 50 projects</td>
<td>9.1</td>
</tr>
<tr>
<td>More than 50 projects</td>
<td>1.8</td>
</tr>
</tbody>
</table>

The mean of responses is about 15 projects. This is the stage at which the project manager will be assigned the responsibility of controlling the project. This has nothing to do with the size of the project under consideration but it is most likely that this assignment is carried out by the top management taking into their consideration the previous record of the anticipated project manager.

This reinforces the quality of our survey as the replies obtained by these very experienced project managers ensures the reliability and substance of their contributions.
- Number of projects directly responsible for as a project manager.

The breakdown of this is shown below with the corresponding percentages.

<table>
<thead>
<tr>
<th>Range</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 10 projects</td>
<td>70.0</td>
</tr>
<tr>
<td>11 to 20 projects</td>
<td>19.1</td>
</tr>
<tr>
<td>21 to 50 projects</td>
<td>8.2</td>
</tr>
<tr>
<td>More than 50 projects</td>
<td>2.7</td>
</tr>
</tbody>
</table>

There is a similarity between this distribution and the previous one.

It is clear that the majority (70 percent) have been responsible for up to 10 projects.

- Number of projects the project manager is currently responsible for.

The number of projects the project managers are currently responsible for is shown below with the corresponding percentages.

<table>
<thead>
<tr>
<th>Range</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 project</td>
<td>90.0</td>
</tr>
<tr>
<td>2 to 3 projects</td>
<td>0.9</td>
</tr>
<tr>
<td>3 to 5 projects</td>
<td>7.3</td>
</tr>
<tr>
<td>More than 5 projects</td>
<td>1.8</td>
</tr>
</tbody>
</table>

The main observation is that the large number of projects the project manager is directly or currently responsible for is a result of the seniority of the project managers under study, the large size of organisation and the increasing business activities specially in the oil and power industries as many of our sample are specialised in.

- Overseas working experience

This question was asked to investigate the experience background of our project managers as a measure for the
validity of their contribution. 83 out of 110 project managers have had an overseas working experience. This makes a percentage of 75.5%. The large number of project managers with an overseas working experience contributes positively to our survey and accordingly to the reliability of their contributions.

**Posts held during career**
This was hoped to help in the study of the project manager's career. The number of posts held during the career will help to clarify the total process of preparing a project manager for his job. The responses were grouped and are shown below with the corresponding percentages.

<table>
<thead>
<tr>
<th>Range</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 5 posts</td>
<td>24.5</td>
</tr>
<tr>
<td>6 to 10 posts</td>
<td>56.4</td>
</tr>
<tr>
<td>11 to 20 posts</td>
<td>14.5</td>
</tr>
<tr>
<td>More than 20 posts</td>
<td>4.5</td>
</tr>
</tbody>
</table>

More than half the project managers have held 6 to 10 posts during their career life before becoming project managers. This is an interesting observation because it shows the variety of posts occupied by the respondents.

More than 30 percent of the project managers have occupied up to 10 posts in their career. Accordingly it is evident that to qualify for the post of a project manager the individual is expected to have a wide based experience gained from different posts.

13. **Skills Portfolio**
As it was mentioned earlier, this portfolio was divided into seven major parts as follows:

1. Technical skills (15 listed skills)
2. Managerial skills (11 listed skills)
3. Financial skills (7 listed skills)
4. Computer skills (9 listed skills)
5. Legal skills (6 listed skills)
6. Communication skills (4 listed skills)
7. General skills (4 listed skills)

The top twenty skills are listed in Table 3.15 with the corresponding percentage of total responses rating these skills high on the scale given.

**Table 3.15 Top 20 highest rated skills**

<table>
<thead>
<tr>
<th>Skills</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership skills</td>
<td>98.2</td>
</tr>
<tr>
<td>Planning and scheduling</td>
<td>97.3</td>
</tr>
<tr>
<td>Delegation</td>
<td>96.4</td>
</tr>
<tr>
<td>Chairing meetings</td>
<td>96.1</td>
</tr>
<tr>
<td>Negotiation techniques</td>
<td>95.5</td>
</tr>
<tr>
<td>Presentation skills</td>
<td>95.3</td>
</tr>
<tr>
<td>Establishing budgets</td>
<td>94.3</td>
</tr>
<tr>
<td>Draft contracts and negotiations</td>
<td>92.4</td>
</tr>
<tr>
<td>Decision making techniques</td>
<td>91.8</td>
</tr>
<tr>
<td>Financial reporting systems</td>
<td>90.6</td>
</tr>
<tr>
<td>Correspondence and memo writing</td>
<td>90.6</td>
</tr>
<tr>
<td>Motivation and promotion</td>
<td>90.0</td>
</tr>
<tr>
<td>Team working skills</td>
<td>90.0</td>
</tr>
<tr>
<td>Construction management activities</td>
<td>89.1</td>
</tr>
<tr>
<td>Report writing</td>
<td>88.7</td>
</tr>
<tr>
<td>Basic technical knowledge in own field</td>
<td>84.5</td>
</tr>
<tr>
<td>Understanding of organisation</td>
<td>84.5</td>
</tr>
<tr>
<td>Productivity and cost control</td>
<td>82.7</td>
</tr>
<tr>
<td>Time management</td>
<td>82.7</td>
</tr>
<tr>
<td>Top management relations</td>
<td>81.8</td>
</tr>
</tbody>
</table>
The responses to this major part of the survey will be reported in the following order:

13.1 Relevancy of these skills.
13.2 The effectiveness of sources.

13.1 Relevancy of Skills

The skills are listed in a descending order of their relevancy for each of the major parts with the corresponding percentage of responses rating each skill as highly relevant. (Rated 4 or 5 on the given scale of 5 to 1).

1. Technical Skills

<table>
<thead>
<tr>
<th>Rank</th>
<th>Skills</th>
<th>Percentage of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Planning and scheduling</td>
<td>97.3</td>
</tr>
<tr>
<td>2</td>
<td>Construction management activities</td>
<td>89.1</td>
</tr>
<tr>
<td>3</td>
<td>Basic technical knowledge in own field</td>
<td>94.5</td>
</tr>
<tr>
<td>4</td>
<td>Productivity and cost control</td>
<td>82.7</td>
</tr>
<tr>
<td>5</td>
<td>Forecasting techniques</td>
<td>74.5</td>
</tr>
<tr>
<td>6</td>
<td>Quality control</td>
<td>72.7</td>
</tr>
<tr>
<td>7</td>
<td>Estimating and tendering</td>
<td>70.9</td>
</tr>
<tr>
<td>8</td>
<td>Material procurement</td>
<td>65.5</td>
</tr>
<tr>
<td>9</td>
<td>Reading and understanding drawings</td>
<td>62.7</td>
</tr>
<tr>
<td>10</td>
<td>Design activities and background</td>
<td>59.1</td>
</tr>
<tr>
<td>11</td>
<td>Site layout and mobilization</td>
<td>54.5</td>
</tr>
<tr>
<td>12</td>
<td>Technical writing</td>
<td>49.1</td>
</tr>
<tr>
<td>13</td>
<td>Work study (method study)</td>
<td>12.7</td>
</tr>
<tr>
<td>14</td>
<td>Operation research</td>
<td>9.1</td>
</tr>
<tr>
<td>15</td>
<td>Plant and plant hire</td>
<td>8.2</td>
</tr>
</tbody>
</table>

The high percentage of respondents, especially for the first 10 skills, shows that technical background is indispensable for the project managers.
2. Managerial Skills

<table>
<thead>
<tr>
<th>Rank</th>
<th>Skills</th>
<th>Percentage of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Leadership skills</td>
<td>98.2</td>
</tr>
<tr>
<td>2</td>
<td>Delegation</td>
<td>96.4</td>
</tr>
<tr>
<td>3</td>
<td>Negotiation techniques</td>
<td>95.5</td>
</tr>
<tr>
<td>4</td>
<td>Decision making techniques</td>
<td>91.8</td>
</tr>
<tr>
<td>5</td>
<td>Motivation and promotion</td>
<td>90.0 )</td>
</tr>
<tr>
<td>5</td>
<td>Team working skills</td>
<td>90.0 )</td>
</tr>
<tr>
<td>6</td>
<td>Time management</td>
<td>82.7</td>
</tr>
<tr>
<td>7</td>
<td>Top management relations</td>
<td>81.8</td>
</tr>
<tr>
<td>8</td>
<td>Human behaviour</td>
<td>76.4</td>
</tr>
<tr>
<td>9</td>
<td>Strategic planning</td>
<td>60.0</td>
</tr>
<tr>
<td>10</td>
<td>Recruitment</td>
<td>44.5</td>
</tr>
</tbody>
</table>

It is evident that managerial skills are rated considerably high. Apart from recruitment, 60 percent or more of the project managers have rated the managerial skills as very relevant to their jobs.

3. Financial skills

<table>
<thead>
<tr>
<th>Rank</th>
<th>Skills</th>
<th>Percentage of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Establishing budgets</td>
<td>94.3</td>
</tr>
<tr>
<td>2</td>
<td>Reporting systems</td>
<td>90.6</td>
</tr>
<tr>
<td>3</td>
<td>Project finance</td>
<td>74.5</td>
</tr>
<tr>
<td>4</td>
<td>Cash flows</td>
<td>65.1</td>
</tr>
<tr>
<td>5</td>
<td>Investment appraisal</td>
<td>33.0</td>
</tr>
<tr>
<td>6</td>
<td>VAT and taxation</td>
<td>10.4</td>
</tr>
<tr>
<td>7</td>
<td>Stock control and evaluation</td>
<td>9.4</td>
</tr>
</tbody>
</table>

This confirms the earlier discussion regarding the required financial knowledge for project managers. Also it shows the broad financial activities performed by project managers.
4. **Computer Skills**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Skills</th>
<th>Percentage of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Project management software</td>
<td>75.6</td>
</tr>
<tr>
<td>2</td>
<td>Spreadsheet software</td>
<td>59.3</td>
</tr>
<tr>
<td>3</td>
<td>Computer aided design</td>
<td>55.8</td>
</tr>
<tr>
<td>4</td>
<td>Data base software</td>
<td>34.9</td>
</tr>
<tr>
<td>5</td>
<td>Information technology tools</td>
<td>33.7</td>
</tr>
<tr>
<td>6</td>
<td>Operating packages programmes</td>
<td>25.6</td>
</tr>
<tr>
<td>7</td>
<td>Operating systems</td>
<td>24.4</td>
</tr>
<tr>
<td>8</td>
<td>Mainframe computers</td>
<td>11.6</td>
</tr>
<tr>
<td>9</td>
<td>Programming language(s)</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Although computer background is essential for project managers it is still clear that computer knowledge could be regarded as a tool to control the progress of work and reduce the time needed to do the necessary calculations.

5. **Legal Skills**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Skills</th>
<th>Percentage of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Draft contracts and negotiations</td>
<td>92.4</td>
</tr>
<tr>
<td>2</td>
<td>Health and safety law</td>
<td>76.2</td>
</tr>
<tr>
<td>3</td>
<td>Industrial relations</td>
<td>57.1</td>
</tr>
<tr>
<td>4</td>
<td>Preparation of claims &amp; litigation</td>
<td>55.2</td>
</tr>
<tr>
<td>5</td>
<td>General law background</td>
<td>35.2</td>
</tr>
<tr>
<td>6</td>
<td>Trade Unions and public authorities</td>
<td>33.3</td>
</tr>
</tbody>
</table>
6. Communication Skills

<table>
<thead>
<tr>
<th>Rank</th>
<th>Skills</th>
<th>Percentage of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Presentation skills</td>
<td>95.3</td>
</tr>
<tr>
<td>2</td>
<td>Correspondence and memo writing</td>
<td>90.6</td>
</tr>
<tr>
<td>3</td>
<td>Report writing</td>
<td>88.7</td>
</tr>
<tr>
<td>4</td>
<td>Public speaking</td>
<td>74.5</td>
</tr>
</tbody>
</table>

In general, the high rating of communication skills shows the interactive role of the project managers to communicate with the different hierarchical levels in their organisations as well as the outer world.

7. General Skills

<table>
<thead>
<tr>
<th>Rank</th>
<th>Skills</th>
<th>Percentage of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chairing meetings</td>
<td>96.1</td>
</tr>
<tr>
<td>2</td>
<td>Understanding of organisation</td>
<td>84.5</td>
</tr>
<tr>
<td>3</td>
<td>Marketing and sales skills</td>
<td>50.5</td>
</tr>
<tr>
<td>4</td>
<td>Public relations</td>
<td>49.5</td>
</tr>
</tbody>
</table>

The above responses highlight the need for strong managerial background and show the diversified role played by project managers.

8. Feedback on required skill by the respondents.

The following is a list of contributions regarding the skills and knowledge needed by project managers.

* Quality Assurance
* Set goals on what is needed from computers
* Insurance
* Financial cost control
* Enthusiasm
* Safety management
* Total quality management (TQM)
* Change control
* Spelling and English grammar
* Listening skills
* Personal skills (i.e. communications, diplomacy, common sense)
* Budget risk
* Reference books

It is important to say that safety management and total quality management have been repeatedly mentioned by six responses. This reflects the current practice in the construction industry and the growing attention to these two major issues. Effective communication and financial skills were highly recommended by respondents besides other managerial knowledge and skills.

9. Contributions of Knowledge and Skills

This part describes the effectiveness of the listed sources in the questionnaire which were:

- Academic course;
- Formal training;
- Job experience;

in contributing these skills to the project managers.
Table 3.16 shows the percentage of responses rating these sources as highly effective (have been rated 7 to 9 on the scale of 1 - 9) in contributing each individual skill.

Table 3.16 Effectiveness of sources in contributing knowledge and skills

<table>
<thead>
<tr>
<th>Skills</th>
<th>Academic Courses %</th>
<th>Formal Training %</th>
<th>Job Experience %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technical Skills</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Understanding of basic technical knowledge in own field</td>
<td>28.2</td>
<td>18.2</td>
<td>80.0</td>
</tr>
<tr>
<td>2. Forecasting techniques</td>
<td>8.2</td>
<td>9.1</td>
<td>64.5</td>
</tr>
<tr>
<td>3. Site layout and mobilization</td>
<td>0</td>
<td>0.9</td>
<td>82.7</td>
</tr>
<tr>
<td>4. Material procurement</td>
<td>0.9</td>
<td>1.8</td>
<td>77.3</td>
</tr>
<tr>
<td>5. Operation research</td>
<td>5.5</td>
<td>1.8</td>
<td>13.6</td>
</tr>
<tr>
<td>6. Technical writing</td>
<td>17.3</td>
<td>20.0</td>
<td>51.8</td>
</tr>
<tr>
<td>7. Design activities and background</td>
<td>21.8</td>
<td>10.9</td>
<td>67.3</td>
</tr>
<tr>
<td>8. Reading and understanding drawings</td>
<td>21.8</td>
<td>11.8</td>
<td>81.8</td>
</tr>
<tr>
<td>9. Construction management activities</td>
<td>0.9</td>
<td>13.6</td>
<td>86.4</td>
</tr>
<tr>
<td>10. Planning and scheduling</td>
<td>3.6</td>
<td>13.6</td>
<td>77.3</td>
</tr>
<tr>
<td>11. Estimating and tendering</td>
<td>2.7</td>
<td>11.8</td>
<td>74.5</td>
</tr>
<tr>
<td>12. Productivity and cost control</td>
<td>3.6</td>
<td>15.5</td>
<td>72.7</td>
</tr>
<tr>
<td>13. Work study (method study)</td>
<td>4.5</td>
<td>7.3</td>
<td>18.2</td>
</tr>
<tr>
<td>14. Plant and plant hire</td>
<td>0.9</td>
<td>0.9</td>
<td>24.5</td>
</tr>
<tr>
<td>15. Quality control</td>
<td>6.4</td>
<td>27.3</td>
<td>66.4</td>
</tr>
<tr>
<td><strong>Managerial Skills</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Leadership skills</td>
<td>3.6</td>
<td>23.6</td>
<td>83.6</td>
</tr>
<tr>
<td>2. Time management</td>
<td>4.5</td>
<td>23.6</td>
<td>61.8</td>
</tr>
<tr>
<td>3. Decision making techniques</td>
<td>7.3</td>
<td>27.3</td>
<td>70.9</td>
</tr>
<tr>
<td>4. Negotiation skills</td>
<td>3.6</td>
<td>23.6</td>
<td>76.4</td>
</tr>
<tr>
<td>5. Delegation</td>
<td>0.9</td>
<td>8.2</td>
<td>79.1</td>
</tr>
<tr>
<td>6. Strategic planning</td>
<td>5.5</td>
<td>5.5</td>
<td>49.1</td>
</tr>
<tr>
<td>7. Human behaviour</td>
<td>8.2</td>
<td>20.0</td>
<td>63.6</td>
</tr>
<tr>
<td>8. Motivation and promotion</td>
<td>5.5</td>
<td>19.1</td>
<td>64.5</td>
</tr>
<tr>
<td>9. Recruitment</td>
<td>0</td>
<td>10.0</td>
<td>43.6</td>
</tr>
<tr>
<td>10. Team working skills</td>
<td>6.4</td>
<td>25.5</td>
<td>74.5</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>11. Top management relations</td>
<td>2.7</td>
<td>6.4</td>
<td>70.0</td>
</tr>
</tbody>
</table>

**Financial Skills**

1. Reporting systems | 3.6 | 11.8 | 68.2 |
2. Project finance | 9.1 | 13.6 | 59.1 |
3. Investment appraisal | 10.9 | 13.5 | 32.7 |
4. VAT and taxation | 3.6 | 5.5 | 18.2 |
5. Stock control and evaluation | 3.6 | 5.5 | 17.3 |
6. Cash flows | 8.2 | 16.4 | 47.3 |
7. Establishing budget | 7.3 | 12.7 | 80.9 |

**Computers**

1. Operating systems | 5.5 | 5.5 | 15.5 |
2. Programming language(s) | 9.1 | 4.5 | 8.2 |
3. Operating packages programmes | 5.5 | 6.4 | 16.4 |
4. Spreadsheet software | 4.5 | 9.1 | 33.6 |
5. Database software | 3.6 | 5.5 | 25.5 |
6. Mainframe computers | 5.5 | 3.6 | 14.5 |
7. Computer Aided Design (CAD) | 4.5 | 8.2 | 33.6 |
8. Project management software | 5.5 | 10.0 | 39.1 |
9. Information technology tools | 4.5 | 7.3 | 17.3 |

**Legal aspects**

1. General law background | 10.9 | 12.7 | 34.5 |
2. Draft contracts and negotiations | 3.6 | 17.3 | 69.1 |
3. Industrial relations | 1.8 | 9.1 | 48.2 |
4. Health and safety law | 1.8 | 22.7 | 55.5 |
5. Preparation of claims & litigation | 0.9 | 6.4 | 50.9 |
6. Trade Unions and Public Authorities | 0.9 | 4.5 | 41.8 |

**Communication**

1. Presentation skills | 3.6 | 34.5 | 73.6 |
2. Report writing | 10.0 | 20.0 | 69.1 |
3. Correspondence and memo writing | 7.3 | 10.9 | 77.3 |
4. Public speaking | 3.6 | 26.4 | 64.5 |
From Table 3.16 it is clear that the project managers have rated the job experience as a major source contributing to their knowledge and skills.

This raises the following issues:

1. The high ratings for job experience raises the question of practicality in the technical courses. This is not to say that academic courses have not contributed to the knowledge of the graduates, but it indicates that knowledge was better gained by field work. Lack of good links between the industry and the educational institutions might be addressed as one of the factors contributing to this problem. Thorpe and Alkass\(^7\) have stated that, so far, the outcome with respect to undergraduate training is unsatisfactory, particularly with respect to the graduates embarking on a career in construction. This in addition to the previous discussions raises the issue of reviewing the overall policies of education and training of professional engineers particularly at the undergraduate level. Masters courses, unconstrained by institutional guidelines, offer more scope for practical training\(^7\).

2. Achieving the balance between the theory and practice is essential to secure effective comprehension of the taught subjects. People responsible for the design of the curriculum and the contents of each course must ensure the practical applications are included in order for the students to realise the general applications for such theories.

3. Although the formal training was rated lower than on-the-job experience, it is noticed that on overall it performed...
3. Although the formal training was rated lower than on-the-job experience, it is noticed that on overall it performed better than the academic courses. Nevertheless, it should be emphasised that the training courses must be designed in a way to ensure practicality of the course contents and fulfilling the needs of the trainees. The availability of advanced computer simulation software in many areas has made this task easier given that resources are made available.

4. Academic courses, although rated low, play an important part in the whole issues. Without the basic theories it would have been difficult to benefit from the job experience. Furthermore without the qualifications gained from the educational institutions it would have been impossible to be recruited at the first place and, accordingly, participants would have never gained such experience.

10. **Willingness to receive a copy of the report**
87 respondents have indicated their willingness to receive a copy of the survey's report. This is about 80 percent of the total number of responses. This indicates the enthusiasm of the participants towards their profession and this survey. Copies of the report are to be sent, at no cost, upon completion of the analysis.

11. **Willingness for interview**
As mentioned earlier, interviews were thought to be needed to clarify some of the issues raised by the project managers.

The total number of respondents willing to be interviewed is 69. This is much higher than expected, given the demanding job of the respondents and their involvements. Interviews are to be scheduled according to the final outcome of the analysis.

12. **Comments raised by the project managers**
The comments and discussions raised by the project managers are shown in Appendix 6 due to the size of contributions.
24 respondents have commented on the questionnaire and the issue of education, training and experience of project managers. The major issues raised by the respondents are listed below:

1. Emphasis on practical approach.
2. Effective communication skills are indispensable.
3. The importance of personal qualities and characteristics.
4. Management is very essential for project managers and it has been ignored throughout the engineering curriculum.
5. The need for technical background is very essential.
6. Too many courses are geared to what can be taught not what is required.
7. Academic courses are blamed to lack practicality.
8. Job experience has been repeatedly argued to be one of the major sources for contributing skills and knowledge.
9. Computers are only a tool for the project managers; special qualified staff might assist in conducting many of the required jobs.
10. A blend of academic training, formal training and on the job experience is necessary to achieve balance.

13. **Sex**

One of the completed questionnaires was received with a polite note: "Please note that I am a female!"

Actually that was the fault of a senior manager of a very large company, who did not indicate the title of this project manager. Nevertheless, this shows the considerably low percentage of women at this profession. In our survey this came out to be 0.9%.
PART 3

Associations of Factors in the Survey

1. This part investigates the associations amongst the major factors and the age. The main aim of this part is to set up a clearer picture of the need for skills and knowledge required by the project managers at different stages in their career life. Age was considered to be a major factor. Therefore, most of these analysis were conducted based on the different age groups.

This is done for further investigation and integration of the findings achieved in Part Two in order to give a clearer picture of these findings.

Chi-square tests of association between the major factors are used throughout this part. For further statistical details on this test, please refer to Appendix 7. The choice of Chi-square test for the measure of association is based on the fact that it is the most appropriate test for the hypothesis in question and furthermore in instances where it is applied the assumptions necessary for the validity of the test are satisfied.

2. Years on the present job
In order to study the relationship of years spent on the present job and the age of the respondents, a breakdown of responses was carried out. Table 3.17 shows this relationship.

<table>
<thead>
<tr>
<th>Years on the Job</th>
<th>Young 30 - 40 yrs</th>
<th>Middle 41 - 50 yrs</th>
<th>Mature 51 - 63 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 5 years</td>
<td>65.2</td>
<td>42.0</td>
<td>32.4</td>
</tr>
<tr>
<td>6 - 10 years</td>
<td>21.7</td>
<td>34.0</td>
<td>27.0</td>
</tr>
<tr>
<td>More than 10 years</td>
<td>13.0</td>
<td>24.0</td>
<td>40.5</td>
</tr>
</tbody>
</table>
A test of association between age and time on present job showed evidence of dependence

\[ \chi^2 = 8.73 \text{ and } P = 0.068 \]

From the above table, it is interesting to notice the increasing percentage of participants spending more than 10 years on the present job. Hence the older the project manager the more time he spends on the job. This describes some of the characteristics of the project manager's job. By this I mean on one hand it is not a routine job due to the varieties involved in the job, on the other hand it reflects the seniority of this post.

3. **Years with this employer by age**

Table 3.18 shows the breakdown of years spent by the respondents with their employers by the age groups. The aim of this breakdown is to study the stability of employment within the sample in order to get a clear picture of the general trend as well as further investigation into the successfulness of the project managers participating in this survey.

**Table 3.18  Years Spent with the Present Employer by Age**

<table>
<thead>
<tr>
<th>Years with employer</th>
<th>Young 30 - 40 yrs</th>
<th>Middle 41 - 50 yrs</th>
<th>Mature 51 - 63 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 5 years</td>
<td>30.4</td>
<td>20.0</td>
<td>13.5</td>
</tr>
<tr>
<td>6 - 10 years</td>
<td>34.8</td>
<td>10.0</td>
<td>2.7</td>
</tr>
<tr>
<td>More than 10 years</td>
<td>34.8</td>
<td>70.0</td>
<td>83.8</td>
</tr>
</tbody>
</table>

A test of association between age and time spent with the present employer showed evidence of dependence

\[ \chi^2 = 19.19 \text{ and } P = 0.0007 \]
It is very interesting to notice that 34.8% of the young group, 70% of the middle group and 83.8% of the mature group have spent more than 10 years with the same employer. This is evidence that our sample are very successful in their career. This is explained by the stable nature of their employment. Accordingly it implies that they are in secure employment. Accordingly, it reflects the relationship between the employers and their employees. Therefore, candidates at this post are expected to spend their entire career with the organisation. Hence, better opportunities must be made available and different strategies must be followed in order to look after these invaluable assets.

4. **Course contents by age**

The aim of this breakdown is to study the trend of the course contents for the basic education of the respondents. This process will highlight the changes in the curriculum course contents over the decades.

4.1 **Technical course contents by age**

Table 3.19 shows the breakdown of the technical course contents by the age groups.

<table>
<thead>
<tr>
<th>Range of contents</th>
<th>Age Groups (% of each group)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Young 30 - 40 yrs</td>
</tr>
<tr>
<td>0 - 5%</td>
<td>17.4</td>
</tr>
<tr>
<td>6 - 15%</td>
<td>0</td>
</tr>
<tr>
<td>16 - 30%</td>
<td>4.3</td>
</tr>
<tr>
<td>More than 30%</td>
<td>78.3</td>
</tr>
</tbody>
</table>

Although no significance was found by the statistical test, it is very clear by the statistical test, that the technical course contents are very high. Almost 80% of the participants have had more than 30% of technical subjects in their curriculum.
4.2 Science subjects course contents by age
Table 3.20 shows the breakdown of the science subjects course contents by age.

Table 3.20 Science subjects course contents by age

<table>
<thead>
<tr>
<th>Age - Groups (% of each group)</th>
<th>Young 30 - 40 yrs</th>
<th>Middle 41 - 50 yrs</th>
<th>Mature 51 - 63 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range of contents</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 - 5%</td>
<td>39.1</td>
<td>14.0</td>
<td>37.8</td>
</tr>
<tr>
<td>6 - 15%</td>
<td>17.4</td>
<td>24.0</td>
<td>8.1</td>
</tr>
<tr>
<td>16 - 30%</td>
<td>39.1</td>
<td>32.0</td>
<td>18.9</td>
</tr>
<tr>
<td>More than 30%</td>
<td>4.3</td>
<td>30.0</td>
<td>35.1</td>
</tr>
</tbody>
</table>

A test of association between age and science subjects course contents showed evidence of dependence

\[
\chi^2 = 16.85 \text{ and } P = 0.009
\]

It is significant that the science subjects course contents have changed over the last three decades. The trend could be noticed from the table. The young group are having less science subjects in their curriculum.

4.3 Management subjects course contents by age
Table 3.21 shows the breakdown of the management subjects course contents by age.
Table 3.21 Management Course Contents by Age

<table>
<thead>
<tr>
<th>Range of contents</th>
<th>Young 30 - 40 yrs</th>
<th>Middle 41 - 50 yrs</th>
<th>Mature 51 - 63 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 5%</td>
<td>47.8</td>
<td>58.0</td>
<td>67.6</td>
</tr>
<tr>
<td>6 - 15%</td>
<td>34.8</td>
<td>34.0</td>
<td>21.6</td>
</tr>
<tr>
<td>16 - 30%</td>
<td>8.7</td>
<td>4.0</td>
<td>8.1</td>
</tr>
<tr>
<td>More than 30%</td>
<td>8.7</td>
<td>4.0</td>
<td>2.7</td>
</tr>
</tbody>
</table>

Although it is statistically not significant the trend is encouraging. We can notice from the top and bottom rows of the above table that the percentage of 0 to 5% of management course contents is increasing towards the larger age group. On the lower rows the trend is the opposite. This is a good indication that management subjects course contents are getting larger in the recent decades. Nevertheless, this issue must be brought into focus and more management course contents must be incorporated. This was partly explained by the top 20 skills required for the project managers and partly by the comments raised by the participants.

4.4 Accounting and finance course contents by age

Table 3.22 shows the breakdown of the accounting and finance course contents by age.
We can notice that this is even worse than the distribution of management subjects course contents. If we look at the top row of this table and compare it with the top row of Table 3.21 we will realise that finance and accounting subjects are scarcely given. The majority of participants have had very low finance and accounting related subjects. The likely percentage of the contents at the undergraduate level is almost ZERO. Comparatively more financial and accounting course contents are given to the young group.

4.5 Computer subject course contents by age

Table 3.23 shows the breakdown of the computer subjects course contents by age.

Table 3.23 Computer subject course contents by age
It is obvious that computers were hardly available for the mature group. The trend is clearly increasing for the younger groups. This trend shows the increasing attention paid by the educational establishments to the computer education. There was not any statistical significance but the table gives a clear picture.

5. *Further Educational Qualification by Age*

The breakdown of further educational qualifications by age is shown in Table 3.24.

**Table 3.24 Further Educational Qualifications by Age**

<table>
<thead>
<tr>
<th>Age Groups (% of each group)</th>
<th>Young 30 - 40 yrs</th>
<th>Middle 41 - 50 yrs</th>
<th>Mature 51 - 63 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>No further qualifications</td>
<td>30.4</td>
<td>60.0</td>
<td>64.9</td>
</tr>
<tr>
<td>With further qualifications</td>
<td>69.6</td>
<td>40.0</td>
<td>35.1</td>
</tr>
</tbody>
</table>

It is very encouraging to see that almost 70% of the young project managers have had further educational qualifications. This is another supporting evidence of the earlier discussions regarding the further educational qualifications of the project managers in our survey. The Chi-square test shows a very significant association ($\chi^2 = 67.5, P < 0.05$) between the age groups and the further educational qualifications.

6. *Ratings of the major sources by age*

The aim of this breakdown is to study the effectiveness of the major sources in contributing knowledge and skills to the respondents. This breakdown is shown in Table 3.25. This table shows the ratings given
to these sources by the three age groups of our sample. The 'P' value shows the significance of the Chi-square test.

Table 3.25 Ratings of the major sources of knowledge by age groups

<table>
<thead>
<tr>
<th>Age Groups (% of each group)</th>
<th>Young 30 - 40 yrs</th>
<th>Middle 41 - 50 yrs</th>
<th>Mature 51 - 63 yrs</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratings</td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td>Academic's training course</td>
<td>13.0</td>
<td>73.9</td>
<td>13.0</td>
<td>32.0</td>
</tr>
<tr>
<td>On-the-job training</td>
<td>0</td>
<td>4.3</td>
<td>95.7</td>
<td>0</td>
</tr>
<tr>
<td>Off-the-job-training</td>
<td>8.7</td>
<td>78.3</td>
<td>13.0</td>
<td>20.4</td>
</tr>
<tr>
<td>Self learning courses</td>
<td>47.8</td>
<td>52.2</td>
<td>0</td>
<td>48.0</td>
</tr>
<tr>
<td>Lectures or Seminars</td>
<td>52.2</td>
<td>47.8</td>
<td>0</td>
<td>48.0</td>
</tr>
<tr>
<td>Secondment to other</td>
<td>39.1</td>
<td>34.8</td>
<td>26.1</td>
<td>30.6</td>
</tr>
<tr>
<td>departments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Ratings:  
  L = Low contribution (1 - 3)  
  M = Moderate contribution (4 - 6)  
  H = High contribution (7 - 9)

From this table the following observations are worth mentioning.

- **Academic training courses**
  The younger group have given higher rating than both the other groups. 13 percent of the young respondents have rated the academic training as 'Low'. On the other hand, if we added the 'Middle' and 'High' ratings for the three groups we can notice that the younger group is still higher than both the other groups. This might indicate that standards of academic training courses are improving.

- **On-the-job training**

96
As mentioned earlier in Part 2, this source was awarded the highest ratings. All the respondents at the 'Middle' group have rated on-the-job training as the highest among the other sources of knowledge. This raises the need for more attention to be given by all the concerned parties to revise their policies in order to build up strong links and better atmosphere of cooperation. At the end the industry in general will benefit from such moves. From the table we can notice that there is less weight given by the younger age group.

- **Off-the-job training**
The middle and the mature groups have given lower ratings than the young group. More than 91% of the young group have rated this source as moderate to high. This raises the alarm on the effectiveness of off-the-job training courses. As one of the comments raised by one of the respondents indicated that training courses are designed to teach what can be taught not what is needed. This raises the need for reviewing the contents of the training courses. Lack of practicality and consistency are some of the hurdles to be overcome. This is also valid for all the other sources. But the need for better design and structured courses are not diminished. Therefore, flexibility and efficiency in the design of these courses must be given the highest priority to fulfil the customers needs. Cost of these courses must be highlighted as one of the key issues that face the employers or the employees in pursuing their off-the-job training and unless it is subsidised or made tax deductable the situation might be at a standstill and the industry will suffer as a whole. This point of view is also intended to the academic training courses.

- **Self learning courses**
This source has received the lowest rating so far. The middle group have rated this higher than both the mature and young groups. This raises the following issues:
1 - availability of time;
2 - load and pressure of work for the user;
3 - the successfulness of the design of these courses;
4 - commitment and motivation of the user;
5 - cost and availability of such courses.

Nevertheless, serious moves must be undertaken to develop such courses by all the concerned parties. Employers are also encouraged to make such courses available for their employees to develop their skills and knowledge.

- **Lectures and Seminars**
  This is almost the same as the self learning courses with low ratings by all the groups. None of the young group have rated this source as high. This raises the question of whether this young group are given the opportunity to attend such lectures or seminars. Or is the effectiveness of these lectures or seminars questionable

- **Secondment to other departments**
  We can notice that the young and middle groups have rated this source as the second highest after on-the-job training. This also highlights the need for diversity in the career life of the project manager. Proper supervision and guidance are needed in order to enhance the effectiveness of such sources.
7. *Full-time training achievements by age*

This is aimed at investigating the full-time training achievements of the respondents by their age groups. Table 3.26 shows the breakdown of full-time training attended, at least for one course, by the respondents by the age groups. The 'P' values, shown across each training field, are the calculated Chi-square values.

**Table 3.26 Full-time Training by Age**

<table>
<thead>
<tr>
<th>Fields of training</th>
<th>Age - Groups (% of participants attended full-time training)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Young 30 - 40 yrs</td>
</tr>
<tr>
<td>Own technical field</td>
<td>34.8</td>
</tr>
<tr>
<td>New technology</td>
<td>8.7</td>
</tr>
<tr>
<td>Management</td>
<td>73.9</td>
</tr>
<tr>
<td>Business studies</td>
<td>56.5</td>
</tr>
<tr>
<td>Marketing and Sales</td>
<td>39.1</td>
</tr>
<tr>
<td>Languages</td>
<td>0</td>
</tr>
</tbody>
</table>

From Table 3.26 the following observations are worth mentioning:

**Own technical field:**
Full-time training in own technical field is very essential. Therefore, we expect the project managers to update their background accordingly. We can notice that the young group has the lowest percentage. The relatively higher percentage of participant at the middle and mature groups indicates the undiminished need for technical training for the project managers at all levels. As shown in the table, the 'P' value is not significant.

**New technology**
The very low percentages of the young group attending full-time training courses in new technology raises the fear that they are confined to a narrow scope of work. On the other hand it might be argued that their job at this level does not require that extra training in
new technology. The trend shows a growing need at later stage in new technology of the career. In general the overall impression is that this is a very low percentage, especially for the young group. The statistical Chi-square test value does not show significance.

**Management**
Full-time training in management has the highest percentages across all the groups and among all the proposed fields of training. This emphasizes what was mentioned earlier regarding the lack of management training at the undergraduate level. This also shows the great demand for management education. The statistical Chi-square value does not show significance.

**Business Studies:**
Training in business studies has the second highest percentage after the management training. This reflects some of the other required skills and knowledge for project managers. No significance was found from the Chi-square test.

**Marketing and Sales:**
The increasing competition in the construction industry might have contributed to the growing attention awarded to marketing and sales. The young group have had the highest percentage. This reflects the role of project managers at the young group. In that, I mean, they are more oriented towards attracting new contracts or businesses. On the other hand it might show the interest of their employers in preparing them for the anticipated competitive markets. The statistical Chi-square test value does not show significance.

**Languages:**
Languages have had very low scores. This reflects British attitudes towards learning a new language. The middle group have considerably higher percentages than both the other groups. The need for languages is expected to increase as a result of the open European markets. Therefore all the concerned parties must take proper measures to include foreign languages if they are looking to compete with other nations. The Chi-square test has shown significance with a 'P' value = 0.01.
8. **Part-time Training by Age**

Table 3.27 shows the part-time training attended by the respondents, for at least one course, broken down by their age groups.

**Table 3.27 Part-time Training by Age**

<table>
<thead>
<tr>
<th>Fields of training</th>
<th>Age Groups (% of participants attending part-time training)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Young 30 - 40 yrs</td>
</tr>
<tr>
<td>Own technical field</td>
<td>30.4</td>
</tr>
<tr>
<td>New technology</td>
<td>69.6</td>
</tr>
<tr>
<td>Management</td>
<td>39.1</td>
</tr>
<tr>
<td>Business studies</td>
<td>26.1</td>
</tr>
<tr>
<td>Marketing and Sales</td>
<td>17.4</td>
</tr>
<tr>
<td>Languages</td>
<td>21.7</td>
</tr>
</tbody>
</table>

From Table 3.27 the following observations are made.

**Own technical field**: Participants at the mature group have had less part-time training in own technical field than those at the middle and young groups. By comparing Table 3.26 and Table 3.27 we can notice that the mature project managers have had more full time training than both the other groups. This might explain the lower percentage of the part time training recorded in Table 3.27. The Chi-square 'P' value does not show significance.

**New technology**: The situation is completely different as the younger project managers have had considerably more part time training. This reflects the increasing demand for training in new technology. The younger project managers are the most likely candidates for this. The percentages for the young and middle groups are higher than those achieved at the previous table of full time training. This explains that part-time training in new technology is more likely to be of less
disturbance to the flow of work. The Chi-square 'P' value shows significance ('P' = 0.01)

Management: Part-time management training records are almost half those records of full-time training. This shows the preference of attending management training on a full-time basis.

Business Studies: The part-time training records is almost have those achieved in full-time training across all the groups. There was no significance of the Chi-square test.

Marketing and Sales: There is a similar trend to the records achieved in the full-time training. This trend is also decreasing through the older age groups. The Chi-square test does not show any significance.

Languages: Apart from the low percentage of those project managers at the middle group, the situation is made clear that there is a growing attention awarded to part-time training in languages. The Chi-square test does not show any significance.

This observation might raise the question of who is paying for this training. Is it the employer or the employee? Nevertheless the need for foreign languages is expected to increase in the near future.

9. Willingness for Future Training by Age
Table 3.28 shows the breakdown of the participants' willingness to attend future training by the age groups. This is aimed at investigating the required training of the participants throughout their careers.
Table 3.28 Willingness for Future Training by Age

<table>
<thead>
<tr>
<th>Fields of training</th>
<th>Young 30 - 40 yrs</th>
<th>Middle 41 - 50 yrs</th>
<th>Mature 51 - 63 yrs</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own technical field</td>
<td>13.0</td>
<td>16.0</td>
<td>2.7</td>
<td>0.14</td>
</tr>
<tr>
<td>New technology</td>
<td>13.0</td>
<td>10.0</td>
<td>2.7</td>
<td>0.30</td>
</tr>
<tr>
<td>Management</td>
<td>17.4</td>
<td>16.0</td>
<td>10.8</td>
<td>0.72</td>
</tr>
<tr>
<td>Business studies</td>
<td>17.4</td>
<td>20.0</td>
<td>16.2</td>
<td>0.90</td>
</tr>
<tr>
<td>Marketing and Sales</td>
<td>13.0</td>
<td>14.0</td>
<td>0</td>
<td>0.06</td>
</tr>
<tr>
<td>Languages</td>
<td>21.7</td>
<td>28.0</td>
<td>2.7</td>
<td>0.01</td>
</tr>
</tbody>
</table>

The most significant chi-square 'P' values were for languages and marketing and sales. This emphasizes the growing demand for foreign languages and marketing and sales.

The mature group has a very low percentage of 2.7%. The willingness for training in languages is the highest for the middle and young groups among the other fields of future training. The need for further training in management and business studies is still high. The middle group has the highest percentage among the other groups for future training in management.

It is interesting to notice that the mature group has shown a very low willingness for future training in own technical field and new technology. This shows that participants at this group have a very low interest in further technical training and that their present roles are highly managerial. This could be explained by the relatively high willingness for further future training in management and business studies. The percentages for these two fields are 10.8% and 16.2% respectively.
10. Experience of Respondents by Age

10.1 Number of projects before becoming a project manager.
The chi-square test does not show any significance. 43.5 percent of the young group have been associated with more than 10 projects before becoming project managers. This ratio is higher than those of the middle and mature groups, where these percentages are 36 and 32.4 respectively.

10.2 Number of projects directly responsible for by age.
This is concerned with the number of projects for which the respondents have been directly responsible for as project managers.

The result of the 'P' value of the chi-square test came out to be 0.046, which is very significant. This shows the differences amongst the three groups. In other words, the older project managers are responsible for more projects than the younger project managers. Table 3.29 shows the breakdown of this.

Table 3.29 Number of Projects respondents have been directly responsible for before becoming project managers by age

<table>
<thead>
<tr>
<th>Age - Groups</th>
<th>Young 30 - 40 yrs</th>
<th>Middle 41 - 50 yrs</th>
<th>Mature 51 - 63 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 to 2 projects</td>
<td>47.8</td>
<td>18.0</td>
<td>16.2</td>
</tr>
<tr>
<td>3 to 5 projects</td>
<td>17.4</td>
<td>34.0</td>
<td>32.4</td>
</tr>
<tr>
<td>More than 5 projects</td>
<td>34.8</td>
<td>48.0</td>
<td>51.4</td>
</tr>
</tbody>
</table>

It is interesting to notice that project managers at the young group had better chances for their career promotion as project managers. 34.8 percent of the young project managers are directly responsible for more than 5 projects.
11. *Relevancy of skills by age*

The aim of this analysis is to investigate the relevancy of skills to the project manager at the different stages of their age. Hence we will be able to highlight the skills required at the different age groups. This section will discuss the following:

- the general relevancy of skills to the project managers according to their age groups;
- the most required skills for each age group as rated by the respondents;
- the top 20 skills required for each group.

11.1 Relevancy of technical skills by age

Table 3.30 shows the relevancy of technical skills broken down by the age groups of the respondents.

From Table 3.30, the following observations are made:

1. Although no significance was found for the understanding of basic technical knowledge in own field, the message was very clear. More than 80 percent of the participating project managers have rated this skill as highly relevant to their job. This provides another strong evidence that the need for technical knowledge and skills is not diminished throughout the project manager's career.

2. Forecasting techniques associated skill did not show any significance. But we can realise that it is needed at a later stage of the project manager's career. The middle aged group has shown the highest rating for this skill. This explains part of the role played by project managers at their mid career life.
Table 3.30 Relevancy of technical skills by age

<table>
<thead>
<tr>
<th>Rating*</th>
<th>L</th>
<th>M</th>
<th>H</th>
<th>L</th>
<th>M</th>
<th>H</th>
<th>L</th>
<th>M</th>
<th>H</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young</td>
<td>0</td>
<td>13.0</td>
<td>87.0</td>
<td>0</td>
<td>16.0</td>
<td>84.0</td>
<td>0</td>
<td>16.2</td>
<td>83.8</td>
<td>0.93</td>
</tr>
<tr>
<td>Middle</td>
<td>13.0</td>
<td>65.2</td>
<td>8.0</td>
<td>14.0</td>
<td>78.0</td>
<td>8.1</td>
<td>16.2</td>
<td>75.7</td>
<td>0.46</td>
<td></td>
</tr>
<tr>
<td>Mature</td>
<td>4.3</td>
<td>56.5</td>
<td>39.1</td>
<td>4.0</td>
<td>34.0</td>
<td>52.0</td>
<td>10.8</td>
<td>21.6</td>
<td>67.6</td>
<td>0.07</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young</td>
<td>4.3</td>
<td>34.8</td>
<td>60.9</td>
<td>4.0</td>
<td>34.0</td>
<td>62.0</td>
<td>2.7</td>
<td>24.3</td>
<td>73.0</td>
<td>0.84</td>
</tr>
<tr>
<td>Middle</td>
<td>13.0</td>
<td>39.1</td>
<td>47.8</td>
<td>8.0</td>
<td>26.0</td>
<td>66.0</td>
<td>13.5</td>
<td>29.7</td>
<td>56.8</td>
<td>0.63</td>
</tr>
<tr>
<td>Mature</td>
<td>13.5</td>
<td>29.7</td>
<td>56.8</td>
<td>13.5</td>
<td>29.7</td>
<td>56.8</td>
<td>13.5</td>
<td>29.7</td>
<td>56.8</td>
<td>0.63</td>
</tr>
<tr>
<td>3.</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young</td>
<td>8.7</td>
<td>34.8</td>
<td>56.5</td>
<td>4.0</td>
<td>30.0</td>
<td>66.0</td>
<td>16.2</td>
<td>21.6</td>
<td>62.2</td>
<td>0.32</td>
</tr>
<tr>
<td>Middle</td>
<td>8.7</td>
<td>4.3</td>
<td>87.0</td>
<td>2.0</td>
<td>10.0</td>
<td>88.0</td>
<td>2.7</td>
<td>5.4</td>
<td>91.9</td>
<td>0.54</td>
</tr>
<tr>
<td>Mature</td>
<td>8.7</td>
<td>4.3</td>
<td>87.0</td>
<td>2.0</td>
<td>10.0</td>
<td>88.0</td>
<td>2.7</td>
<td>5.4</td>
<td>91.9</td>
<td>0.54</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young</td>
<td>4.3</td>
<td>13.0</td>
<td>82.6</td>
<td>6.0</td>
<td>16.0</td>
<td>78.0</td>
<td>10.8</td>
<td>0</td>
<td>89.2</td>
<td>0.13</td>
</tr>
<tr>
<td>Middle</td>
<td>56.5</td>
<td>34.8</td>
<td>8.7</td>
<td>60.0</td>
<td>26.0</td>
<td>14.0</td>
<td>62.2</td>
<td>24.3</td>
<td>13.5</td>
<td>0.89</td>
</tr>
<tr>
<td>Mature</td>
<td>69.6</td>
<td>26.1</td>
<td>4.3</td>
<td>76.0</td>
<td>16.0</td>
<td>8.0</td>
<td>67.6</td>
<td>21.6</td>
<td>10.8</td>
<td>0.76</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young</td>
<td>8.7</td>
<td>21.7</td>
<td>69.6</td>
<td>6.0</td>
<td>16.0</td>
<td>78.0</td>
<td>5.4</td>
<td>27.0</td>
<td>67.6</td>
<td>0.76</td>
</tr>
<tr>
<td>Middle</td>
<td>8.7</td>
<td>21.7</td>
<td>69.6</td>
<td>6.0</td>
<td>16.0</td>
<td>78.0</td>
<td>5.4</td>
<td>27.0</td>
<td>67.6</td>
<td>0.76</td>
</tr>
<tr>
<td>Mature</td>
<td>8.7</td>
<td>21.7</td>
<td>69.6</td>
<td>6.0</td>
<td>16.0</td>
<td>78.0</td>
<td>5.4</td>
<td>27.0</td>
<td>67.6</td>
<td>0.76</td>
</tr>
</tbody>
</table>

* Relevancy:

L = Low
M = Moderate
H = High

3. Site layout and mobilization skill has shown a significant Chi-square 'P' value of 0.07. This indicates that this skill is required by project managers at a more senior level. Accordingly it shows some of the industry's specific characteristics. That is, the project managers at a more senior level are responsible for site layout and mobilization.

4. The table provides a clear picture of the relevancy of the listed technical skills to the three age groups. Although no statistical Chi-square significance was detected the table reflects the relevancy of these skills to the project managers.
The top 5 technical skills required by the project managers at the young age group are:
1 - planning and scheduling;
2 - construction management activities;
3 - understanding of basic technical knowledge in own field;
4 - productivity and cost control;
5 - quality control.

The top 5 technical skills required by the project managers at the middle age group are:
1 - planning and scheduling;
2 - construction management activities;
3 - understanding of basic technical knowledge in own field;
4 - productivity and cost control;
5 - quality control.

The top 5 technical skills required by the project managers at the mature age group are:
1 - planning and scheduling;
2 - construction management activities;
3 - productivity and cost control;
4 - understanding of basic technical knowledge in own field;
5 - forecasting techniques.

This interesting observation is that the project managers at the mature age level rate productivity and cost control skills higher than both the other age groups. Also they have rated forecasting techniques as a very highly needed skill. Both the other groups did not. The understanding of basic technical knowledge in own technical field came fourth at the mature age group. Both the young and middle age groups rated this as third. This shows that the need for basic technical knowledge in own field might be less needed for later career level.

Forecasting techniques rated high by the mature group replacing quality control. This shows that project managers at the mature age group are more concerned with the business aspects rather than the quality control rated by the middle and young age groups.
11.2 Relevancy of management skills by age

Table 3.31 shows the relevancy of management skills broken down by the age groups.

**Table 3.31 Relevancy of management skills by age**

<table>
<thead>
<tr>
<th>Ratings*</th>
<th>Age Groups (% of each group)</th>
<th>Young 30-40 yrs</th>
<th>Middle 41-50 yrs</th>
<th>Mature 51-63 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>M</td>
<td>H</td>
<td>L</td>
<td>M</td>
</tr>
<tr>
<td>1. Leadership skills</td>
<td>0</td>
<td>4.3</td>
<td>95.7</td>
<td>0</td>
</tr>
<tr>
<td>2. Time management</td>
<td>0</td>
<td>17.4</td>
<td>82.6</td>
<td>0</td>
</tr>
<tr>
<td>3. Decision making techniques</td>
<td>0</td>
<td>21.7</td>
<td>78.3</td>
<td>0</td>
</tr>
<tr>
<td>4. Negotiation skills</td>
<td>0</td>
<td>4.3</td>
<td>95.7</td>
<td>0</td>
</tr>
<tr>
<td>5. Delegation</td>
<td>0</td>
<td>4.3</td>
<td>95.7</td>
<td>0</td>
</tr>
<tr>
<td>6. Strategic planning</td>
<td>4.3</td>
<td>34.8</td>
<td>60.9</td>
<td>8.0</td>
</tr>
<tr>
<td>7. Human behaviour</td>
<td>0</td>
<td>17.4</td>
<td>82.6</td>
<td>4.0</td>
</tr>
<tr>
<td>8. Motivation and promotion</td>
<td>0</td>
<td>8.7</td>
<td>91.3</td>
<td>2.0</td>
</tr>
<tr>
<td>9. Recruitment</td>
<td>26.1</td>
<td>21.7</td>
<td>52.2</td>
<td>16.0</td>
</tr>
<tr>
<td>10. Team working skills</td>
<td>0</td>
<td>17.4</td>
<td>82.6</td>
<td>4.0</td>
</tr>
<tr>
<td>11. Top management relations</td>
<td>0</td>
<td>13.0</td>
<td>87.0</td>
<td>8.0</td>
</tr>
</tbody>
</table>

* Relevancy:
  L = Low
  M = Moderate
  H = High

** Cells with values <5 = 66.7% (hence not significant)

From Table 3.31, the following observations are made:

1. Most of the listed management skills were highly rated by all the groups.

2. The strategic planning and recruitment skills were the lowest rated skills. This raises very important arguments. First of all, it might reflect that these project managers are not occupying senior managerial level at their organizations. Hence they are not involved in strategic planning activities. Accordingly this might support the argument that the majority of British organizations are led by professionals from other disciplines such as accountants. If this is the
case then it shows a serious problem. The calculated 'P' value of the Chi-square test was found to be 0.08. This is very significant.

3. The low ratings of recruitment skills is not of importance. It reflects the organizations hierarchies. Given the large sizes of organizations involved in our study, it is evident that the recruitments are undertaken by the concerned departments.

11.3 Relevancy of financial skills
Table 3.32 shows the relevancy of financial skills broken down by the age groups.

<table>
<thead>
<tr>
<th>Table 3.32 Relevancy of financial skills by age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Age Groups (% of each group)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Ratings*</td>
</tr>
<tr>
<td>L</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>1. Reporting systems</td>
</tr>
<tr>
<td>0.43</td>
</tr>
<tr>
<td>2. Project finance</td>
</tr>
<tr>
<td>4.3</td>
</tr>
<tr>
<td>3. Investment appraisal</td>
</tr>
<tr>
<td>43.5</td>
</tr>
<tr>
<td>4. VAT and taxation</td>
</tr>
<tr>
<td>62.2</td>
</tr>
<tr>
<td>5. Stock control and evaluation</td>
</tr>
<tr>
<td>73.9</td>
</tr>
<tr>
<td>6. Cash flows</td>
</tr>
<tr>
<td>8.7</td>
</tr>
<tr>
<td>7. Establishing budget</td>
</tr>
<tr>
<td>4.3</td>
</tr>
</tbody>
</table>

* Relevancy:
  L = Low    M = Moderate    H = High

From Table 3.32 the following observations are made:

1. The highest rated financial skills by the young group are:
   - reporting systems;
   - establishing budget;
   - cash flows.

2. The highest rated financial skills by the middle group are:
   - establishing budget;
3. The highest rated financial skills by the mature group are:
   - establishing budget;
   - reporting system;
   - project finance.

4. It is interesting that the cash flows skill was rated high by the young group only. The Chi-square test showed significance (P = 0.01). This indicates that the young project managers are more involved in the cash flow process than both the other groups. On the other hand, the mature and the middle groups are more involved in the project financial aspects.

5. The low rating by all the groups for investment appraisal shows that these project managers are not involved in this activity. This might be argued from the point of view that the majority of our project managers are employed by contractors. Hence they don't need this skill. But if this was not the case then it might explain the management style adopted by their organizations.

11.4 Relevancy of computer skills by age

Table 3.33 shows the relevancy of computer skills broken down by the age groups.

From Table 3.33 the following observations are made:

1. The low ratings for computer skills in general support our previous arguments and the feedback of some of the respondents that computers are tools used in achieving the aims. It will now be established that understanding the basics is more important than the tools used.
Table 3.33 Relevancy of computer skills by age

<table>
<thead>
<tr>
<th>Ratings*</th>
<th>L</th>
<th>M</th>
<th>H</th>
<th>L</th>
<th>M</th>
<th>H</th>
<th>L</th>
<th>M</th>
<th>H</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Operating systems</td>
<td>60.9</td>
<td>21.7</td>
<td>17.4</td>
<td>50.0</td>
<td>30.0</td>
<td>20.0</td>
<td>51.4</td>
<td>29.7</td>
<td>18.9</td>
<td>0.93</td>
</tr>
<tr>
<td>2. Programming language(s)</td>
<td>91.3</td>
<td>8.7</td>
<td>0</td>
<td>82.0</td>
<td>18.0</td>
<td>0</td>
<td>81.1</td>
<td>16.2</td>
<td>2.7</td>
<td>0.54</td>
</tr>
<tr>
<td>3. Operating packages programmes</td>
<td>56.5</td>
<td>34.8</td>
<td>8.7</td>
<td>46.0</td>
<td>32.0</td>
<td>22.0</td>
<td>54.1</td>
<td>21.6</td>
<td>24.3</td>
<td>0.48</td>
</tr>
<tr>
<td>4. Spread sheet software</td>
<td>34.8</td>
<td>26.1</td>
<td>39.1</td>
<td>22.0</td>
<td>32.0</td>
<td>46.0</td>
<td>29.7</td>
<td>18.9</td>
<td>51.4</td>
<td>0.57</td>
</tr>
<tr>
<td>5. Database software</td>
<td>43.5</td>
<td>26.1</td>
<td>30.4</td>
<td>32.0</td>
<td>42.0</td>
<td>26.0</td>
<td>32.4</td>
<td>40.5</td>
<td>27.0</td>
<td>0.75</td>
</tr>
<tr>
<td>6. Main frame computers</td>
<td>82.6</td>
<td>13.0</td>
<td>4.3</td>
<td>66.0</td>
<td>22.0</td>
<td>12.0</td>
<td>75.7</td>
<td>16.2</td>
<td>8.1</td>
<td>0.63</td>
</tr>
<tr>
<td>7. Computer aided design CAD</td>
<td>34.8</td>
<td>30.4</td>
<td>34.8</td>
<td>24.0</td>
<td>30.0</td>
<td>46.0</td>
<td>29.7</td>
<td>24.3</td>
<td>45.9</td>
<td>0.82</td>
</tr>
<tr>
<td>8. Project management software</td>
<td>21.7</td>
<td>26.1</td>
<td>52.2</td>
<td>26.0</td>
<td>6.0</td>
<td>68.0</td>
<td>24.3</td>
<td>24.3</td>
<td>51.4</td>
<td>0.11</td>
</tr>
<tr>
<td>9. Information technology tools</td>
<td>43.5</td>
<td>47.8</td>
<td>8.7</td>
<td>38.0</td>
<td>32.0</td>
<td>30.0</td>
<td>40.5</td>
<td>27.0</td>
<td>32.4</td>
<td>0.2</td>
</tr>
</tbody>
</table>

* Relevancy:
  L = Low  
  M = Moderate  
  H = High

2. The highest rated computer skill by all the groups was the project management software. The middle group has awarded the highest rating among the other group. This shows the great need for tracking the progress of projects under their control.

3. Spread sheet and computer aided design software are becoming increasingly required by project managers especially for the young and the middle groups. This trend, in my opinion, is expected to increase considerably in the future. Therefore special attention must be given to educate the young graduates in these fields.

4. Main frame computers were given very low ratings. This indicates that there is a growing interest in personal computers and work stations. The availability of network systems and modems has contributed considerably to this. Furthermore, the remoteness of construction sites has rendered the main computers almost dead. Also the mobility of personal computers and the relatively low cost of these machines have contributed to this besides the availability of relatively cheaper software.
11.5 Relevancy of legal skills by age

Table 3.34 shows the relevancy of legal skills broken down by the age groups.

**Table 3.34 Relevancy of legal skills by age**

<table>
<thead>
<tr>
<th>Ratings*</th>
<th>Young 30-40 yrs</th>
<th>Middle 41-50 yrs</th>
<th>Mature 51-63 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>M</td>
<td>H</td>
</tr>
<tr>
<td>1. General law background</td>
<td>13.0</td>
<td>43.5</td>
<td>43.5</td>
</tr>
<tr>
<td>2. Draft contracts and negotiations</td>
<td>0</td>
<td>43.5</td>
<td>95.7</td>
</tr>
<tr>
<td>3. Industrial relations</td>
<td>17.4</td>
<td>30.4</td>
<td>52.2</td>
</tr>
<tr>
<td>4. Health and Safety law</td>
<td>8.7</td>
<td>17.4</td>
<td>73.9</td>
</tr>
<tr>
<td>5. Preparation of claims and litigation</td>
<td>17.4</td>
<td>21.7</td>
<td>60.9</td>
</tr>
<tr>
<td>6. Trade Unions and Public Authorities</td>
<td>34.8</td>
<td>30.4</td>
<td>34.8</td>
</tr>
</tbody>
</table>

* Relevancy:
  
  L = Low  
  M = Moderate  
  H = High

From Table 3.34 the following skills are the top 3 highly rated skills for all the groups:

1. draft contracts and negotiations;
2. health and safety law;
3. preparation of claims and litigation.

The interesting observation is that the above three skills have the same order of importance for the three age groups.

11.6 Relevancy of communication skills by age

Table 3.35 shows the relevancy of communication skills broken down by age groups.
Table 3.35 Relevancy of communication skills by age

<table>
<thead>
<tr>
<th>Ratings*</th>
<th>Young 30-40 yrs</th>
<th>Middle 41-50 yrs</th>
<th>Mature 51-63 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Presentation skills</td>
<td>L   M    H</td>
<td>L   M    H</td>
<td>L   M    H</td>
</tr>
<tr>
<td>0 21.7 78.3</td>
<td>2.0 6.0 96.0</td>
<td>5.4 0 94.6</td>
<td>0.00 **</td>
</tr>
<tr>
<td>2. Report writing</td>
<td>4.3 21.7 73.9</td>
<td>6.0 8.0 86.0</td>
<td>5.4 2.7 91.9</td>
</tr>
<tr>
<td>3. Correspondence and memo</td>
<td>writing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 13.0 87.0</td>
<td>2.0 12.0 86.0</td>
<td>5.4 5.4 89.2</td>
<td>0.57</td>
</tr>
<tr>
<td>4. Public speaking</td>
<td>8.7 21.7 69.6</td>
<td>6.0 14.0 80.0</td>
<td>13.5 24.3 62.2</td>
</tr>
</tbody>
</table>

* Relevancy:
  L = Low          M = Moderate         H = High

** (Not significant - High number of cells <5)

From Table 3.35 the following observations are made:

1. Presentation skills are highly required at a later career life. The middle and mature groups have rated these skills as the highest.

2. Report writing was given a relatively low rating by the young group. Their jobs required good report writing skills. Nevertheless, the young group have given the lowest low rating amongst the other two groups. This might show that they are aware of this.

3. Public speaking was awarded the highest rating by the middle group. This shows their job involvement and reflects their role in representing the organization they are working for.

11.7 Relevancy of general skills by age

Table 3.36 shows the relevancy of general skills broken down by age groups.
Table 3.36 Relevancy of general skills by age

<table>
<thead>
<tr>
<th></th>
<th>Young 30-40 yrs</th>
<th>Middle 41-50 yrs</th>
<th>Mature 51-63 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratings*</td>
<td>L</td>
<td>M</td>
<td>H</td>
</tr>
<tr>
<td>1. Marketing and sales skills</td>
<td>30.4</td>
<td>21.7</td>
<td>47.8</td>
</tr>
<tr>
<td>2. Public relations</td>
<td>13.0</td>
<td>39.1</td>
<td>47.8</td>
</tr>
<tr>
<td>3. Understanding of organization</td>
<td>4.3</td>
<td>13.0</td>
<td>82.6</td>
</tr>
<tr>
<td>4. Chairing meetings</td>
<td>0</td>
<td>4.3</td>
<td>95.7</td>
</tr>
</tbody>
</table>

* Relevancy:
  L = Low          M = Moderate       H = High

** Not significant (high number of cells <5)

From Table 3.36 the following observations are made:

1. Marketing and sales skills are rated by the middle group higher than the other two groups. This shows their higher involvement in marketing and sales. The Chi-square test shows significance with a 'P' value = 0.09.

2. Chairing meetings was the highest rated skill by all the three groups. No significance was found, but the ratings show a great relevancy.

3. Understanding of organization came second for all the three groups, although no significance was found.

11.8 The top 20 skills for the young group

Table 3.37 shows the top 20 highest rated skills for the young group. These skills are listed in descending order of their importance.
Table 3.37 The top 20 skills for the young group (30-40 yrs)

<table>
<thead>
<tr>
<th>Skills</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Planning and scheduling</td>
<td>100.0</td>
</tr>
<tr>
<td>2. Leadership skills</td>
<td>95.7</td>
</tr>
<tr>
<td>3. Delegation</td>
<td>95.7</td>
</tr>
<tr>
<td>4. Financial reporting systems</td>
<td>95.7</td>
</tr>
<tr>
<td>5. Draft contracts and negotiations</td>
<td>95.7</td>
</tr>
<tr>
<td>6. Chairing meetings</td>
<td>95.7</td>
</tr>
<tr>
<td>7. Motivation and promotion</td>
<td>91.3</td>
</tr>
<tr>
<td>8. Establishing budget</td>
<td>91.3</td>
</tr>
<tr>
<td>9. Construction management activities</td>
<td>87.0</td>
</tr>
<tr>
<td>10. Top management relations</td>
<td>87.0</td>
</tr>
<tr>
<td>11. Cash flows</td>
<td>87.0</td>
</tr>
<tr>
<td>12. Correspondence and memo writing</td>
<td>87.0</td>
</tr>
<tr>
<td>13. Understanding of basic technical knowledge in own field</td>
<td>87.0</td>
</tr>
<tr>
<td>14. Productivity and cost control</td>
<td>82.6</td>
</tr>
<tr>
<td>15. Time management</td>
<td>82.6</td>
</tr>
<tr>
<td>16. Human behaviour</td>
<td>82.6</td>
</tr>
<tr>
<td>17. Team working skills</td>
<td>82.6</td>
</tr>
<tr>
<td>18. Understanding of organization</td>
<td>82.6</td>
</tr>
<tr>
<td>19. Presentation skills</td>
<td>78.3</td>
</tr>
<tr>
<td>20. Decision making techniques</td>
<td>78.3</td>
</tr>
</tbody>
</table>
### The top 20 skills for the middle group

Table 3.38 shows the top 20 highest rated skills for the middle group. These skills are listed in descending order of their importance.

### Table 3.38 The top 20 skills for the middle group (40-50 yrs)

<table>
<thead>
<tr>
<th>Skills</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Leadership skills</td>
<td>100.0</td>
</tr>
<tr>
<td>2. Planning and scheduling</td>
<td>96.0</td>
</tr>
<tr>
<td>3. Decision making techniques</td>
<td>96.0</td>
</tr>
<tr>
<td>4. Strategic planning</td>
<td>96.0</td>
</tr>
<tr>
<td>5. Presentation skills</td>
<td>96.0</td>
</tr>
<tr>
<td>6. Delegation</td>
<td>96.0</td>
</tr>
<tr>
<td>7. Negotiation skills</td>
<td>96.0</td>
</tr>
<tr>
<td>8. Motivation and promotion</td>
<td>92.0</td>
</tr>
<tr>
<td>9. Team working skills</td>
<td>90.0</td>
</tr>
<tr>
<td>10. Establishing budget</td>
<td>90.0</td>
</tr>
<tr>
<td>11. Time management</td>
<td>88.0</td>
</tr>
<tr>
<td>12. Chairing meetings</td>
<td>88.0</td>
</tr>
<tr>
<td>13. Construction management activities</td>
<td>88.0</td>
</tr>
<tr>
<td>14. Correspondence and memo writing</td>
<td>86.0</td>
</tr>
<tr>
<td>15. Report writing</td>
<td>86.0</td>
</tr>
<tr>
<td>16. Draft contracts and negotiations</td>
<td>86.0</td>
</tr>
<tr>
<td>17. Financial reporting systems</td>
<td>86.0</td>
</tr>
<tr>
<td>18. Understanding of basic technical knowledge</td>
<td>84.0</td>
</tr>
<tr>
<td>in own field</td>
<td></td>
</tr>
<tr>
<td>19. Public speaking</td>
<td>80.0</td>
</tr>
<tr>
<td>20. Productivity and cost control and quality</td>
<td>78.0</td>
</tr>
<tr>
<td>control</td>
<td></td>
</tr>
</tbody>
</table>
The top 20 skills for the mature group

Table 3.39 shows the top 20 highest rated skills for the mature group. These skills are listed in descending order of their importance.

Table 3.39 The top 20 skills for the mature group
(351-63 yrs)

<table>
<thead>
<tr>
<th>Skills</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Planning and scheduling</td>
<td>97.3</td>
</tr>
<tr>
<td>2. Leadership skills</td>
<td>97.3</td>
</tr>
<tr>
<td>3. Delegation</td>
<td>97.3</td>
</tr>
<tr>
<td>4. Decision making techniques</td>
<td>94.6</td>
</tr>
<tr>
<td>5. Team working skills</td>
<td>94.6</td>
</tr>
<tr>
<td>6. Presentation skills</td>
<td>94.6</td>
</tr>
<tr>
<td>7. Report writing</td>
<td>91.9</td>
</tr>
<tr>
<td>8. Construction management activities</td>
<td>91.9</td>
</tr>
<tr>
<td>9. Establishing budget</td>
<td>91.9</td>
</tr>
<tr>
<td>10. Correspondence and memo writing</td>
<td>89.2</td>
</tr>
<tr>
<td>11. Productivity and cost control</td>
<td>89.2</td>
</tr>
<tr>
<td>12. Chairing meetings</td>
<td>89.2</td>
</tr>
<tr>
<td>13. Motivation and promotion</td>
<td>86.5</td>
</tr>
<tr>
<td>14. Top management relations</td>
<td>86.5</td>
</tr>
<tr>
<td>15. Draft contracts and negotiation</td>
<td>86.5</td>
</tr>
<tr>
<td>16. Understanding of basic technical knowledge in own field</td>
<td>83.8</td>
</tr>
<tr>
<td>17. Financial reporting systems</td>
<td>83.8</td>
</tr>
<tr>
<td>18. Understanding of organization</td>
<td>81.1</td>
</tr>
<tr>
<td>19. Human behaviour</td>
<td>78.4</td>
</tr>
<tr>
<td>20. Time management</td>
<td>75.7</td>
</tr>
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</table>
PART 4 - SUMMARY AND CONCLUSIONS

1. The successful design of the questionnaire has contributed to the high response rate achieved. This rate exceeded 70%. Participants have stated their satisfaction and enthusiasm for the contents of the questionnaire.

The enthusiasm of the responses indicates a body of professional staff who are enthusiastic and proud about their jobs, their skills, their knowledge and are keen to contribute to the development of project management.

2. We have been successful in surveying successful project managers representing successful construction companies. The bias in this data is that all these project managers are regarded as successful by their comments.

3. About 40 job titles were used by the participating project managers. The most popular one was "project manager". 47 out of 110 participants have this job title although the majority of our sample are employed by contractors. This shows that this title is used by the British contracting companies. Other countries, such as USA, will use this title to represent those employed by clients or consultants.

4. The majority of project managers are engineering graduates. More than 90 percent of the participating project managers have engineering and technical degrees, hence they are of strong technical background. The conventional wisdom is to take the graduate with an engineering degree and graft on management, human relations and leadership skills to produce our project managers. Hence management education comes as secondary in the education process of these project managers.

5. Our survey has shown the contents of the basic academic qualifications obtained by the project managers. The technical and scientific contents of these degrees are very high. Hence, very low course contents for management and finance. Computer subjects course contents was found to be low but there was an indication that they are increasing. Management and finance course contents were found to be very low.
6. The most interesting observation was the further educational qualifications obtained by the respondents. 49 out of 110 of the project managers in our survey have obtained further educational qualifications. That is 44.5 percent of today's successful project managers have had their basic education considerably extended. This reflects the realisation of the importance awarded to the further education by the respondents.

It is now well established that further educational qualifications beyond the basic degree are of value to the individual and to the employer. The data in this survey represents those project managers employed by large organizations. Therefore, we were not able to conclude that this percentage is expected for the smaller organizations.

7. The majority of our project managers have spent their entire career life with the same employer. This adds to the successfulness of these project managers and to the reliability of their contributions discussed in this survey. Accordingly, employers must take this into consideration and revise their policies in order to offer proper education and training programmes to their project managers throughout their career life with the organization.

8. On-the-job experience was rated as the best means of acquiring knowledge and skills. Off-the-job training was rated as the second major source of knowledge. This calls for a better effective cooperation between the educational establishments and employers in order to integrate their efforts and optimise achievements to formulate successful graduates capable of fulfilling their role.

9. The academic training courses were rated third. This implies that the quality of academic training courses is not bad at all. But the educational establishments must take the necessary steps to enhance the cooperation with the employers. Quality and accessibility must be revised in order to develop a better and more effective basis of cooperation.
10. The most worrying aspect is how low self learning courses are rated. If education had unlocked an enquiring mind then the self learning courses would have been rated higher.

11. Participants have contributed to this issue by giving other sources of knowledge and skills. These sources are:
- tailor-made company training courses;
- working for a contractor;
- mentoring/coaching;
- a variety of posts;
- other jobs in different fields;
- experience;
- association with professional personnel;
- private study, e.g. computer literacy;
- mistakes.

12. More than three quarters of our project managers have had at least one full-time training course in management and human resources. This is by far the highest in all other fields of training obtained by the respondents. This reflects the great need for management education expressed by the training achievements of the participating project managers.

13. Fifty percent of the participating project managers have had at least one full-time training course in business studies. This comes second to management full-time training achievements. This shows the great need of business studies for project managers in the construction industry.

14. Despite the strong technical background of our project managers, 42.7 percent of them have attended at least one full-time training course of advanced technology in their own field. This gives an indication that the need for technical knowledge is not diminished for the project managers.

15. Full-time training in languages was very low. Only 11.8 percent have had at least one full-time training course in languages. This shows negative attitudes towards languages by the industry. Employers must
encourage full-time training in languages in order to compete in the open European markets.

16. Part-time training in new technology has been the highest in part-time training obtained by the respondents. 43.6 percent of the project managers have had at least one part-time training course in new technology. This shows the need for updating the technical knowledge to the project managers. Also, it supports our argument that the need for technical knowledge for the project managers is not diminished.

17. Part-time training in management and human resources was the second highest type of training achieved by our project managers. 36.4 percent of the participants have had at least one part-time training course in management and human resources. This reflects the need for management and human resources knowledge and skills to the construction project managers.

18. Part-time training in languages is more popular than full-time. 19.1 percent of our project managers have had at least one part-time training course in languages. The percentage of full-time training obtained in languages was 11.8%.

19. The percentage of part-time training in advanced technology in own field was 27.3%. This reflects the need for advanced technical training in the own fields of the project managers. Hence it also shows that the technical knowledge for the project managers is not diminished.

20. The percentage of project managers willing to obtain training in business studies and languages were the highest. 18.2 percent of respondents have indicated their willingness to take further training in these two fields. This reflects the demand for such training required for the construction project managers.

21. More than 68 percent of our project managers were very satisfied or satisfied with the training opportunities made available to them by their employers. 25.7 percent of the respondents have said that they are fairly satisfied. Given the sizes of the organizations in our study, these percentages might not be satisfactory. This question in the
survey was found to be very sensitive. Hence, a clear judgement of satisfaction is not possible.

22. More than 63 percent of participants were appointed as project managers after being involved in up to 10 projects. 90 percent of our project managers are currently responsible for one project.

23. 83 out of 110 project managers participating in our survey have had overseas working experience. This is a percentage of 75%. This large proportion adds to the reliability of the contributions obtained by our survey. Also, this is a strengthening sign of the successfulness of our project managers participating in the survey.

24. Our survey has established the relevancy of 56 skills to the construction project managers. Table 3.15 shows the top 20 highest rated skills required by the project managers. The top five skills were:

- leadership skills;
- planning and scheduling;
- delegation;
- chairing meetings;
- negotiation techniques.

These skills show the great demand of management skills required for the construction project managers.

25. On-the-job experience was rated as the best means of acquiring knowledge and skills. Although effectiveness of the formal training was rated considerably lower than on-the-job experience. It is noticed that overall it performed better than the academic courses.

26. A considerably low percentage of women occupy the post of a project manager. In our survey only one out of 110 project managers was a woman. This is 0.9 percent.

27. Participants were very enthusiastic about our survey. They have contributed many comments and feedbacks. Appendix 7 lists all these comments. The major messages were as follows:

- the importance of communication skills;
- management is very essential for project managers and it has been ignored throughout the engineering curriculum;
- the need for technical background is very essential;
- too many courses are geared to what can be taught not what is required;
- lack of practicality in academic courses;
- computers are only a tool for the project managers;
- a blend of academic training, formal training and on-the-job experience is necessary to achieve balance.

28. There is a significant relationship between the age of the project managers and the time spent on the present job. This implies that the older the project manager the more time he spends on the job. This reflects the seniority of the project manager's job.

29. The majority of our project managers have spent their entire careers with the same employer. This was found to be significant by applying the Chi-square test with a 'P' value = 0.0007. This is another evidence that our sample of project managers are very successful. Given this stable employment, employers are expected to provide more education and training programmes for their project managers.

30. Technical course contents were found to be very high across the three age groups. Almost 80 percent of the participants have had more than 30% of technical subjects in their curriculum.

31. A test of association between age and science subjects course contents showed evidence of dependence. The 'P' value was 0.009. It is significant that the science subjects course contents have changed over the last three decades. The young group are having less science subjects in their curriculum.

32. Management course contents are still very low although it was found earlier that management skills are very essential for the project manager.
33. Financial course contents are even worse than management course contents. The majority of participants have had very low finance and accounting related subjects.

34. There is an increasing trend for computer subjects course contents in the participants' curriculums. This trend shows the increasing attention paid by the educational establishments to the computer education.

35. About 70 percent of the young project managers (aged 30-40 yrs) have had further educational qualifications. The percentages for the middle (aged 41-50 yrs) and mature group (aged 51-63 yrs) were 40 and 35.1 percent respectively. The Chi-square test shows a very significant association ($\chi^2 = 7.5, P < 0.05$) between the age groups and the further educational qualifications.

36. Table 3.25 shows the ratings of the major sources of knowledge broken down by the three age groups. The highest rating of academic training was expressed by the young group. This shows that the quality of academic training is getting better.

On-the-job training was rated considerably as the highest effective source of knowledge by the three groups. Secondment to other departments was rated as the second highest source by the young and middle groups. This highlights the need for diversity in the careers of project managers.

37. Full-time training achievements of the participating project managers were as follows:
- The highest percentages of full-time training obtained by our project managers was in management. These were 7.39, 80.0 and 75.7 percent for the young, middle and mature groups respectively. This shows the great demand for management education. It also reflects the low management backgrounds of the project managers after their graduation. Hence management was the highest needed subject.
Business studies full-time training was the second highest training obtained by the young and middle groups. The percentages were 56.5 and 50.0 percent for the young and middle groups respectively. Training in business studies came third for the mature group. 45.9 percent of the mature group have had at least one full-time training course in business studies.

Training in own technical field was third for the middle group. But it was the second highest for the mature group. 42.0 percent of the middle group have had at least one full-time training course in own technical field. Training in own technical field was fourth for the young group. 34.8 percent of the young group have had at least one full-time training course in own technical field. This is the lowest among the other groups. These observations show the demand for technical knowledge for today's project managers. The accelerating rate of technological advancements explains the increasing trend of technical training for the three groups. Hence, project managers are expected to update their technical backgrounds regularly to keep with the changes in technology.

Training in marketing and sales was the third highest type of training obtained by the young group. 39.1 percent of the young group have had at least one training course in marketing and sales. This reflects part of the competitive construction market today.

None of the young group have had full-time training in languages. On the contrary, 22 percent and 5.4 percent of the middle and mature groups respectively, have had at least one full-time training course in languages. This was found to be statistically significant.

28 percent of the middle group, 27 percent of the mature group and 8.7 percent of the young group have had at least one full-time training course in new technology. The middle and mature
groups are having better percentages for training in new technology.

38. Part-time training achievements of our project managers were as follows:

- Training in new technology is the highest type of training achieved by the young group. 69.6 percent of the young group have had at least one part-time training course in new technology. The percentages for the middle and mature groups were 44 and 27 percent respectively. This reflects a greater training achievement in new technology by the young group. Hence we can conclude that part-time training in new technology is the most popular type of training for the young project managers.

- Part-time training in languages is more popular for the young and mature groups. 21.7 percent of the young group and 24.3 percent of the mature group have had at least one part-time training course in languages. The situation is quite different for the middle group. Only 14 percent of the middle group have had at least one part-time training course in languages.

- Training in management and business studies remains relatively high for the three groups.

- Training in own technical field was relatively high for the young and middle groups. 30.4 percent of the young group and 34.0 percent of the middle group have had at least one part-time training course in own technical field. Only 16.2 percent of the mature group have had part-time training in own technical field. Accordingly, part-time training in own technical field is still popular with the young and middle groups. Also it reflects the need for technical education in the project manager's job.

39. The willingness of project managers from all groups to take future training in management and business studies was relatively high. This shows the great demand for training in these two fields.
The highest percentages of project managers willing to take training in languages were for the young and middle groups. 21.7 percent of the young group and 28.0 percent of the middle group have shown their willingness for future training in languages. Only 2.7 percent of the mature group are willing to do so. It is observed that the willingness of the young and middle groups for future training in languages was the highest in all types of training listed in the questionnaire. Therefore, employers are expected to provide better opportunities of training in languages for their project managers in order to prepare them for a better role in open Europe.

40. The mature group has shown a very low willingness for future training in own technical field and new technology. Only 2.7 percent of the mature group have indicated their willingness for these two types of training. This shows that project managers in this group have a very low interest in further technical training. This might explain the highly managerial role of these project managers.

41. The older project managers, the larger number of projects they have been directly responsible for. This was statistically very significant. (Please see Table 3.29 for details). Nevertheless, 34.8 percent of the young project managers have been directly responsible for more than 5 projects before becoming project managers. This indicates that the young project managers are having better chances for their career promotion.

42. Our survey has established the top 20 skills required for the young, middle and mature groups of project managers. Tables 3.37, 3.38 and 3.39 list these skills for the three groups respectively. From these three tables the following observations are made:

- Planning and scheduling and leadership skills were the top two highly rated skills by project managers of all ages.

- The need for the understanding of basic technical knowledge in own field was found to be slightly decreasing for the older project managers. This skill was rated thirteenth highest needed
skill for the young group. It was rated eighteenth and sixteenth for the middle and mature groups respectively. But under no circumstances the need for technical knowledge and skills was not diminished for the project managers.

All the project managers from the three age groups have indicated the need for a mixed set of knowledge and skills to cover the following areas of skills and knowledge:

- managerial;
- technical;
- financial;
- legal;
- communications.

The order of the importance of these skills was shown in the previously mentioned tables (Tables 3.37, 3.38, 3.39) for each age group of the participating project managers. It was found that the older the project manager the greater the need for management and financial related skills.

43. This chapter lists the skills and knowledge that project managers themselves think that they require. This may conflict with the views of other parties to a construction project such as consultants and clients.
CHAPTER 3 REFERENCES


6. Department of Civil Engineering, Loughborough University of Technology and University of Salford.

CHAPTER 4
FORMATION OF CONSTRUCTION PROJECT MANAGERS

1. Overview

Previously, construction project managers were predominantly ambitious, daring, hard working craftsmen who progressed through the trades, and their knowledge was gained by apprenticeship and hands-on experience.

There was then little interest in the education of construction managers at a professional level. Neither was there technical literature, nor research to support such study. This has changed and many universities, predominantly in the UK and USA provide postgraduate study and research in construction management.

Advancing technology, increasing complexity and growing competition have made project management essential for many organisations in the construction industry. These have contributed to the growing attention awarded to the education of construction project managers.

This chapter highlights the major issues related to the effective formation of construction project managers. Also, it investigates the major aspects of the project manager's job and the relationships between these aspects and the knowledge and skills required for the post of project manager. The chapter also investigates the education and training of engineers in the United Kingdom.

Furthermore, this chapter reports the interviews conducted with some of the leaders in the UK construction industry. These interviews were aimed at investigating and discussing some of the major findings of our survey and research.

2. The Role of the Construction Project Manager

This chapter addresses the role of the construction project manager who is engaged by a contractor.
The project manager's job is not an easy one. Everything seems to revolve about the project manager. Fluor\(^{(2)}\) has described the new responsibilities of project managers at Fluor Corporation:

"Project management continues to become more challenging and we think this trend will continue. This means we have to pay special attention to the development of project managers who are capable of coping with jobs that range from small to mega projects and with life spans of several months to ten years. At Fluor, a project manager must not only be able to manage the engineering, procurement and construction aspects of a project, he or she must also be able to manage aspects relating to finance, cost engineering, schedule, environmental considerations, regulatory agency requirements, inflation and cost escalations, labour problems, public and client relations, employee relations and changing laws. That's primarily on the domestic side. On international projects, the list of additional functions and considerations adds totally different complications".

Wilemon and Cicero\(^{(3)}\) have described the project manager's role as:

- Managing human interrelationships in the project organization;
- Maintaining the balance between technical and managerial functions;
- Coping with risk associated with project management;
- Surviving organizational restraints.

The above role is very broad. In real life the role of the project manager is not clearly defined and might change as a result of many factors such as:

- organizational policies;
- project specific characteristics;
- resources available;
- market conditions;
- qualifications and skills of the project manager in charge of the project.

The above list shows a brief list of the major factors that help to clarify the role of the project manager.
Our survey has established the knowledge and skills required for the post of a project manager. It has shown the relevancy of these major skills and knowledge as well as the means of acquiring them.

The project manager's role is critical to the success of the project. The key elements in this role are:

- planning;
- organising;
- directing;
- controlling.

These key elements were further amplified by Kerzner(1) as follows:

- **Planning**
  - become completely familiar with all contract documents;
  - develop the basic plan for executing and controlling the project;
  - direct the preparation of the project budget;
  - direct the preparation of the project schedule;
  - direct the preparation of the basic design criteria and general specifications;
  - direct the preparation of the plan for organising, executing and controlling field activities;
  - review plans and procedures periodically and execute changes if necessary; and
  - establish the resources required.

- **Organising**
  - develop and organisation chart for the project;
  - review project position descriptions, outlining duties, responsibilities and restrictions for key project supervisors;
  - participate in the selection of key project supervisors;
  - develop project manpower requirements; and
  - continually review project organisation and recommend changes if necessary.

- **Directing**
  - direct all work on the project that is required to meet contract obligations;
- develop and maintain a system for decision-making within the project team whereby decisions are made at the proper level;
- establish objectives for project manager and performance goals for key project supervisors;
- maintain, foster and develop a spirit of project team effort;
- assist in resolution of differences or problems between departments or groups on assigned projects;
- anticipate and avoid or minimise potential problems by maintaining current knowledge of overall project status; and
- develop clear written strategy guidelines for all major problems with clear definition of responsibilities and restraints.

• Controlling
  - monitor project activities for compliance with general corporate policies;
  - interpret, communicate and require compliance with the contract, the approved plan, project procedures, and directives of the client;
  - maintain personal control of adherence to contract provisions;
  - closely monitor project activities for conformity to contract scope provisions. Establish change notice procedure to evaluate and communicate scope changes; and
  - see that the plans for controlling and reporting on costs, schedule and quality are effectively utilised.

From this role we can conclude that the project manager is actually a manager who gets to know the total operation of the project. Kerzner(1) has elaborated on this issue and stated the project managers get to know more about the total operation of a company than most executives.

In this thesis we are concerned with the knowledge and skills required for the post of a project manager. Therefore, it is clear from the role, described earlier, that there is a strong need for a broad background in order for the project manager to fulfil his role. This comes in line with the results of our survey. Nevertheless, it is important to emphasize that the need for technical background is not diminished throughout the project manager's career life.
3. Knowledge and Skills of the Project Manager

From the interpretation of the characteristics of construction projects in Chapter two and the project manager's role, it is possible to define the general background of the knowledge and skills required for the project manager's post in the construction industry. On a wide spectrum there are two main categories of skills and qualifications: these are technical and managerial qualifications and skills.

Bent(4) has expressed the fact that to effectively implement a project, the manager should possess the following:

- technical expertise;
- management expertise;
- business expertise;
- leadership qualities;
- effective communication capabilities.

The study group of the International Labour Organisation(5) recommended knowledge and skill requirements in respect of project management. These requirements included, on the one hand, those relating to site management plus considerable knowledge and skills in management in principle, organisation and office management, and a good working knowledge and skills in preparation of interim and final accounts and law. The ILO report highlighted that current practices in the training of civil engineers and architects in many countries tends to neglect the management aspects to a certain extent and it is left to students to pick up management skills on the job.

The reality, as I believe, that this is also valid for all other engineering fields.

From the literature review and the outcome of the survey the following extra skills must be added to the above list of knowledge and skills required for a project manager:

- legal background;
- health and safety laws;
- public authorities expertise.
This describes the wide range of knowledge and skills required for the post of project manager. The question to be asked again and again is "If these are the knowledge and skills required for this post, are the anticipated project managers well prepared for this role?"

In order to investigate this, it is important to discuss the following issues:

- educational background;
- training;
- further education;
- experience.

As it was found earlier, that the most likely candidates for the post of a project manager are graduates of engineering schools, the following sections will discuss the previously mentioned issues within the engineering profession.

4. Education for Engineers in the United Kingdom

In general, engineers follow three levels of formal education. These levels are as follows:

- school level;
- undergraduate; and
- postgraduate level.

This classification was done to focus on the general territorial boundaries of the educational process and to discuss the general issues contributing to the successful educational policies.

4.1 School Education

4.1.1 General policy

This is the first level of education for the young members of society. Accordingly, it has a relatively higher priority in the general educational policies. It sets up the foundation of the individual’s educational career.
I don’t intend to elaborate on this level but it is rather important to highlight the following issues raised in a report by the Working Party, set up by the Conservative Party to enquire into the relationship of education to industry in the United Kingdom, published in 1978(6).

- It is important that in school children should receive a broadly based education to enable them to lead a full adult life and have sufficient general knowledge of the world in which they are to live. They need to be able to express themselves clearly, orally and in writing and, if possible, in a second language. They should also have a good mathematical and scientific background, with an appreciation of modern technology.

- Parents and teachers play a key role in determining the career that a young person will follow when he or she leaves school. It is therefore important that as much relevant information as possible should be made available to schools and particularly parents quite early on in a child’s school career. The Working Party does not believe that it is too early to start giving some thought to this question when a child has reached the age of twelve.

- If many of the misconceptions surrounding an industrial career are to be removed, it is essential in the first place to ensure that correct and accurate information relating to industry’s role in society is made available to the schools and that they are also made aware of job opportunities, career patterns and remuneration levels offered in the engineering industries.

- The responsibility for coordinating work at the local level really lies with the local education authority, who should be alive to the need for maintaining contact with employers, unions, teachers and other interested bodies in order to ensure that close cooperation between secondary schools and industry becomes a reality in their area.

- Universities and polytechnics should be encouraged to play a more active part in school/industry/higher and further education
links through forum schemes. Such activities should be eligible for financial support from the concerned authorities.

- Industry, for its part, must be prepared to devote time and effort to these initiatives if they are to be successful.

Although these points raised in the report show a serious attempt to improve the educational policy for schools, the following observations must be made:

- The broad education is essential at this level. But there is a bias towards mathematic and scientific backgrounds. This bias is explained by the dominating number of participants, in the Working Party, of strong technical and scientific background.

- Broadly based education must be as broad as the term implies. This is because in reality there are many knowledge and skills shared by large dominating proportion of individuals in society. Therefore, it must be emphasized that there must be a clearer policy for educating the young members of the society in order to cater for most of the required skills and knowledge at the first place and then move towards a more specific specialization at higher levels.

- The situation is, rather, chaotic. The latest move of schools opting out of the educational authorities in the United Kingdom towards adopting an independent status explains part of this dilemma. This indicates some of the social need towards filling the gaps created by the rigid educational policies implemented in the United Kingdom.

- Extra emphasis given to some scientific and technical subjects will affect the students' chances of being given other subjects. Generally, these subjects such as human sciences, communication etc. are needed for the majority of students in their future careers, if not all.
Industry's links with schools should have a better atmosphere. This must be conducted by alleviating and/or diminishing the existing red tape made available partly by the authorities and partly by the absent role of those in charge of schools. This negative role is almost a major cause of creating artificial barriers between industries and schools.

In order to overcome some of these hurdles more market oriented policies should be exercised in order to instigate creativity towards more positive links. Things might not change overnight but it should at least help in setting a competitive ground for schools.

There is a clear conflict in the report mentioned earlier. A broad educational policy was emphasized while the policies followed concerning the 'A' levels used in England and Wales indicates a narrower vision towards educating those students looking towards joining engineering schools. This simply shows the narrow background of students joining engineering schools.

4.1.2 Qualifications awarded by schools

Qualifications awarded by schools in the United Kingdom are of many different kinds and levels. Some are predominantly academic, others vocational. Some are normally obtained through study at school, others through further education. Courses leading to qualifications up to and including 'A' level or its equivalent are generally referred to as non-advanced further education (NAFE); qualifications above 'A' level standard as advanced further education (AFE)(7)

The following is a brief list of the qualifications:

- GCSE (General Certificate of Secondary Education)
- SCE Standard Grade (SCE: Scottish Certificate of Education)
- GCE 'A' level (General Certificate of Education)
- AS level (Advanced Supplementary)

The above listed qualifications are discussed briefly as follows:
GCSE: General Certificate of Education courses were introduced in 1986 to replace both CSE (Certificate of Secondary Education) and GCE 'O' level (General Certificate of Education), creating a single examination system in England, Wales and Northern Ireland for those aged 16 or over.

GCSE is awarded on a 7-point scale, with much emphasis placed on coursework as well as a final examination. The first examination took place in Summer 1988(7).

SCE Standard Grade
In 1984, the first SCE Standard grade courses started to replace 'O' grades in Scotland, with the first examinations in 1986(1). They are to be taken by all pupils with three levels of study and award (Formation, General and Credit). Pupils receive a certificate at the end of their fourth year giving a 'profile' of their abilities(7).

GCE 'A' Level
The GCE 'A' level was introduced in 1951 in England, Wales and Northern Ireland. 'A' levels are aimed at the most academically able pupils. About 10% of school pupils take two or more 'A' levels between the ages of 17 and 19.

The GCE 'A' levels are widely used as entrance qualifications for higher education. Statham et al(1) stated that the Higginson Report in 1988 recommended that 'A' levels should cover a wide range of subjects, with candidates normally taking five 'A' levels rather than two or three. Unfortunately, the government's immediate response was to reject this proposal.

SCE Higher Grade
The SCE Higher Grade is the Scottish alternative to the 'A' level. The difference being that the Scottish Highers are taken one year after 'O' grade rather than two years in the 'A' levels. The SCE Higher Grade covers four or five subjects rather than two or three in the GCSE 'S' levels.
AS Level
This is a new examination to be taken alongside 'A' levels, involving about half the work at an 'A' level, and aimed at broadening the curriculum. It has been available since September 1987, with the first examinations in Summer 1989.

4.1.3 Broadness of Secondary Education
The introduction of the 'A' levels and similar qualifications shows the narrowly adopted policy by the government educational authorities towards education. This implies that pupils at the age of 16 have to make a decision towards their future careers. This policy towards the early specialization implies that pupils are given more specialized chosen subjects and less broad education in the other fields.

In contrast to the educational policies followed by other nations, such as the United States of America, France and Germany, the system followed in the United Kingdom looks very unique. The majority of these systems in the above mentioned countries are, in general, broadly based up to the end of the secondary level. Providing the school leavers with a broader education than their counterparts in the United Kingdom.

4.2 Undergraduate Level

4.2.1 Admission Qualifications
Undergraduate education is characterized by the rigid requirements of admission stipulated by the Engineering Council.

A Royal Charter granted in 1965 to the Council of Engineering Institutions, empowers the 15 Institutions of Engineers who are the constituent members of the C.E.I. to grant in turn the qualification of Chartered Engineer to their own corporate members (and to these corporate members only), meeting certain requirements(8).

The Engineering Council's publication (1984) entitled 'Standards and Routes to Registration' (referred to later in the text as SARTOR) draws the main guidelines and highlights the Council's policy
regarding all the engineering education and training aspects in the United Kingdom.

The entry qualifications for accredited courses or partly accredited courses, given by the engineering educational institutions in order to award an academic degree were only shown on the cover page of SARTOR. These entry qualifications ranged from 2 to 3 'A' levels or Scottish equivalent for BEng degree, and 3 or 4 'A' levels or Scottish equivalent for MEng degree. Nothing was mentioned to clarify these entry qualifications nor anything regarding the basis on which this policy was adopted. The point that might be argued is that the secondary education is outside our control. Nevertheless, they should have raised this issue of narrow secondary education for further negotiations and debates on a national basis with all the concerned authorities.

The Engineering Council and the other Institutions of Engineers might be satisfied with these entry qualifications for the undergraduates but evidences, found in the literature review, is against this.

Some of the major evidences are:

- Manley, late in 1992(9), Chairman of the Institution of Electrical Engineers, has explicitly said:
  "The response of the universities must complement those changes. Access must be wide and flexible, so as to discourage early specialisation, and encourage the development of broad syllabuses in the secondary schools".

  This statement is in contradiction with the Institution's stipulation regarding their accreditation of university courses. Accordingly, universities cannot complement this.

- Duggan in 1992(10) has indicated that in the past the professional engineering institutions in the UK have placed far too much emphasis on the entry requirements to degree courses, on the classification of degree obtained by graduates, and on the condition that it is necessary to include substantial elements of
subject specific curricula if the courses are to be accredited by
the appropriate professional institution. This reflects the nature
of the power awarded to the concerned institutions and the
growing demand for more freedom to the universities. Bolton(11) has elaborated on this freedom. He strongly debated
this issue by saying:

"The independence of the Universities and Universities staff is
often referred to as academic freedom. It is not really a
freedom since it requires that academics stand in the path of
some Authority bent on doing the wrong thing, and demand
freedom of responsible action, not for themselves individually,
but for others".

- Bolton(11) has also raised the issue of entry qualifications
stipulated by the Institution of Civil Engineers by saying:

"To present them with a set of petty fogging rules about crude
grades at 'A' level passes for example is, however, as useless,
and as tactless, as a husband giving his wife a set of detailed
rules about how to do the housework".

- If early specialization is considered by the Institutions to be
effective in preparing the undergraduate students for their
perception of the courses to be given this case is also arguable.
MacKeith and Burrow (1992) have highlighted the observation
that the mathematical abilities of school leavers in the UK have
fallen progressively over the past 20 years and they are now at a
crisis level(12). This is a problem for the educational
institutions and to conventional student entrants who have
mathematics qualifications such as 'a' level. It was stated (12)
that these students are often 'woefully' incompetent at, what
used to be considered as, straightforward mathematics.

- During the 1980's there developed an increasing awareness of a
shortfall in the recruitment of suitably qualified students to
Higher Education engineering courses(13). In 1992, Otter and
May(13) have stated that one of the most important reasons was
that only approximately 14% of candidates undertaking GCE Advanced level, or equivalent studies, took a combination of subjects which satisfied the longstanding and generally rigorously applied entry requirements for Bachelor of Engineering or Higher National Diploma courses in Engineering.

Several attempts were undertaken following a successful pilot scheme at the Polytechnic of Central London. The United Kingdom Government, through its National Advisory Body for Higher Education, funded an initiative which was designed to provide the opportunity for candidates without a mathematics and science background to embark on an engineering career(13). Over twenty polytechnics were permitted to offer one year Higher Introductory Technology and Engineering Conversion Courses (HITECC) which, if successfully completed, facilitated entry to a wide range of Engineering Degree and HND schemes(13).

The aim behind this extensive presentation was to highlight the chaotic situation faced by the educational institutions, presented by the polytechnics, and the wasted efforts, money and time in order to amend what could be amended by fundamental changes at the school levels.

- In an unpublished discussion paper on educational formation by the Institution of Civil Engineers in 1992(14) it was stated that for many years the accepted entry standards for Honours Degrees was based on a narrow range of 'A' levels and consequent early specialisation. The Working Party of the Institution of Civil Engineers(14) added that with the continuing pressure (by the Government) to increase the number of students on courses, there is evidence that the traditional theoretical scientific and mathematical standard needed by students for the education of Chartered Engineers is falling. They concluded that:
  - indeed these standards as measured by 'A' level scores are one of the lowest in universities;
this must eventually lead to a high drop-out and failure rate or a lowering of standards at degree level.

The bad news is that this paper, regardless of the crucially important conclusions and suggestions, may never see the light. The good news is that I am going to discuss some of the issues raised in this paper, whenever appropriate or relevant, in this thesis.

Therefore, we can conclude that in order to raise the standards of engineering education major steps should be taken.

1. Review the pre-university educational system. A wider based secondary educational system is highly recommended in order to prepare the school leavers for better careers regardless of their destinations.

2. Closer links between the schools and the universities or polytechnics must be encouraged in order to secure compatibility of the contents in the curriculums. This will save much of the efforts and resources.

3. Cooperation between schools and engineering educational institutions must be enhanced in order to secure proper feedback on the performance of the undergraduate students.

4. Teachers and lecturers must be encouraged to discuss their mutual comprehensions, expectations and the anticipated changes, on a frequent and individual basis. Briefings and evaluations of the successful practices are to be shared by all the concerned parties.

5. The Institution's entry requirements must be diminished. Broader entry requirements must be adopted in order to enhance the broadness of undergraduate education. This step must be preceded by the changes at the pre-university educational policy. The educational institutions are well qualified to handle such issues regarding the entry
qualifications. The centralised powers given to the Institutions have contributed to these dilemmas. Therefore, if Government authorities cannot 'trust' the educational institutions (or at least want to keep a good grip of the system) to handle such issues, different qualifying bodies must be encouraged to compete. The customers, represented by the employers and graduates, will be able to choose. Hence, survival of such institutions will be determined on the market oriented basis.

4.2.2 Engineering Course Contents

This part is aimed to highlight the general policy of educating engineers in the United Kingdom. It is not aimed at discussing the specific course contents of each branch of engineering.

The Engineering Council’s publication entitled 'SARTOR' has established the main guidelines for the accredited courses. It was stated that the procedure operated through the nominated and authorised bodies will attach considerable importance to the thought which has been put into the planning of course content with particular emphasis on:

- the watchwords 'integration' and 'relevance';
- the impact of new materials and the exclusion of obsolete material;
- the teaching of fundamentals and of engineering applications;
- the devising of experimental, project and design work offering intellectual challenge;
- appropriate examining methods;
- the maintenance of output standards;
- the need for engineers to be prepared for work in interdisciplinary teams.

McCaffer, 1987, has indicated that the latest guidelines of the Institution of Civil Engineers for undergraduate courses take their objectives from the Engineering Council’s document SARTOR. The guidelines do not define the careers or training for careers to which students undertaking the degree may aspire.
The following major issues were highlighted:\(^{(16)}\):
- The guidelines as a specification for graduate civil engineers are cast as a loose recipe rather than a performance specification;
- The guidelines only allow management studies, without defining what they mean, as part of the 'not easily quantified subjects';
- Law and economics are classed as subjects which might be included.
- The Institution of Civil Engineers (ICE) issued some advice on the coverage of engineering applications in undergraduate courses. The ICE's remarks on how well Construct Technology and Construction Management subjects were that these subjects were superficially covered.
- Thompson\(^{(17)}\) of UMIST, presented data which showed that, with respect to Construction Management, the position was not much better.

Thompson\(^{(17)}\) has cited that only reference to management was given in Guideline 7. The Institution appears reluctant to acknowledge the value of the breadth of education and training gained from courses in the extended courses developed to meet the Engineering Council requirements for MEng.\(^{(17)}\).

The growing number of people asking for a broader engineering education is evidence of:
- rigidity of the accreditation procedures;
- the narrow curriculums used at the undergraduate levels;
- the high technical course contents and the low or even non-existence of management, financial, law and other required subjects.

The following are a few of these claims.

- Corfield\(^{(18)}\), former founding Chairman of the Engineering Council has said:
"It seems to me that there are two key areas in which major changes are required, Training and Qualification".
He has added "Having been closely involved, as founding Chairman of the Engineering Council, with the strongly held views of the many Institutions of the profession, I am well aware of the objections which proposals for change can engender".

Sir Kenneth Corfield was trying to avoid direct attacks but he has made his views indirectly by saying: "With sixty qualifying Institutions, a hundred and more technical colleges, very few polytechnics and the economic pressures which made universities the province of the few who could manage to fund both full time higher education and an equally full time practical training, it is small wonder that Sir Graham Day and others remain perplexed by the lack of clarity surrounding the status of the professional engineer. Advances have been made, C.Eng, F.Eng and lately Eur.Ing. coupled with Institution letters signifying the area of specialisation and the general adoption of a degree requirement all assist in negotiating the minefield. But the minefield remains". It is important to note that the style used by Sir Kenneth Corfield was very difficult to follow as he tried to avoid the direct criticism with colleagues and the Engineering Council. This is my personal appraisal of his paper, which I have attended its presentation in Portsmouth.

Duggan, 1992,(10) states that engineering should be concerned not only with the application and management of science and technology in creating new benefits for mankind, but with the socio-economic factors involved and the interaction between engineering, the environment and human systems. He continued his remarks by saying, "It is suggested that, if this is accepted, then a much more radical approach to engineering education and training is required".

The indirect tone was even clearer when Duggan(10) stated that "it is perhaps surprising that engineering educators at the forefront of knowledge in their specialised areas and often responsible for bringing about technological change, are in
many instances those who have the greatest difficulty in accepting the fundamental changes which are required in engineering education to satisfy the long term needs of industry and society".

- Manley, 1992, (9) admittedly stated "there has been a continuing pressure to extend the syllabus. Employers are concerned to see a broader engineering content, and the inclusion of business and economic elements. The need for mastery of more than one language in business today is well appreciated, and increasingly features in engineering courses".

- Educationalists and industrialists speaking at a conference on "Civil Engineers for the 1990s" in Kingston consistently underlined the need for technologically competent but adaptable graduates, capable of meeting the varying demands of a changing industry (19).

- Sparkes, 1989, (20) provides a reflective commentary on how to develop means of assessment more appropriate to these objectives.

- The Working Party of the Institution of Civil Engineers, 1992, (14) have addressed the need to encourage diversity of degree courses. It was clearly stated that the provision of civil engineering courses should to some extent be demand led and will only be successful if they provide what the industry needs.

The growing number of calls for changes have been met by very hostile response. Changes are a must for a prosperous educational system and successful, capable and motivated graduates. The interpretation of the analysis of our survey is an other supporting evidence for changes to be implemented sooner not later.

Finally, the interesting message came from Finniston, 1983, (22) who said "The results of this inquiry confirm the considerable dissatisfaction which engineers have with themselves and with the formation system which did not provide them with what they thought
were the essential elements of engineering in a modern industrial context. This evidence shows that they would have been better prepared for wider roles in industry and business of their formation had equipped them to understand costing and finance, to be able to express and communicate verbally and in writing, in the conduct of their management and in meets - and so on”.

### 4.2.3 Postgraduate Education for Construction Managers

The postgraduate education is in a better shape than the undergraduate. Masters courses, un constrained by institutional guidelines, offer more scope for practical training\(^{(21)}\). Higher education has been under great economic pressure, which has resulted in greater flexibility and openmindedness\(^{(23)}\). There was little interest in education of construction managers at a professional level\(^{(24)}\). Neither was there technical literature, nor research to support such study\(^{(24)}\). McCaffer and Adham, 1992, have indicated that this has changed and many universities, predominantly in the USA and UK provide postgraduate study and research in construction management\(^{(24)}\).

### 4.2.4 Training of Engineers

Training has been defined as instruction and practice in developing intellectual and practical skills and as such forms a continuum with education and with the responsible experience required for registration\(^{(15)}\).

The Engineering Council’s Policy Statement\(^{(15)}\) asks for a well defined objective expressed through tasks for which the performance of each trainee can be judged. It also stressed that the training objectives and the standards to be achieved should be stated in clear and simple terms. They reasoned that these may differ from discipline to discipline but should always be aimed at developing the trainee’s abilities to undertake engineering duties requiring a high degree of practical expertise\(^{(15)}\). We can notice the broad guidelines of such policy. But what about the guidelines issued accordingly by the concerned institutions?

The route to corporate membership of the Institution of Civil Engineers is explained in a document entitled 'ICE 43 (Post
Chilver)\(^{(16)}\). For the graduate civil engineer the route is: 3 years' training under agreement or 6 years' experience followed by Professional Examination (PE1), then at least 1 year more experience, but perhaps as much as three more years, followed by Professional Examination 2 (PE2)\(^{(16)}\).

McCaffer, 1987,\(^{(16)}\) has expressed his views on this issue and stated that "However, one effect is to establish that 'management' is something for the later stages of an engineer's formation. Coming on top of a university course that has also minimised the subject, this has a damaging effect on the attitudes of young engineers. Furthermore it is a major inhibition to self-development and delays the acquisition of skills which industry requires.

In a study conducted by Leicester Polytechnic, 1983, on the basis of hour-long interviews with a representative sample of 250 engineers\(^{(25)}\) the following major findings were reported:

- One third of respondents had not undertaken a formal training scheme at any time.
- Almost all respondents (96%) preferred sandwich to full-time education, even though 54% had been full-time students themselves. A period of training or work between school and higher education received very strong support (60%).
- Sponsorship was thought desirable or very desirable by 66% of engineers because it offers more money, a sense of security for students, assured training places and often, they thought, better training. More students would have accepted sponsorship had it been available.

- These engineers are repeating criticism made by their colleagues and others for the last hundred years. It is arguable that inadequate provision is made for training because engineers are regarded not as full professionals who need thorough preparation but as technicians whose training needs are more modest. The passive tone of many of these engineers' responses suggests that they have accepted this definition of themselves.
The Working Party of the Institution of Civil Engineers, in 1992,\(^{(14)}\) has recognised such issues. They stated:

"It would be necessary to recognise that the Institution's training programme would need to be reviewed and industry would need to respond accordingly".

The rigidity of the training guidelines was highlighted by Thompson, 1986,\(^{(17)}\). He urged the Institution to change its attitude to extended (M.Eng) courses and to accept the additional year of training as part of the period of industrial experience required for the Professional Examination 1 (PE1).

It is important to highlight the fact that it will take as much as seven years or more for a student entering the undergraduate education, to obtain his chartered status. In contrast to other European and international standards the situation is quite different. This is causing resentment amongst the graduates, employers and educationalists.

The Working Party's Report\(^{(16)}\), published by the Conservative Party in the United Kingdom in 1978, were at the point when they discussed the implications of postgraduation training. They have stated that the post-graduation training at the absolute minimum level is encountered in several special situations including the following:

- Small companies with very limited resources.
- Organisations employing engineers for jobs requiring neither engineering skills nor other special training.
- Organisations which positively provide no training as a fundamental point of policy.
- Organisations which have rejected formal training schemes after a trial period, whether based on rational argument (cost/benefit analysis) or irrational argument (arbitrary decision).
- Organisations which vary their training schemes to suit circumstances and/or personnel.
- Agency engineering.
Although the relevant statistics were lacking the Working Party have stated that it is generally understood that at that time (1978) such situations are met by a large proportion of graduate engineers.

Regarding training at level 2, to meet certain institutional standards, the Working Party expressed that the situation is frequently encountered in industrial organisations employing graduate engineers.

The economical recession at the time of writing this thesis raises the following:

- Are the employers prepared to keep their spending on training and further education budgets the same as it used to be at the boom time in the eighties?

- Can the educational establishments take their role in contributing to training, further education and assessment without the rigid and complicated regulations exercised by the Institutions?

- Can we learn and/or exchange experiences of other nations? The nations are getting more united but this issue seems to be facing objection by some concerned institutions.

- Government must interfere to solve the chaotic situation in the education system across all levels. Privatisation was one of the revolutionary tactics exercised in the late 70's. Why is such a move far from reach? Revolutionary actions must be brought forward if we are seriously interested in solving this crisis.

- The Engineering Council and it's associated institutions must be prepared and attentive towards such revolutions. They should review their policies in the light of the present situation. Collaboration with all the concerned parties must be encouraged and effective measures must be adopted. Bureaucracy and Centralisation are some tactics from the past. Existence is for the competent bodies who can build up their status, reputation and accreditation from the society and by the society and to the benefit of the society.

- The situation cannot be changed by words. Actions are needed in order to bring changes into the educational system. The industry and the educational establishments are able to bring changes and fulfil the needs.
There are no chances for pleasing or avoiding confrontations if we are looking towards bringing fundamentally required changes to the present system. Therefore, actions and only actions are needed to resolve this dilemma.

5. Interviews with some of the leaders in construction

The major aim of these interviews was to investigate the validity of some of the major findings of our survey of the successful construction project managers. It was also intended to discuss other related issues in the formation of engineering graduates.

The leaders of the construction industry interviewed were:

1. Mr T E Chappell: Director of Projects, Powergen plc.

2. Mr H Bedelian: Deputy Chief Executive Balfour Beatty Ltd.

3. Mr R Broadhead: Deputy Managing Director Taylor Woodrow Construction Holdings Ltd.

4. Mr I Reeves: Chairman High-point plc.

5. Mr C A Stanhope: General Manager Construction John Brown Engineers and Constructors Ltd.

The interviews were conducted in an unstructured way. This was partly because of the limited time allocated to each interview and partly because it will give more freedom to the interviewee to contribute the most important messages he wants to convey.

Appendix 8 lists all the comments raised by the interviewees. In brief the messages obtained from these interviewees are grouped under the following headings:

- technical background of the project manager;
- engineering curriculum;
- experience of project managers;
- further education and training.

5.1 Technical background of the project managers

From the five interviews, the technical background of the project managers was highlighted as a fundamental knowledge required to qualify the project managers for their roles. The following is a summary of the points raised by the construction leaders:

- You cannot take somebody from a non-technical background and ask him to manage engineering construction projects;
- The technical knowledge is the foundation;
- The project manager has got to be an engineer;
- The technical background for the project manager is absolutely vital;
- The project manager has to be able to understand the technical issues, he has got to make some technical judgements, he has got to be able to make some assessments on what he has been doing;
- Having a technical degree is a better foundation for the project manager;
- Managing a project is a technical thing.

The comments raised by the leaders interviewed emphasise that the engineering degree is one of the best basic academic qualifications to qualify the project manager for his role. It also emphasises that the technical background is fundamental to the project manager.

Our survey of project managers has established that the majority of construction project managers are engineering graduates with very strong basic academic technical background. The need for technical knowledge is
not diminished throughout the project manager's career. These findings were strongly supported by the views of the industry's leaders.

5.2 Engineering Curriculums

The following is a summary of the issues raised by the interviews:

- Universities should take a more business orientation;

- Project managers are expected these days to be involved investment appraisal rather than simply the construction or project management;

- The management of construction is something that is not taught at universities and colleges as much as it should be;

- The construction companies must input into the educational curriculum and the educational establishments must be able to provide some of the courses for the companies;

- There is no harm to have some of the highly analytical courses for some people and for some people you expect them to have more practical 'vocational' type courses;

- You need to have technical and administrative knowledge;

- I have a fundamental belief that in this country one of our problems is that we have messed around with the school education system, we have messed around with degree or there is a tendency to mess around with degrees;

- Universities and educational establishments in general over-emphasise the technical capability of people and under develop the personal qualities of people;

- There needs to be much more understanding of behavioural science, psychology, far more development of management skills, financial and legal understanding by managers;
- They have to have a better total self confidence of the total environment within which they are operating;

- We need people who understand about the relationships within their companies, understanding of legal and financial and administrative required knowledge;

- None of which, in my view is adequately taught within the universities or their courses;

- We need to develop the people in the broader human sense;

- Half the technical expertise taught to these people (engineers) is used. There are a lot of theories that they learn and no practicality;

- The rate of change in the curriculum contents is slow.

The above comments show that employers are expecting broadly educated engineering graduates. Actually, one of the comments had indicated that there is no harm in keeping some of the analytical courses, but it also emphasises the need for broader curriculum. The comments have shown also that employers are expecting the engineering graduates to be fully aware of the world around them. this awareness must cover certain knowledge and skills such as investment appraisal, management, administrative, personal qualities, behavioural science, financial, legal, and environmental. Academic courses were criticised as being theoretical and they lack the practicality.

Our survey has investigated the distribution of the contents of the basic academic degrees obtained by construction project managers.

It was found that these project managers are of very strong technical and scientific academic background and low managerial and financial academic course contents. We have also investigated the changes in the academic course contents for the different age groups of the participating project managers. Apart from computers, the rate of change is very slow. This point was strongly highlighted by one of the comments listed above. These comments raised by the people interviewed support our previous arguments in Chapter Three that there is an increasing demand for broader engineering
curriculums. These curriculums must be designed in a way to fulfill the employers requirements not the requirements stipulated by the guidelines issued by the concerned professional engineering institutions. Accordingly, engineering curriculums must cover many of the required expertise such as technical, managerial, financial, legal and other communication skills. The low ratings awarded by the participating project managers to the academic and training courses show the lack of practicality in these courses. The comments raised by the project managers themselves have also highlighted this issue. It is interesting to see this encouraging support explicitly mentioned by the leaders from the construction industry to our findings which indicates the successfulness of our survey. But, nevertheless, changes in the curriculums are what is required. The engineering educational establishments must fulfill the employers needs and play their role in providing better qualified, capable and broadly educated engineers.

5.3 Experience of Project Managers

The following is a summary of the comments raised by the leaders of the construction industry regarding the experience of construction project managers:

- Project management is not something that you can teach. You have to do it by experience;

- The project manager is expected to spend about 10 to 15 years to be able to manage a multi million pound project;

- The project manager has to obtain the right experience to qualify him for the job he is expected to do;

- We, as Balfour Beatty, see how our engineers perform on jobs as they go up from engineers, assistant engineers, section engineers, sub-agents and we have yearly assessments of all our staff on which we can gauge who have got the management sort of capability;

- On-the-job record is obviously the main area that they can show us that they are capable;
- I would look for the engineer's experience on site;

- I will be looking for someone who has worked for the company for quite a long time, normally I would look for a project manager who had been with me for ten years so I knew had been with me through the mill and he would stick at it when things go rough;

- The project manager will be appointed normally at the age of 35 years after long working experience;

- On-the-job experience gives you an awareness of what you are doing. This is why it is essential.

From the above listed comments we can realise the industry's views awarded to the experience of the project managers. Industry puts great emphasis on experience. Project managers normally take about 10 years before they are given full responsibility of the projects they are to be responsible for. Evaluation of the project manager's progress is highlighted as a key issue in testing the capability of the project manager. Another important issue highlighted in these comments was the time spent by the project manager with the employer. This was stressed upon as a very important issue towards the appointment of the project manager.

Our project managers have over emphasised the importance of experience as a major source contributing to their knowledge and skills. They have also rated on-the-job experience as the highest effective source contributing to the 56 skills and knowledge listed in the mailed questionnaire. The comments received from the participating project managers have repeatedly emphasised the important role of experience in the formation of construction project managers. Furthermore, our survey has investigated the time spent by the participating project managers with the present employer. It has been found that many of the respondents have spent their entire career life with the same employer. These observations are in line with the comments obtained from the leaders listed earlier.
5.4 Further Education and Training

The following is a list summarising the comments raised by the interviewees:

- The project manager needs to supplement his technical knowledge by very strong business emphasis built on the engineering background;

- The people that we employ are former engineering graduates; we put them on business courses, we put them on project management courses, we look for MSc courses in construction management or project management, and we put them in specific tailor-made courses;

- To be able to become a good project manager, you have got to go through a period of planning, experience and training and so on;

- The company has to be responsible to make sure that their engineers are trained and developed in the way the company wants them to be;

- We select certain people and put them on certain training courses in management, in-house or outside;

- The project manager picks up a lot of the skills with courses and experience along his route;

- People like managers and engineers have only got a limited amount of time for training because they have got the rest of the business to run;

- Currently you can qualify for professional status after 4 years if you had a training agreement; without the training agreement it will take 6 years;

- You can get training with a large company under agreement, but you get paid less than some other smaller companies;

- These smaller builders will pay more, but they don’t give any training;

- We need to develop leaders, we need people with the self confidence and willingness;
- We should follow an intermediate transitional phase during which training is to be funded by the Government, it needs to be supported by some central funds and it could not happen at once;

- Most of these required skills are delivered by short courses; large companies will do it themselves.

The comments listed above, show the industry's view regarding further education and training of their project managers. Employers realise the need for supplementing the project manager's technical background by very strong business emphasis. They put these engineering graduates on courses in management, business studies and the like. One of the comments has emphasised the employer's awareness towards postgraduate courses, particularly courses in construction management and project management. Other comments have described the different types of courses used by the employers either by in-house, tailor-made and/or from the outside. The comments show that employers are aware of the importance of training offered to their project managers. One of the comments has highlighted that it might take 4 or more years for the engineering graduate under training agreement to obtain his professional status and discusses an important issue regarding those graduates joining smaller organisations. The last comment raises a fundamental issue, that is the cost of training. This has been emphasised as it would be appreciated if Government would pay for such training or otherwise funds are made available by some central funds.

First of all, our survey has investigated the importance of the major sources of training. It has been found that off-the-job experience is the second major source contributing to the knowledge and skills of today's construction project managers. Academic training courses came third.

Secondly, we have been able to investigate the training achievements of the participating project managers. It has been found that the highest obtained types of training were in management and business studies. This comes in line with what was raised by the comments, that employers put great emphasis on management and business training.
Thirdly, none of these comments has raised the training in languages. Our survey has established the willingness of today’s successful project managers for further training in languages.

Fourthly, one of the comments raises the issue of time availability for training of the project managers. Although it was argued that it is very crucial for the project manager to look after the business, it is also very crucial that the project manager must be given the chance and offered the required time to update his knowledge and skills. The lack of strong laws governing and encouraging the issues of further education and training for the employees has created such tendency towards giving lesser awareness towards further education and training. Hence, the concerned authorities must ensure that employers are encouraged to do so through making such costs tax deductible and/or setting some incentives for the employers who do follow such policies.

Nevertheless, our survey has found that 49 out of 110 project managers employed by the large organisations have had their basic academic knowledge extended. But the main issue remains. That is the preparedness of the smaller organisations to do so. The last comment in the above list strongly supports this argument. The answer remains in the hands of the concerned government authorities. Actually, the issue was discussed, virtually, with Mr John Drew, Head of the United Kingdom Offices, European Commission. After the discussion of the system used in France (see Chapter 5 for more details) Mr Drew said that there will be similar laws to be adopted by the United Kingdom in the near future. The need for such laws is crucially important for the benefit of this industry. Therefore, we will be waiting for such regulations sooner not later.

CONCLUSIONS

1. The role of the project manager is very diversified. Thus he requires a broad background of skills and knowledge.

2. The school educational policy in the United Kingdom is very narrow at the secondary level.
3. Fundamental changes are required in order to broaden the secondary educational curriculum. The adoption of a new policy and the abandonment of the existing one must be enforced by the concerned Government authorities.

4. A wider approach to university entry requirements could be achieved after the changes at the secondary level are implemented.

5. Collaboration amongst educators at all levels and employers must be instigated and encouraged by all the concerned parties.

6. Undergraduate courses are designed to secure accreditation by the concerned professional institutions. Freedom of educational institutions does not exist.

7. Market oriented educational strategy must be exercised across all the concerned parties. The main aim is to fulfil the needs of the customers not the Institutions.

8. Revolution in education is the key to success. Government authorities are the key player to secure the fundamental changes required in all the education systems.

9. The centralised authorities possessed by the Engineering Council and their associated institutions must be eliminated and diminished. Different bodies must be allowed to compete. The society in general will decide who is the voted winner(s).

10. The educational dilemma has remained throughout the past two or three decades. Without definitive actions it will remain in a chaotic situation.

11. Our survey has established the skills and knowledge required for project managers. The majority of these project managers are engineering graduates. Hence, we recommend a broader based undergraduate education in order to increase the chances of having better prepared engineers. Many of these graduates are going to
benefit from this broad education. Accordingly the industry will benefit as a whole.

12. The validity of the major findings of our survey was strongly supported by five leaders from the construction industry. The major points raised by the interviews are discussed under article number 5 in this chapter. Briefly, the interviews have raised and discussed the following issues:

- the technical background of the project managers;
- engineering curriculums;
- further education and training.

It was found that the technical background is very essential but needs to be supplemented by managerial, financial, administrative, and legal knowledge and skills. An engineering graduate is the most likely candidate for the project manager's job. Employers require broadly educated engineering graduates. Experience was highlighted as the most important issue for the formation of the project managers. Finally, employers are fully aware of the need for further education and training. These major issues raised by the leaders of the construction industry were generally in line with the findings of our survey of successful project managers.
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CHAPTER 5

ENGINEERING EDUCATION IN FRANCE, GERMANY, USA AND JAPAN - "A COMPARATIVE STUDY"

I. INTRODUCTION

This chapter is aimed at investigating the engineering educational policies in France, Germany, USA and Japan, as compared to the policy of the United Kingdom. Through literature review, the following issues are going to be investigated:

- School education;
- Admission requirements;
- Undergraduate education;
- Management education and training.

These issues are thought to highlight the practices of other developed nations and by comparing them to the British system we can draw a better picture of the situation. Hence we can draw conclusions regarding the required changes in our system.

Chapter Four of this thesis discusses the British educational system. Hence this chapter complements and interacts with the previous chapter.

From the findings of our survey, we found that a broader range of skills and knowledge is required for the project managers. Therefore this chapter comprises a comparative study, in the light of the main objective to the formation of project managers in the construction industry, amongst the five countries.

Another aspect discussed in this chapter is how the graduate engineers are appreciated by the employers, and the professional recognition and status of the graduate upon his graduation. Tables 5.1, 5.2, 5.3, and 5.4 at the end of this chapter highlight the major practices across the five countries.
2. SCHOOL EDUCATION

This part is aimed at discussing the general educational policies and achievements at school level in the above countries. Some data were not available for true comparison. Nevertheless, this part is aimed at investigating the issue of broadness at the pre-university level.

2.1 France

Education is compulsory between the ages of 6 and 16\(^{(1)}\). The first 9 years are the same for all pupils: elementary school from 6 to 11 years of age and the junior high school from 11 to 15 years of age. At the end of the 9 years, pupils have to choose between two principal specialities as follows\(^{(1)}\):

- a short professional training lasting two or three years (technical high school); or
- the preparation for the baccalaureat in secondary school which lasts three years.

The baccalaureat is a national degree and is prepared in liberal arts or professional lycees. This degree opens the door to higher education.

Depending on the wishes or aptitude of the student, he/she has the choice of several options\(^{(1)}\). The options leading to scientific or technological studies correspond to the series C, D, E or sometimes F.

In a face to face interview with a senior project manager who has followed this system, it was found that the contents of the baccalaureat in secondary school were broadly based. He criticised this system as very theoretical. For example, students are given many theories on economics without emphasis on the practical side.

2.2 Germany

The political changes in recent years have made the task of reporting of the school educational system difficult. The literature review will discuss the system followed by the Federal Republic of Germany or what was known as West Germany.
One of the fundamental importances for the system of higher education in West Germany is the fact that the country is a federation, consisting of 11 "Länder" (including Berlin, which has special status)(1). According to the Constitution of the Federal Republic of Germany, the "Länder" have jurisdiction in almost all aspect of education and they are responsible for educational policy and planning(1). Nevertheless, the following description gives a general idea of the system.

Education is compulsory for 10 years between the ages of 6 and 16. The school system can be divided into three main sectors(1) as follows:

- Primary level: The first 4 years are spent in the "Grundschule" (Primary School)

- Secondary Level I: This covers the classes 5 - 10 of the "Gymnasium" (Grammar School), the "Realschule" (Non-classical Secondary School), the "Hauptschule" (Secondary Modern School) or the "Gesamtschule" (Comprehensive School) and leads to the graduating certificates at intermediate level (Fachoberschulreife”).

- Secondary Level II: This covers the classes 10 - 12 of "Berufliche Schulen" (i.e. Vocational School, Intermediate Technical School) and "Fachoberschule" (Senior Technical School) which consists of several branches which differ in orientation and duration and lead to the conclusion of vocational training or to the "Fachhochschulreife"; it covers the classes of 10 - 13 of the "Gymnasiale Oberstufe" which lead to the "Hochschulreife/Abitur”.

Handy(2) in a report on management education, 1987, stated: "As well as having breadth, education in West Germany must have relevance to the working life”. This reflects the breadth and the practicality of the education system in Germany.

2.3 United States of America

In most States education is compulsory up to the age of 16 and in a few until 17(2). Most Americans attend high school up to the age of 17 years. Seventy-two percent of 18-year olds have a High School Diploma(2). These
diplomas require a specified minimum of course credits, some in subjects laid down by the State. Most States require proficiency tests in particular areas\(^2\). The 72 percent figure is not expected to change much during the next 10 years\(^2\).

As in Germany, education plays a major role in American life. Each State sets its own standards. The academic high school programme in the USA will include courses in algebra, geometry, biology, physics or chemistry, English literature and composition and possibly a foreign language\(^3\).

2.4 Japan

Japanese school systems at secondary and tertiary level were completely remoulded in 1949 copying exactly those of the USA\(^4\).

Japan has no natural resources. It has to work to live and has to work more effectively than others if she is to live well\(^2\). Handy, in 1992\(^2\) commented that it follows that it makes a lot of sense to everyone, but particularly to parents and to corporations, to invest as much as they can afford to in the development of those people assets.

Japan has a great advantage of a uniformly well-education force (94 percent in school until age 18)\(^2\). I must highlight this record and repeat that 94 percent of the young Japanese generation remain in schools until the age of 18 years. This must be highly admired and it sets a challenging record for all other nations.

Japanese primary and secondary education up to high schools have established an internationally acknowledged reputation for their high quality, well-balanced education with a high average level of student achievement\(^4\).

3. ADMISSION REQUIREMENTS

This part is aimed at highlighting the major entry requirements for engineering students. The subject is very diversified, but I hope to draw a general picture of these requirements, for the relevant countries, as briefly as possible.
3.1 France

Applicants to all engineering schools are admitted only after passing a competitive entrance examination which varies from school to school(1).

There are two main types of admission procedure(5):

1. Entry by competitive examination ("Concours") after at least two years of special classes ("Classes préparatoires") run in certain "lycées" throughout France.

2. Entry by interview and inspection of school records (after passing the "Baccalaureat").

"Ecoles" are often grouped for joint "concours" and within the group there is usually a pecking order as regards prestige(5).

3.2 Germany

The three types of higher education institutions in Germany are as follows(1):

1. Universities, including technical universities;
2. Comprehensive universities;
3. "Fachhochschulen"; these are intended to provide scientific training based on practice-related teaching. This leads to the degree of Dipl.-Ing. which enables the student to continue studying at the academic universities.

In order to be admitted to studies at one of these three university institutions, foreign applicants must provide proof of having a school-leaving certificate equivalent to German "Hochschulreife/Abitur"(1).

3.3 United States of America

Almost half of those graduating with a diploma will go on to college, either a four-year undergraduate college or a two-year community college awarding an associate degree(2). The admission into engineering courses was described(4) to be based on multilateral judgement by scores,
recommendation, academic record at high school, interview,... etc. Much account is given to personal views and evaluations\(^4\). High school graduation is almost universal in the United States and more than half of these graduates continue on to some form of college-level education\(^3\).

### 3.4 Japan

Admission into Japanese engineering universities is judged by scores of National Test Centre\(^4\). Personal judgement is regarded as unfair and only scores of paper test serve as sacred scale for admission\(^4\).

American authors have made extensive research on the Japanese educational system. The following quotes give a better picture of how these authors have perceived the Japanese policy.

1. "American students, by and large, take examination to get out of school. Japanese take them to get in", 1983\(^5\).

2. "In Japanese system, entrance examination is very tough but once a student overcomes the barrier, his way to the graduation is relatively easy"\(^4\).

### 4. UNDERGRADUATE EDUCATION

#### 4.1 France

The most significant feature of the French engineering education system is that it is almost exclusively the province of some 140 "écoles d'ingénieurs" of varying levels throughout France, which are for the most part quite divorced from the universities\(^5\).

The length of studies for an engineering degree is generally five years after the baccalaureat (four years for 15 schools)\(^1\).

Engineering schools are free to propose a curriculum. The curriculum is checked and controlled by the Commission of Titles (La Commission des Titres d'Ingénieurs)\(^1\). This Commission delivers the degrees to graduates.
The programs favour a basic scientific education rather than a more specialized one\(^1\). The student is encouraged to acquire general attitudes which should lead to greater adaptability rather than acquiring a specific professional competence\(^1\). The engineering schools are different in their regulations. One third of them are governed by technical ministries such as the Ministry of Agriculture, of Defense, etc..., two thirds are ruled by the Ministry of National Education\(^1\).

The admission procedure discussed earlier has contributed to a practically zero drop-out or failure rate. 98 percent of those admitted to "écoles" obtain their "diplômes"\(^5\). "Ecoles" usually have continuous assessment and small group teaching, and students are gently chivvied to ensure no-one gets left behind\(^5\).

The graduates of "Écoles" have a virtually 100% guarantee of employment. This is not the same for graduates of universities\(^5\).

In contrast to the system of the United Kingdom, no obligatory period of apprenticeship in industry after the "diploma" degree is required to obtain the professional recognition. Little emphasis on training is emphasized at the undergraduate level. On average students spend four months in project works or industrial attachment to gain an insight into working life.

The senior management of French industry largely consists of people with engineering "diplômes"\(^5\).

Some universities are criticised that their teaching is unrelated to the needs of industry\(^5\).

The French system is different from the British system. The French graduate with diploma enjoys a high status. He is regarded as fully trained and qualified as soon as he obtains his degree. On the contrary the British graduate is not regarded like that at all.
4.2 Germany

The two main routes to an engineering qualification are the "Technische Hochschulen" (technical universities) and the three general universities, "Bochum", "Erlangen", and "Trier-Kaisersbautern", having an engineering faculty leading to the "Diplom Ingenieur" (Dipl.Ing.) qualification, and Fachhochschulen (engineering schools) leading to the "Ingenieur Graduiert" (Ing. Grad.) qualification(7). The system is broadening and it is possible to obtain a qualification called "Dipl.Ing." at a Gesamthochschule (comprehensive university)(7).

The route chosen depends largely on the type of secondary school attended and the educational level reached(7). The recommended allocation of time in an ideal engineering course is roughly as follows(8):

- Humanities 10%;
- Foreign Languages 10%;
- Technical Writing 7%;
- Industrial Administration, Economics and Social Science 12%;
- Design Engineering 24%;
- and Basic and Speciality Engineering combined 13%.

Most technical subjects require a period of practical training or an industrial practice ("Praktikum") lasting several months, some or all of which must be completed before studies begin(1).

In a comparative study, 1981, it has been stated(7) that most German engineers were satisfied with their education and training, but there was an appreciable feeling among the Ing. Grads. that their courses had not been practical enough and were too diluted and superficial.

The time spent at engineering universities is relatively higher than the time spent at the British system. This time is ranging between 5 and 6 years(7).

Germany university engineering education is more specialized and involves an average stay of six years which includes six months industrial training, whereas in British by contrast only three years are spent at university plus two years training in industry for those who seek the Chartered Engineer status(7). German engineers seem to have a stronger technical as opposed to management orientation than the British(7). This shows that German engineers are of stronger technical background than their British counterparts. The broader curriculum of the German system explains part of this conflict between the two systems. Nevertheless, the German engineer's dominance of management posts at all levels reflects the fact of
quality, general aptitude and the German appreciation of their engineers. I believe the situation is different for their British counterparts.

In a telephone interview on 25 October 1992 with Professor Frank Harris of Wolverhampton University, he pointed out that technical universities offering "Dip. Ing." control their own curriculum content and they carry out their own accreditation. He pointed out that graduates might spend up to 7 years to get their degree. He also mentioned that other universities are controlled by the "Länder", hence their curriculum contents must meet the requirements set by those authorities. An interesting comment made by Professor Harris was that all the graduates are accepted as fully qualified engineers upon their graduation. Additionally, universities are not bound by professional institutions because they don't have such institutions.

4.3 United States of America

A student must complete a 4-year course to be entitled to a Bachelor's degree(3). This is on credit-hours basis ranging from 120 - 142 credit-hours with an average of about 134(3). There are several options that a student has for obtaining engineering education. First, the student may enrol in a community college for a 2-year programme leading to an associate degree qualifying as an engineering technician(3). Some of these students may be accepted for engineering programmes and enter into the third year at a four-year college, but the vast majority of the graduates accept employment upon graduation(3).

The range of engineering programmes in the United States is extensive and diverse(3).

Accreditation of engineering programmes in the USA is performed by the Engineers' Council for Professional Development (ECPD) - the organization accepted by the professional technical societies as the accrediting agency for the profession(3).

It is important to highlight the fact, reported in 1977, that 54 percent of the freshmen are enrolled in non-accredited degree programmes(3). This gives an indication that the educational establishments in the USA are less concerned about the accreditation restrictions, given the large percentage of
enrolment. This also reflects the market oriented policy towards education in the USA.

Freedom of curriculum is somehow restricted(4). The Engineers' Council for Professional Development (ECPD) sets the curriculum content guidelines. These guidelines state that the curricula content of the programme should include(3):

1. The equivalent of approximately three and one-half years of study in the area of mathematics, science and engineering. The coursework should include at least one-half year of mathematics beyond trigonometry, plus one-half year of basic sciences, one year of engineering sciences and one-year of design synthesis and systems. An additional one-half year should be devoted to one or a combination of the subjects listed above so as to meet the objectives of a particular programme of the institution or to complete a meaningful individual course of study.

2. The equivalent of one-half year as the minimum content in the area of the humanities and social sciences.

Hutton and Lawrence(17), in 1981, have stated the fact that the only country that devotes such a high proportion of time as 30 percent to related non-engineering subjects is the USA. Germany and Britain devote the least time (about 12 percent) and France is in the middles (about 17%)(7).

Ohashi(4), 1992, has summarised the key features of the American undergraduate courses as follows:

- Much home assignment to improve understanding, supported by office hour and teaching assistants;
- Effective learning through systematic arrangements of prerequisite;
- Two-way classes with much question and assignment;
- Poor understanding = poor professor's performance.

Graduation theses are not common(4). Students may participate in project work on paid basis. The retention rate is 70 to 80 percent. Degree awarded is a certificate of achievement(4). The expectation of employment is high.
Graduates are expected to be semi-finished products with limited experience\(^4\). Therefore employers expect more out of the graduates.

4.4 Japan

To the contrast of what was mentioned earlier, the higher education system of Japan is considered the weakest part of the entire system\(^4\). Among the most discussed issues are the entrance examination, the quality of undergraduate education, rigidities in the university-based research system, and the limited opportunity for graduate and continuing education (cf Japanese Education Today, 1987). Japanese industries have been steadily developing over the past 30 years and have established a firm standing in international competitiveness\(^4\). This remarkable performance has been supported partly by the massive supply of fresh engineers from the educational institutions\(^4\).

If the engineering education in Japan has been so ineffective as the system has been evaluated, then the industry must have badly experienced the lack of qualified engineers. The situation is completely different. As Ohashi\(^4\), 1992, has elaborated on this issue and stated that there must be a kind of subtle understanding between employers and the education of Japan so that universities supply engineers who may be not well finished at the point of graduation but are willing and flexible enough to be trained after the employment in accordance with the employers’ needs for specific engineering assignment. I would like to emphasize this issue, of mutual understanding between the industry and the educational establishment, and the remarkable achievement of the Japanese industries. Japan has shown the best example, so far, on how the industry can play a key role in the educational effectiveness.

Ohashi\(^4\) has described the Japanese education system as a duplicate of the American system. There is, therefore, little difference in the organizations, degree requirements and curricula of both systems\(^4\).

The main features of the Japanese engineering courses are\(^4\):

- Passive attitude in class with few question and involvement. Frequent cut class;
- Result of exam at the semester end determines pass or fail;
- Poor guidance for systematic learning with few prerequisites;
- One-way classes with silent listening;
- Poor understanding = poor student's ability.

Graduation thesis is compulsory for graduation(4). Students are intensively involved in the thesis work and learn team work together with graduate students(4).

The accreditation system is quite different from other countries. Before the foundation of a university, Ministry of Education inspects whether all requirements (mostly quality and quantity of faculties and facilities) are met according to the regulation(4).

If once permitted, the license keeps valid for ever(4). No guarantee on the quality of education but complete freedom of curriculum design(4).

The retention rate is considerably high, 90 to 95%(4). Department heads are almost employment mediating officers(4). Strong ties with industries through the mediation of recruitment activities.

5. MANAGEMENT EDUCATION AND TRAINING

The key conclusion in the report on management education, training and development published by the National Economic Development Office (NEDO) in 1987, was that most managers in the USA, the Federal Republic of Germany, France and Japan have been educated to a higher level than in the UK(10). Moreover, many managers in these four countries have had the benefit of formal and systematic policies for continuing education and development(10).

In an earlier report of a survey, published in 1974, investigating and reviewing the existing literature on the educational, professional, occupational and social backgrounds of managers in Britain, particularly of those in the manufacturing industry, it was pointed out that graduates in technical subjects do not appear to be promoted into top management positions as often as arts graduates, accountants and some other non-graduates.

In another paper presented by Craig(12), in 1986, a chief civil engineer, BP International Limited, it was pointed out that civil engineers have not
managed to penetrate or be represented in the general business areas as successfully as those with non-engineering backgrounds.

All the previous evidence has raised many questions regarding the effectiveness of management education and the successfulness of further education and training programmes to equip the engineers to occupy leading positions in the industry. In my view this is a result of many factors which have contributed to this dilemma. On one hand, the effectiveness and broadness of the education, as discussed earlier, have affected the background of these engineers and other members of society. On the other hand, many issues such as:

- industrial policies, regarding the employers' commitment and their preparedness to train, educate and motivate their employees;

- the policy of the government towards the encouragement of such moves by setting the regulations to ensure a minimum level of commitment by the industry. These regulations must ensure effective measures to motivate the industry by making such expenditures on education and training tax deductible;

- the perception of the society, in general, towards the importance of effective management education and training.

These are but a few of the issues to be mentioned.

This part comprises a literature review and discussion of the main issues regarding management education and training in the five countries, including the UK.

5.1 France

France has traditionally relied on a small number of highly educated individuals produced by the "grandes écoles" of engineering and business to provide the large companies with the core of the "cadres" of management(10). The French have a law requiring every organisation with more than 10 employees to spend a minimum of 0.5 percent of their wage bill on the initial formation and 1.1. percent on continuing formation of their employees(10).
If they do not spend it all the balance goes to the National Exchequer\textsuperscript{(10)}. Handy\textsuperscript{(10)} has pointed out that the large organisations spend much more than the law requires (3.3\% percent on average for organisations with more than 2,000 employees) and typically devote 30\% percent of it to management training. The organisation is also required by law, to supply statistics on their training activities and to prepare a formal development plan for the organisation\textsuperscript{(10)}.

Three quarters at the top management level of large companies in France are graduates of engineering schools\textsuperscript{(10)}.

Most of the engineering schools in France have a scientific or technological speciality but some, including the Polytechnique (the foremost engineering schools), are more generalist in emphasis and hence many engineers in industry have not only a scientific but a broader, non-specialised educational background\textsuperscript{(10)}. From the previous review and the literature review of many sources the following are the major characteristics of the French system:

\begin{itemize}
  \item About 10-25\% percent of all engineers go on to do post-graduate studies after obtaining their diploma\textsuperscript{(5)}.
  
  \item Many of the major "écoles" are developing large programmes of in-service training for updating and re-cycling working engineers\textsuperscript{(5)}. For the development of these programmes they can benefit from state funds through a national levy on industry which in some cases can be paid direct by a firm to an individual "école"\textsuperscript{(5)}.
  
  \item Every individual has the right to individual training leave in whatever subject he/she chooses\textsuperscript{(2)}. The company may defer permission, giving reasons, but for no longer than 12 months. The leave may not exceed one year if full-time\textsuperscript{(2)}.
  
  \item The employee may receive up to 100\% percent of his/her previous salary\textsuperscript{(2)} upon completion of such a programme.
  
  \item Actual expenditure by companies on training in 1983 was 18 billion francs, with a provisional figure of 18.7 billion francs for 1984\textsuperscript{(2)}.
\end{itemize}
This total does not include all expenditure on senior management training which is estimated to be about 30 percent of these totals\(^{(2)}\).

- The average expenditure on training per employee per year ranged from FF. 1026 for small companies (10 - 19 employees), to FF. 3704 for large companies (more than 2,000 employees)\(^{(2)}\). These figures are for 1984.

- Greater emphasis is given to train engineers and managers. About one third of engineers and managers benefit from training as opposed to 11 percent for unskilled workers\(^{(2)}\).

- Costs of management courses are very high compared to UK. Prices in 1984 for these programmes were around 50,000 francs (excluding accommodation, travel, etc.)\(^{(2)}\). This is equivalent to £10,000. Therefore, we can conclude that these prices are very high compared to the prices in the UK. Therefore, French companies require management staff to sign a contract committing them to stay with the company for a defined period\(^{(2)}\).

- Foreign language teaching is a distinctive feature of many establishment, both at graduate and continuing education level\(^{(2)}\).

- A wide variety of training methods are used. On-the-job training is very widespread and believed by many to be the best method there is\(^{(2)}\). This is in line with the results of our survey of project managers reported in Chapter 3. The major problem, however, is that immediate superiors are seldom trained to train\(^{(2)}\).

- Short courses in the main are very much seen as returning to school and are often criticised for being too passive and unrelated to company needs\(^{(2)}\). I would like to remind the reader of the valuable comment raised by one of the project managers in our survey (see Appendix 7, Comment No.6) who said: "Too many courses are geared to what can be taught not what is required". Therefore, we can conclude that this dilemma exists in the French system as well as the UK educational systems. One of the available solutions is the fulfilment of the
industry's requirements. Industry requires practicality and relevancy of the courses given by the educational institutions.

- French companies think that the formation plan is useful as a means of dialogue, but observers in training organisations hold the view that often the plans never matched the expectations raised and are often very disappointing. This reflects another dilemma of improper planning for training in the French industry. In my view this situation is much better than the UK. The French companies are in a better shape as they are required to draw such plans. On the contrary, the British companies hardly think of such plans and this issue is left to the individual company to set its own plan.

- There is more attention being paid to personal qualities, good leadership and communication skills and ability to motivate. French companies depend on the commitment and involvement of senior management. Therefore, continuing education is becoming more rooted in the organisation. This was a result of the clear government commitments towards the development of the French nation.

5.2 Germany

The quality and quantity of vocational education and training in West Germany are internationally admired. Work and manufacturing work in particular are treated very seriously. A knowledge and understanding of the work to be done at all levels is a prerequisite of advancement. A large percentage of senior managers have doctorates in a relevant field of study. This emphasis on professionalism carries over into management development. The West German manager is expected to be well and appropriately educated before joining the company but must still expect to do a period of 'apprenticeship' in his chosen function and to be judged solely on his performance. The following are some of the major features of the German system:

- Business regards university graduates as good abstract thinkers, but requires two years 'apprenticeship' before they are really useful to the company; whereas the more practically educated polytechnic graduates are up and running almost from the start of their careers.
This reflects the high industrial approach of the Germans. Also it emphasizes the great attention awarded to technical aspects required for candidates in the industry. As it was proven in our survey, that technical knowledge is not diminished even after the engineer is promoted to a senior managerial level.

- A doctorate is almost essential for the upper ranks of certain professions, such as the chemical industry(2). This fact is explained by the large number of graduates with a doctorate degree in 1982. This number was 13,000, of whom 1,000 were engineers. The large number emphasises the importance given to post-graduate education by the Germans, and reflects the appreciation of the industry of such qualifications.

The doctor title is a very positive aid to promotion in industry and commerce: of the top managers in large companies who have studied one of the economic sciences at university, approximately two-thirds pass the doctorate(2). In a comparative study, published in 1981(7), it has been stated that German firms employ more people with higher formal qualifications, especially technical qualifications, than the British firms across all the different sizes of companies studied.

- There is a distinction in the development of managers between large, medium-sized and small companies(2). Many large companies have set up extensive development programmes which are provided for internally(2). Some medium-sized firms show an awareness of the need to develop management talent and, because they do not have the resources, they are obliged to send their managers on external courses(2). Most small companies claim that they have neither the time nor the money to indulge in management development(2). Large companies run in-house training as a major part of their training policy to ensure loyalty. But medium-sized companies are facing the significant problem of training costs which are high(2). Small companies are not successful in their training policies. The reason appears to be connected with the entrepreneur mentality(2).

Handy has stated that the entrepreneurs themselves do not go on courses because they are too involved in the running of their own
business and they harbour serious doubts as to whether anyone can teach them anything about their particular line of business\(^2\). In my view this is one reason for this problem. Other reasons are:

- cost of training;
- the short sighted policies;
- the market competition.

Generally speaking, German small companies are in a better shape than their British counterparts, because of the quality, broadness of education, and training achieved by the employees at their recruitment time. Although the British companies are under stricter regulations, small companies might give less importance to training and career development programmes. Therefore, the French policy looks a better option to be adopted.

Nevertheless, management education and training in Germany is successful. Handy states that if success in management education can be measured by an ever increasing percentage of posts at all levels being taken up by university and polytechnic graduates (excluding arts graduates), then it could be argued that West German management education has been remarkably good\(^2\).

This concluding remark by Handy\(^2\) emphasises the great importance of higher education in an industrialised country such as West Germany. Therefore, we can regard our survey results regarding the project managers higher education as a strengthening evidence for the importance of higher education. All parties involved must take the German experience as an example of achievement towards successful and prosperous industry.

5.3 United States of America

The demand for management training has resulted in the formation of the American Society for Engineering Management (ASEM)\(^{13}\).

ASEM defines engineering management as the "art and science of planning, organizing, and allocating resources, directing and controlling activities
which have a technological component” (13). Although this is quite encouraging, the reality is not. Management training for engineers in the USA is not a formalized process at the university level (13). Out of 199 civil engineering departments, approximately 25 offer undergraduate courses covering an aspect of management (13). Poirot (13), in 1986, has said that according to a 1984 ASCE Management Survey, these 25 civil engineering departments primarily offered courses in construction management, but did not recognize the need to provide curriculum space for basic management principles. Poirot (13) has also indicated that a recent survey by the ASCE Management Division, indicates most of the civil engineering department heads have an increasing appreciation for this management training need. It was also mentioned that there are some who steadfastly maintain that the university’s engineering training role is to provide technical training (13). We can notice the contradictions amongst what is mentioned here, the guidelines issued by the Engineers’ Council for Professional Development (ECPD), and what was stated by Hutton and Lawrence (7) in 1981 (discussed in Section 4.3 in this chapter) that 30 percent of time is devoted to non-engineering subjects in the USA. If we accepted that 25 civil engineering departments out of 199 offer courses in construction management and compared this with the data presented by Professor Thompson (14) in 1986, that about half the undergraduate courses in the UK contain some element of management training, although the quality and quantity varies greatly, then we can conclude that the situation in the USA is not better than the situation in the United Kingdom. Therefore, it is possible to conclude that management training for engineering at the undergraduate level is low.

The report published by the United Nations Educational, Scientific and Cultural Organization in 1977 has explained that the increase in the number of electives in the engineering undergraduate programmes, especially in the last year, was caused by the conflicting demands for more engineering specialization that is compatible with graduate programmes and the market demand for engineers with a broader interdisciplinary orientation (3). This reflects an important characteristic of the American system to satisfy a wider market demand.

The main characteristics of the American system are:
Education has always been seen by most Americans as a good investment in their own future\(^{(10)}\). Over 60 percent of school leavers participate in some form of higher or further education at some time\(^{(10)}\).

One quarter of all undergraduates at American universities are majoring in business or management and, similarly, one quarter of all postgraduates are studying for an MBA (Master in Business Administration)\(^{(10)}\). The emphasis given by the Americans on MBA's programmes is unprecedented and shows the perception of the society towards such a degree. The output of MBA's has grown from 58,000 in 1981 to 70,000 in 1987\(^{(10)}\). As a result almost all American managers in the larger organisations will now start their careers with a degree in some subject, topped up sooner or later with formal business and management study either within the firm or in a university programme\(^{(10)}\).

Large amounts of money are spent on formal education and training by the American organizations. Handy\(^{(10)}\) has pointed out, in 1987, that the total 'spend' in direct costs on formal education and training by corporations is thought to be in the region of 60 billion US dollars.

Nevertheless, there is today (as reported by Handy in 1987\(^{(10)}\)) some criticism of the MBA degree and much speculation about its future. One strand of thinking criticised the average MBA programme for:

- emphasising the wrong mode - technical analysis rather than leadership;

- ignoring more important work - human skills, entrepreneurship, internationalism;

- not meeting society's needs;

- fostering undesirable attitudes - short run thinking, unrealistic job expectations.
This will highlight the attitude of the industry towards university programmes. But can we expect this to be valid for all the corporations of smaller size? Statistics are not available, but we can expect that the situation will not be different for other countries as the economical pressures might affect the employers’ willingness for such moves. Therefore, authorities must adopt a proper policy to counteract such drawbacks in order to provide better opportunities for the members of society who are willing to develop their knowledge and enhance their career achievements.

Handy, 1987, has indicated that the Japanese are eroding the commercial self-confidence of the big corporations and thoughtful business men worry about the growing trade deficit. In my view, the Japanese have invaded the rest of the world. Therefore, we can conclude that in order to succeed we have to look for the cons and pros of other policies used by the others in order to adopt whatever is appropriate for the nation, given that social and cultural factors are cared for before such decisions are taken.

5.4 Japan

The Japanese economy is one of the strongest in the world. One of the major characteristics is the uniformly well-educated work-force (94 percent in school until age 18). This was pointed out to be a tradition whereby industry and business get a fair proportion of the best of the graduates of university as a raw managerial stock and a national disposition to think far into the future and to seek to arrange that future in an appropriate way. Their preference for long-term planning as opposed to opportunism shows through most obviously in the way they prepare and groom their managers.

The major characteristics of the Japanese system are:

- The Japanese employers expect their new employees to be well but not necessarily vocationally educated. They then adopt what has been
called a 'slow-burn' developmental procedure of progressive job rotation supplemented by formal reviews and assessments and a variety of forms of formal study ranging from essays written on company problems, classroom instruction on company courses and, most importantly, self-development private study and correspondence courses. The whole process may last as long as 14 years in the bigger groups before one becomes 'Kacho' or section chief. This reflects a strong commitment by the individual employer to develop and enhance his employees' backgrounds and skills. On one hand, the Japanese employment policy works on the basis of lifetime careers in the same organization, therefore employers are encouraged to invest in their human resources. On the other hand, individual employees are motivated to accept this policy, although very lengthy, to develop himself to be promoted at later stages in his career. This is proved by the large percentage of graduates occupying top managerial posts (85 percent of top managers in 1975 were graduates).

The education for business has been left mainly to business to organise, with outside help. This is a result of the assumption of lifetime employment. It also has made sense for the employers to do so. Handy has explained that this process is not so formal nor so extensive in the smaller and medium-sized enterprises, who employ a majority of 80 percent of Japanese workers.

The Japanese habit of study and the pursuit of learning makes them avid readers and keeps them constantly curious about the ways of other people and questioning of their own. Thousands of overseas study visits are arranged every year for Japanese managers, while self-enlightenment is seen as more and more important the higher one gets in the hierarchy. From an interview with a Japanese postgraduate student at Loughborough University of Technology, studying in Information Technology, it was disclosed that the Japanese authorities encourage and sponsor a large number of undergraduate and postgraduate study programmes for Japanese students in almost all the developed countries, to enhance their own experience and compare it with others. This shows a serious and well studied long-term policy for development.
Handy(10) has highlighted that there is evidence of considerable intervention and control over the industry. This applies particularly to measures and organisations designed to improve management education and productivity. Although such measures might be facing objection by organisations from other nations, I believe that this is a successful policy in order to ensure that industry is caring for their most important assets. Furthermore, it will ensure that a larger proportion of the society's members are getting their fair share of education and training. In order to encourage such positive moves, authorities can reward those organisations by considering new policies for taxation.

The large Japanese firms exhibit the following features(10):

- internal labour markets;
- enterprise (single company) unions;
- lifetime employment;
- long-term planning perspectives;
- bottom-up consensus decision-making;
- extensive on-the-job training;
- range of company incentives (bonuses etc.).

These features set the basic contributors to the success of the Japanese large organisations. It might be a different situation for small and medium-sized organisations. But the key message is the successful broad school educational system, commitment of Japanese government, perception of the employers for their newly recruited employees, and the successful cooperation and collaboration of all concerned parties. In my view the most important of all is the clear commitment of the Japanese employers to invest in their most valuable human assets.

The government has handed over the design and operation of management programmes to private sector organisations but maintains a keen interest in it and monitors it assiduously(10). This shows the confidence and trust by delegating such responsibilities. The result is obviously seen by the remarkable performance and exceptional international competitiveness by the Japanese industry.
The impression that Japanese companies rely solely on on-the-job training and in-company classes to develop their managers is clearly mistaken\(^{(10)}\). There is a great deal of off-site training but it mostly consists of short well-defined packages or specific study missions with an emphasis on relevance to the industry and the job\(^{(10)}\). I would say, briefly, that the Japanese are showing a great example by their clearly identified policies toward the development of their human assets. They implement a mix of every thing to enhance knowledge and skills gained by their employees. Rewards are secured to the successful participants. In order for other nations to succeed it will be advisable to look for the Japanese achievements and adopt similar strategies not only from Japan but from other nations as well.

5.5 United Kingdom

Handy\(^{(10)}\), in 1987 has stated that each society has a well-understood route into a managerial career and a clear set of expectations as to how managerial competence can be improved. He added that it is a total process, starting with early schooling, a process which the French accurately call "formation"\(^{(10)}\). We have seen how other nations are thriving on broader education and on the contrary the UK is adopting a narrower approach from bottom to top. An interesting comment was raised by Handy when he said "Until the Finniston report (in 1980) on the engineering profession, the English word was not used in this way, presumably because the British did not recognise the concept"\(^{(10)}\). What I believe is that even until now the situation is still not much better, despite the growing number of calls by educators, employers and others to broaden the educational base and pay more attention to management education and training. The system should be reviewed as a whole in order to bring fundamental changes into the educational policy. Others would rather prefer a patchy policy by ignoring other concerned parties and adopting a very narrow view to the problem.

Handy has concluded that by comparison British, with some notable exceptions among the larger corporations, does not appear to take the preparation and development for her managers as seriously as other countries\(^{(10)}\). In recommending a way out of this dilemma, Handy (1987) has stated that Britain need not "indeed should not", ape the detailed ways of other countries, because they all differ, but must find her own approach.
This is a very broad statement by Handy. The reality is that every nation or individual has to evaluate, compare, learn and review his/her policy(s) in the light of other experiences. Nevertheless this might reflect the British attitude towards changing their policies or strategies easily.

The main characteristics and observations of the British system are:

- Only 21 percent of all managers appear to have degrees or professional qualifications of any sort (including HND) although the record is better for top managers (1983)\(^{15}\). This is quite below the achievements of other nations and raises an important question regarding the role of the graduates employed by such organisations and why they are not promoted to occupy such posts.

- Thirtysix percent of middle managers in one survey (1985) had no management training since starting work\(^{16}\). If this is the situation for such a dilemma, then there is no doubt that management education and training policies must be reviewed by all the concerned authorities if they are ambitious to develop the system.

- Twenty percent of the larger companies (over 1,000 people) made no provision at all for management training in 1986, rising to 75 percent for the smaller ones\(^{17}\). These figures support our previous arguments regarding the relationship of the organisation’s size and the availability of training. This will call for an interaction by authorities to encourage further education and training as mentioned earlier.

- Objectives and appraisal systems are common, but are seldom translated into formal developmental plans and exercises as in Japan\(^{18}\). The implementation of such plans is still rare and depends on the size of the organization. This calls for a change in the policies adopted by the employers and the abandonment of short-term plans for early profits. Accordingly, the losers are not the employees but also the employers who encourage such views.

- Handy has highlighted the crucial fact that the shortage of British managers is an imminent problem\(^{10}\). He cited that there were in 1985 (Labour Force Survey) 3.3 million self-defined managers of all
types in Britain. Assuming a 25-year managerial career we would require a minimum of 130,000 potential new managers each year to replace the stock; of these perhaps 90,000 might be expected to have serious managerial responsibilities\(^{(10)}\). Handy has presented data that Britain produce at most 5,000 first degrees in business and manager, 1,600 diplomas and 1,200 British MBA's\(^{(10)}\). So if we calculated the deficit in the required number of graduates it will be 82,200. Therefore, this is really a very serious problem. Thus this will support our claim for fundamental changes in the education system in order to produce the required number of managers. Hence, the question is are the engineering graduates qualified to fulfil or even partly fulfil some of these jobs. The answer is definitely Yes. As our survey, beside many other before it, have established that engineering graduates are a good product to do so given they are cared for. Again and again, changes are needed sooner or later for a broader educational system.

Handy\(^{(10)}\) has admitted at the end of his report, in 1987, that the best in Britain have not had the same educational base as the best in France - broad, long and relevant. He concluded that three 'A' levels and a degree in the humanities is a poor match for a 'baccalaureat' followed by a 'grande école' in business or engineering with a 'stage' or work assignment. Handy was in pain to say "At this stage the best of the British are, perforce, clever amateurs"\(^{(10)}\). I would like to indicate that Professor Handy did not recommend any solutions for this. Instead he commented indirectly and briefly by saying "Paradoxically, instead of following France more closely and reconstituting the first degree at their prestigious universities or copying Japan with rigorous long-term apprenticeships, the British turned to the US model of post-graduate and post-experience business schools"\(^{(10)}\). With my greatest respect to Professor Handy, I would say it directly, that changes are needed without any delay if we are looking forward for the welfare of our society. Nevertheless, Handy has recommended at the end of his report to expand the educational base by educating more people more broadly for more years, if possible up to first degree level - following the example of all the four countries. This recommendation was in contradiction with what he said earlier in the introduction, that Britain must find her own approach and should not ape the detailed ways of
other countries. Nevertheless, the study presented by Professor Handy was one of the most serious attempts to bring changes into the British educational system.

6. CONCLUSIONS

1. Changes in the British educational system are very crucial and imminent in the light of the discussed achievements by other countries. The results of our study and the many other surveys and reports on this issue show that changes must be made sooner not later in order to enhance the successfulness of the construction industry in the United Kingdom.

2. Management education and training is not conclusive to graduates from arts, business and accounting schools. Engineers must be prepared for this role if the industry in particular and the society in general are to be successful and prosperous.

3. Britain is lagging behind her counterparts. Changes must be enforced, barriers must be removed, restrictions must be eliminated and new thoughts and ideas must be listened for, and then, whenever appropriate, evaluated and implemented.

4. Educational establishments and organisations are able to achieve a successful result without the direct interventions of institutions or other professional bodies. Market orientation policies will determine the successful survivors in the society. Hence, educational establishments must be given their freedom.

5. Authorities must encourage the employers to provide further education and training opportunities for their employees. New tax alleviations, subsidies for educational establishment, and bonuses for those who will adopt such a policy, will ensure a better way forward.

6. In order to ensure successful training for employees, Government authorities must ensure that employers are adopting well planned training policies for their employees. The French system looks a very encouraging solution to be implemented provisionally. This could be
done by issuing laws setting a minimum percentage of the payroll to be paid for the education and training of the employees on a yearly basis.

7. Engineering professional status must be awarded by the concerned educational establishments. This requires extending the curriculum to adapt the required skills and knowledge for the graduates.

8. Broadness in the engineering curriculum is a must to produce better qualified graduates capable of seeing the engineering profession from a wider point of view. They have to be adequately prepared to understand many of the important issues such as management, financial, legal and communication.

9. The successfulness of the industry is the collective performance of all the concerned parties. As the case in Japan, employers do appreciate that the young graduates are semi-finished product, hence they are ready, willing and able to educate and train these graduates. In brief, they consider their human resources as the most valuable assets.

10. The strong need for management education was established by our survey of project managers. The considerable shortage of qualified managers in the United Kingdom provides another evidence for our case. Hence proper measures must be taken to broaden the engineering curriculum in order to produce broadly educated graduates.
<table>
<thead>
<tr>
<th>United Kingdom</th>
<th>France</th>
<th>Germany</th>
<th>USA</th>
<th>Japan</th>
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<tbody>
<tr>
<td>- Compulsory to the age of 16 years.</td>
<td>- Compulsory to the age of 16 years.</td>
<td>- Compulsory to the age of 16 years.</td>
<td>- Compulsory to the age of 16 years and in few States up to the age of 17 years.</td>
<td>- Compulsory to the age of 16 years.</td>
</tr>
<tr>
<td>- 'O' level system reflects a narrower curriculum at the secondary staged (+16) by the 'A' level policy</td>
<td>- Earlier choice to opt out to technical studies.</td>
<td>- Regionally controlled by the 11 &quot;Länder&quot;.</td>
<td>- As in Germany, each State sets its own standards.</td>
<td>- 94% of pupils remain in school until the age of 18 years.</td>
</tr>
<tr>
<td>- Low retention rate after the age of 16.</td>
<td>- Possibility to join at later stage.</td>
<td>- Broad curriculum with extra emphasis on vocational training.</td>
<td>- Most States required proficiency test in particular areas.</td>
<td>- Great emphasis on education by parents and industry.</td>
</tr>
<tr>
<td>- Growing demand to broaden the curriculum.</td>
<td>- Very broad secondary education curriculum.</td>
<td>- Highly practical secondary education.</td>
<td>- Broadly based curriculum with extra emphasis on scientific and technical subjects.</td>
<td>- Primary and secondary education have established an internationally acknowledged reputation for high quality and well balanced education.</td>
</tr>
<tr>
<td>- Downward trend for obtaining 'A' level by candidates joining engineering schools.</td>
<td>- Secondary education is highly theoretical and less emphasis on practicality.</td>
<td>- Retention rate is high as compared to Britain.</td>
<td>- Great emphasis on foreign languages mainly English.</td>
<td>- 72% of 18-year olds have a High School Diploma.</td>
</tr>
</tbody>
</table>
Table 5.2 Comparison of the Admission to Engineering Schools in the five countries

<table>
<thead>
<tr>
<th>United Kingdom</th>
<th>France</th>
<th>Germany</th>
<th>USA</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 3-4 'A' levels, mostly on scientific subjects are required to join universities.</td>
<td>- After passing a competitive entrance exam.</td>
<td>- Student must provide proof of having a school-leaving certificate equivalent to German &quot;Hochschulreife/Abitur&quot;.</td>
<td>- Half of students with diploma will go on to colleges.</td>
<td>- Admission is judged by scores of National Test Centre.</td>
</tr>
<tr>
<td>- Newly adopted policies to admit students obtaining other qualifications such as BTEC or HNC, especially for polytechnics.</td>
<td>- Interviews and inspection of school records after passing the 'Baccalaureat'.</td>
<td>- Possibility to join universities at later stage for technicians.</td>
<td>- Great emphasis on scores, recommendations, interviews and evaluations.</td>
<td>- Personal judgement is regarded as unfair.</td>
</tr>
<tr>
<td></td>
<td>- Joint 'concours' exams plus pecking order for prestigious schools.</td>
<td></td>
<td></td>
<td>- Very tough entry exams.</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>France</td>
<td>Germany</td>
<td>USA</td>
<td>Japan</td>
</tr>
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</tr>
<tr>
<td>Length of study is 3-4 years.</td>
<td>Length of study is generally 5 years.</td>
<td>Length of study is higher than other countries, ranging from 5 to 7 years.</td>
<td>Credit hours courses are used.</td>
<td>Course contents are similar to the American system.</td>
</tr>
<tr>
<td>Curriculum is controlled by the Institutions' guidelines.</td>
<td>The curriculum is checked and controlled by the Commission of Titles.</td>
<td>Curriculum content is set by the technical universities. Other universities have to follow the &quot;Länder&quot; guidelines for contents.</td>
<td>A student must complete a 4-year course.</td>
<td>Accreditation is carried out by the Ministry of Education. If once permitted, the license keeps valid for ever.</td>
</tr>
<tr>
<td>Highly technical contents with less emphasis on human sciences subjects.</td>
<td>The programmes favour a basic scientific education rather than a more specialized one.</td>
<td>More specialized education plus an average stay of 6 months in industrial training.</td>
<td>Several options for the graduate to follow in his course.</td>
<td>Retention rate is considerably high, 90% to 95%.</td>
</tr>
<tr>
<td>Freedom of universities is restricted.</td>
<td>The student is encouraged to acquire general attitudes which should lead to greater adaptability rather than acquiring a specific professional competence.</td>
<td>Engineering graduates dominate the managerial posts in the industrial organizations.</td>
<td>Extensive and diverse engineering programmes.</td>
<td>Graduation thesis is compulsory.</td>
</tr>
<tr>
<td>Professional status of graduates is not granted until a further 2 years of supervised training and passing a qualifying exam.</td>
<td>The graduates of &quot;Ecoles&quot; have a 100% guarantee of employment.</td>
<td>Graduates are fully qualified as professional engineers upon graduation.</td>
<td>Accreditation is performed by the Engineers' Council for Professional Development (ECPD).</td>
<td>Mutual understanding between the employers and the universities.</td>
</tr>
<tr>
<td>Graduates are expected to be semi-finished products.</td>
<td>Graduates are expected to be finished product.</td>
<td>Graduates are expected to be finished products.</td>
<td>54 percent of students were enrolled in non-accredited degree programmes in 1977.</td>
<td>Result of exam at the semester end determines pass or fail.</td>
</tr>
<tr>
<td>Employers expect more of the graduates.</td>
<td></td>
<td></td>
<td>The expectation of employment is high.</td>
<td>Department heads are almost employment mediating officers.</td>
</tr>
<tr>
<td>Employment is not easily obtained by graduates.</td>
<td></td>
<td></td>
<td>Graduates are expected to be semi-finished products.</td>
<td>Graduates are expected to be unfinished products.</td>
</tr>
</tbody>
</table>
Table 5.4 Comparison of the Management Education and Training in the five countries

<table>
<thead>
<tr>
<th>United Kingdom</th>
<th>France</th>
<th>Germany</th>
<th>USA</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Does not appear to take the preparation and development of managers as seriously as the other countries.</td>
<td>- All organizations of more than 10 employees must spend a minimum of 0.5% of their wage bill on the initial formation and 1.1% on continuing formation of their employees.</td>
<td>- The quality and quantity of vocational education and training are internationally admired.</td>
<td>- The growing demand for management training has resulted in the formation of the American Society for Engineering Management.</td>
<td>- Highly uniformly well-educated work force.</td>
</tr>
<tr>
<td>- 21 percent of all managers in 1983 had degrees or professional qualifications of any sort.</td>
<td>- Organizations are required by law to supply statistics on their training activities and to prepare a formal development plan for the organization.</td>
<td>- A large percentage of senior managers have doctorates in a relevant field of study.</td>
<td>- One quarter of all undergraduates are majoring in business or management, similarly, one quarter of all postgraduates are studying for MBA.</td>
<td>- Preference for long-term planning to prepare and groom managers.</td>
</tr>
<tr>
<td>- 36% of middle managers in 1985 had no management training since starting work.</td>
<td>- 75% of the top level of large companies are graduates of engineering schools.</td>
<td>- The German manager is expected to be well and appropriately trained before joining the company and must do a period of apprenticeship.</td>
<td>- Large amount of money is spent on formal education and training by the organizations.</td>
<td>- Progressive job rotation supplemented by formal reviews and assessments and a variety of forms of formal study ranging from essays written on company problems, class-room, instruction on company courses and self-development private study and correspondence courses.</td>
</tr>
<tr>
<td>- 20% of the larger companies made no provision for management training in 1986, rising to 75% for the smaller ones.</td>
<td>- Individuals have the right to individual training leave.</td>
<td>- Technical qualifications are highly required to secure employment.</td>
<td>- Very high utilization of university programmes.</td>
<td>- Life-time career basis is widely accepted by almost all large employers.</td>
</tr>
<tr>
<td>- No formal plans for education and training.</td>
<td>- The employee receives up to 100% of his salary on completion.</td>
<td>- In-house training is the major training activity for large companies to ensure loyalty.</td>
<td>- All of the top 300 corporations in 1986 had used university programmes.</td>
<td>- Open eye over the world to adapt the best practices.</td>
</tr>
<tr>
<td>- 90,000 managers per year are required.</td>
<td>- Greater emphasis is given to train engineers and managers.</td>
<td></td>
<td>- The Japanese are eroding the commercial self-confidence of the big corporations.</td>
<td></td>
</tr>
</tbody>
</table>
REFERENCES - CHAPTER 5


CHAPTER 6

PERFORMANCE IN CONSTRUCTION

1. INTRODUCTION

The effectiveness of the construction industry is largely determined by the collective performance of projects and the effectiveness of the project manager.

Chapter Two discusses many issues such as the project phases, characteristics of construction projects, variables in construction project management and the successful completion of projects.

In Chapter Four we have continued to investigate the complex role of the construction project manager in the light of:

- the literature review in Chapter Two; and
- the findings of our survey of project managers (Chapter Three).

Accordingly we concluded then that the project manager is actually a manager who gets to know the total operation of the project. Furthermore, we have argued that there is a strong need for a broad base of knowledge and skills required by the project manager in order to enable him to fulfil his role. The findings of our survey have strongly supported this argument. But this argument still does not clearly identify the missing link to clarify the subject of formation of construction project managers. Therefore, this chapter was included to investigate the following issues:

1. performance and productivity;
2. the role of the project manager in performance measurement:
   - within the organization,
   - for the other construction organizations;
3. effective use of resources and performance;
4. factors influencing performance;
5. the need for change in the UK construction industry;
6. a UK construction site report;
The main aim of this chapter is to establish the links between skills and knowledge, required for the project manager, and the project manager's role in performance.

2. DEFINITIONS OF PERFORMANCE AND PRODUCTIVITY

Performance is a very broad term used by many people to indicate or measure different things. It might be used to explain different objectives such as:

- productivity;
- production;
- efficiency.

Productivity and production are often regarded as synonymous(1). An improvement in production may be obtained by increasing the resources producing it such as(1):

- increasing the labour force;
- working additional hours;
- providing more capital and equipment.

But productivity tells us how well the resources have been used in producing the product. Wells(2) has said "production is the activity of converting units of input into units of output, but productivity is measured as a relationship between the two".

Productivity in its broadest sense is generally viewed as a more intensive use of conversion resources, such as labour and machines, and if measured on a factual basis should indicate reliably performance of efficiency(1). Norman(1) has commented that the interpretation of such measures is inconsistent and presents a confused perplexing subject.

In engineering terms, efficiency is the measure of the amount of energy supplied (input) and converted into useful work (output).
Therefore, efficiency can be represented in mathematical terms as:

\[
\text{Efficiency} = \frac{\text{Input (energy)}}{\text{Output (work)}}
\]

Hence, efficiency cannot exceed unity (\( \leq 1 \)). But productivity was defined by the National Economic Development Office (NEDO)\(^{(3)}\) as the ratio of the man-hours spent doing the work over the estimated man-hours to do it. This definition implies that the result might exceed unit (i.e. more than 1), since an underestimation of man-hours awarded to do the job will render this ratio to exceed unit. Therefore, the obtained result might be misleading. Hence, great attention must be undertaken to draw the line between the terms of productivity and efficiency. Nevertheless, the arguments are endless. In the scope of this chapter we are going to discuss the major issues to enhance and improve productivity in the construction industry.

3. THE ROLE OF THE PROJECT MANAGER IN PERFORMANCE MEASUREMENT

Performance means different things to different types of organisations such as:

- contractors and sub-contractors;
- consultants;
- clients, etc.

and it also means different things to the different people within these organisations such as:

- senior managers;
- project managers;
- accountants;
- planners, site engineers, estimators, administrators, and supervisors etc.

Therefore, it is necessary to understand the objectives of such performance measurement in order to satisfy the needs of the individuals involved. So far, this argument is very broad. But the message, as discussed earlier, is that the construction industry is organised around individual projects; the
effectiveness of the industry is largely determined by the collective performance of projects and the effectiveness of the project manager. Therefore it is the responsibility of the project manager to ensure that these measures are successfully adopted and effectively implemented to secure successful completion of the project and to satisfy the needs of all the parties involved.

Throughout the project phases and within the variables surrounding the project, as discussed in Chapter 2, the project manager is required to report the progress of the project to his organisation's members. These members have different interests in the project. Additionally other organisations and individuals from outside his organisation might have different interests in the project's progress.

3.1 Performance measurement within the Organisation

To highlight some of the major interests of the organisation's members, the following discussion is presented to clarify the project manager's role (employed by a contractor) in the context of performance measurement activities.

- **Senior managers**
  Senior managers might be interested to be informed on the following:
  - the expected completion dates as compared to the plan;
  - the performance of the subcontractors within the project and whether the completion is going to be affected as a result of slow performance;
  - the profitability of the project;
  - ensuring the client's satisfaction.

This shows the broad terms of interest by the senior management. The degree of interest might be different for different organisations according to the organisational structure and the management's style.

- **Accountants**
  Accountants interests are concerned with the cost of the project as compared to the budgeted cost. In broad terms these might include:
  - cash flows of the project as compared to the budget;
- pay orders for suppliers and providers of services to the project;
- cost controlling of the total project activities and ensuring the compliance with the budget.

**Planners**
Planners are interested to get feedbacks on the original prepared plans to:
- evaluate the progress of the project and detect any deviance from the original plan and/or review plans in the light of new changes or slow progress;
- update their data bases of the job man-hours required as a result of achieved performance records to be used for future jobs;
- make projection on the anticipated completion of the project.

**Estimators**
Estimators are interested in:
- reviewing their estimates in the light of reported actual costs;
- updating their standards for future jobs;
- updating their data bases on the basis of reported achievements;

**Personnel Department**
Personnel Department is interested to:
- ensure availability of human resources required for the project;
- ensure skills compatibility of the required human resources for the specific jobs they are needed for;
- control the recruitment activities throughout the project phases.

**Technical Support Department**
This will include all the concerned departments supplying machinery, equipment and maintenance etc. It's main interests are:
- supplying the required services according to the plan;
- providing supporting services on breakdown incidents, according to the reported deficiencies on the site;
- consideration of other requirements from different sites to eliminate conflict or stoppage of activities.
• Team Members
The term used above is to represent all the personnel within the project manager's team and the project staff involved in the project activities. Their interests are:
- to be briefed on the performance according to the plan;
- getting feedback of the profitability of the project in terms of their collective activities and in the light of the project budget;
- orchestration by the project manager to eliminate conflicts and ensure synergy.

• Procurement Department
Procurement Department is interested in:
- getting feedback on required materials and the availability of site storage facilities;
- responding to the site needs of material and ensuring the delivery of these materials on the prepared schedule or fulfilling the incidental demand from the site as a result of increased productivity.

In general performance might be affected by change of orders issued by the consultant or the client. Hence, another dilemma for the project manager. Therefore, a review of the total process is required, plus the need to evaluate and verify the changes in the light of the contract and the project's documents to ensure legality, and to take the necessary steps and measures accordingly.

3.2 Performance measurement for the other construction organisations

The other construction organisations generally include:
- client(s);
- consultant;
- sub-contractors;
- public authorities, suppliers etc.

The above list is not exhaustive, but it is intended to give a picture of the diversity of these organisations. Each one of these organisations has a different set of criteria. The following is a brief discussion of their interests.
• **Client(s)**
A project might have more than one client. Nevertheless the general interests to the client are:
- ensuring that they are getting good value for their money (through quality);
- ensuring that the project will be completed on schedule and within the agreed contractual value;
- being informed on the project progress regularly or as stipulated in the contract;
- being informed on the likely consequences of their anticipated or required changes if any; the client might be interested to know the likely delays or associated costs if he is going to make changes.

• **Consultant**
The consultant might be interested in:
- getting feedback on the buildability of the design;
- ensuring clarity of the drawings and that they are easily understood by the concerned members of the project team;
- being informed and briefed of changes likely to improve performance without fundamental changes; if changes were essential then liabilities must be investigated and settled accordingly. Accordingly, changes must be considered to set the new terms and procedures for the plans and budgets.

• **Sub-contractors**
Some of the projects could be executed completely on sub-contracted basis. On one hand, this will reduce the load of work for the main contractor. On the other hand it will increase the work load on the project manager. The sub-contractor's interests are:
- getting feedback on their progress as related to the whole project; delays caused by other activities might affect their activities, hence, they need proper updating for all the issues relevant to their jobs;
- assessment of their activities and performance if incentive schemes are used by the main contractor or the client;
- reducing the interruption of their activities caused by other subcontractors and/or late delivery of material and services.

- **Public Authorities**
  The growing awareness on environmental and social issues and the increasing number of health and safety regulations have increased the project manager’s responsibilities. The main interests of public authorities are:
  - ensuring compliance with the health and safety regulations;
  - minimum interruption to public services (i.e. traffic).

Generally, the project manager will also be interested to reduce the number of accidents on site to enhance productivity and reduce interruptions.

4. **EFFECTIVE USE OF RESOURCES AND PERFORMANCE**

An improvement in production may be obtained simply by increasing the resources producing it such as\(^1\):

- increasing the labour force;
- working additional hours;
- providing more capital and equipment.

But the above statement is very general and broad.

In construction management we are always concerned with resources such as\(^4\):

- design staff;
- fabrication facilities;
- labour;
- construction plant and, to a lesser extent, with materials.

Thompson\(^4\) has cited Ballard\(^5\) who says that we aim to achieve maximum use of a given level of resources.

By increasing such resources production will increase but accordingly productivity will be sacrificed. Obviously, there is a limit where an increase
in resources productivity will increase. But up to a certain point at which this relationship will not exist any more and productivity will start declining. Thompson(4) has indicated that due to one of the characteristics of construction projects (that is the change), a conflict with the aim of efficient resource usage will exist. Therefore, throughout the life of the contract or project, it is necessary to predict the implications of different courses of action on the use of our resources(4).

Our plan must, therefore, be flexible and the prediction must be available before the decision to implement is taken(4).

But the question which arises from the previous discussions is "who is the most likely person to undertake such responsibilities?" Obviously, it is the one who is in command of the steering wheel of the project. Regardless of the many titles used, let us say "the construction project manager". Other team members have direct responsibilities to assist and offer consultation, but the final decision is going to be the responsibility of the project manager unless he/she has to refer back to the senior managers of the organisation if needed. Even so he/she is responsible to provide a clear picture of the circumstances and recommend the appropriate action or decision. This implies that the project manager must have the appropriate knowledge and skills in order to fulfil his/her role successfully. A comprehensive discussion of this will follow later.

5. FACTORS INFLUENCING PERFORMANCE

There are many factors that influence performance. They can be divided into two main groups as follows:

- external factors;
- internal factors.

Chapter Two contains an extensive discussion of the variables that affect the project success. Nevertheless, the discussion in this part is concerned with the role of the project manager in order to counteract the effect of these factors. Obviously, the project manager cannot control the external factors. But he can reduce their effect by taking the necessary measure. These measures are
generally explained by implementing flexibility in the plan and predicting the implications of different courses of action, as discussed earlier.

Table 6.1 lists the factors that have an adverse effect on productivity.

### Table 6.1 Factors that have an adverse effect on productivity

| (1) Overtime and/or fatigue          | (17) Jurisdictional disputes               |
| (2) Errors and omissions in plans and specifications | (18) Work rules and restrictive work practices |
| (3) Multitude of change orders       | (19) Availability of skilled labour       |
| (4) Design complexity                | (20) Attitude of work force               |
| (5) Design completeness              | (21) Crew size and composition            |
| (6) Dilution of supervision          | (22) Economic conditions and              |
| (7) Reassignment of manpower from task to task | level of unemployment          |
| (8) Material location                | (23) Size and duration of project        |
| (9) Adverse temperature or weather   | (24) Timeliness of decisions             |
| (10) Inadequate lighting             | (25) Impractical QA/QC tolerances        |
| (11) Groundwater level               | (26) Uncontrolled breaks                 |
| (12) Regulations of various types    | (27) Time of day and day of week         |
| (13) High absenteeism                | (28) Inadequate temporary facilities: parking, changing rooms, rest rooms, etc. |
| (14) High turnover                   |                                           |
| (15) Material shortages              |                                           |
| (16) High accident rate              |                                           |

Source: (6)
Table 6.2 lists the factors that improve productivity(6)

Table 6.2 Factors that improve productivity

| (1) Learning or experience curves improvement | (17) Competition between crews, areas or shifts |
| (2) Education and training programs | (18) Incentives in contract |
| (3) Safety programs | (19) Effective utilization of subcontractors |
| (4) Innovative materials and equipment | (20) Enough tools in working order |
| (5) Prefabrication of building components | (21) Time and motion studies to improve efficiency, reduce fatigue and work smarter |
| (6) Critical path method for planning scheduling and control | (22) Good supervision |
| (7) Value engineering | (23) Time lapse film analysis |
| (8) Precast and prestressing concrete | (24) Industrial relations |
| (9) Computerization of business and engineering activities | (25) Cost reporting and work sampling of management’s effectiveness |
| (10) Worker motivation programs | (26) Optimizing site facilities |
| (11) Constructability review of design | (27) Reasonable foreman to journeyman ratios |
| (12) Standardization | (28) Recognizing and praising good workmanship |
| (13) Pre-planning of activities | |
| (14) Short interval scheduling | |
| (15) Purchasing practices | |
| (16) Use of scale models | |

Source: (6)

From reviewing Table 6.1 and Table 6.2 we can realize the diversified nature of these factors. On one hand, this indicates the difficulty involved in handling the large number of factors involved. On the other hand it reflects the complex nature of the construction industry as discussed earlier.

Borcherding(6) has indicated that construction productivity is largely an issue of management of:

- people;
- the job site;
- the contract;
- the relationship between people and their work;

and not necessarily and by no means solely concerned with getting more work out of the individual worker.

This indicates the crucial role of managers in the construction industry in order to enhance the productivity or performance in general.

The Productivity Task Force of the European Construction Institute has announced, in 1992, that it has sub-divided its broad remit into three main areas as follows(7):

- on-site factors affecting productivity;
- off-site factors; and
- those factors which might be imposed upon the industry by external consideration.

In my view, the above areas could have been reduced to two, as mentioned earlier, in order to achieve better focus on productivity. Therefore, other groupings could be made on the basis of the type of productivity measures. These are:

- quantitative measure;
- qualitative measures.

Nevertheless, the On-site Factors Group of the ECI(7) has conducted a survey of some 136 companies throughout Europe to determine those items which they felt were most instrumental in affecting productivity on site. The reported response rate to this survey was 59 percent. It was reported that the quality of site management was overwhelmingly identified as the single most important factor. It was clearly mentioned that this research is being followed through with an in-depth study under the following terms(7):

To review the key aspects which would lead to an improvement of productivity on site:

(a) The quality of the Site Manager and his Management Team;
(b) The methods by which the site work is organised;
(c) The construction methods adopted;
(d) The motivating factors - team spirit and productivity-related pay;
(e) The level of skill and the degree of trade flexibility achieved.

Also, it has been anticipated that the first stage of this study, covering the United Kingdom, will be completed by November 1992. The second stage, to be conducted in Europe, will be completed in the second half of 1993. The report also indicated that the quality of engineering was felt to be an important factor affecting productivity.

In response to this news article, Horner of the Construction Management Research Unit in the Department of Civil Engineering at the University of Dundee, has written a letter dated 22 July 1992 to the Productivity Task Force of the European Construction Institute indicating that the Construction Management Research Unit (CMRU) at Dundee University has been conducting research into construction labour productivity for the last 10 years. Horner has indicated that they too carried out a survey of the key factors which are perceived to affect productivity. He has presented a table comparing their results with the results obtained by the European Construction Institute (ECI) and indicated that their results (CMRU's) are ordered by rank while the ECI's results are presented in the order given in ECI News.

Table 6.3 is an exact copy of the table presented by Horner.

Table 6.3 Comparison of the ECI and CMRU results

<table>
<thead>
<tr>
<th>ECI</th>
<th>CMRU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of Management</td>
<td>Skill of labour force</td>
</tr>
<tr>
<td>Methods of organisation</td>
<td>Buildability</td>
</tr>
<tr>
<td>Methods of construction</td>
<td>Quality of supervision</td>
</tr>
<tr>
<td>Motivation</td>
<td>Method of working</td>
</tr>
<tr>
<td>Level of skill</td>
<td>Incentive scheme</td>
</tr>
</tbody>
</table>

Source (8)

Homer has expressed his view that the results are very similar.
My response to the above mentioned discussion is as follows:

1. The ECI's News has indicated that the quality of site management was overwhelmingly identified as the single most important factor.

2. The ECI's survey has also indicated that the quality of engineering was felt to be an important factor affecting productivity. This was not included in the letter or shown in the table presented by Horner.

3. Management was completely dropped out by the Construction Management Research Unit (CMRU). In the final report by Horner(9), it was stated that because the method used to determine the level of management control in their earlier study was both complex and subjective; and that they inspected the data from this study(9) and their earlier study to check for simple correlations between productivity and the number of operatives per manager, no simple correlations were found.

   If this is true, then it reflects the rigidity of statisticians attitudes toward ignoring such crucial factors as management by simply indicating that no significance was present. More interestingly, I have reviewed Part 2 of the questionnaire referred to by Horner(9). This part was aimed at investigating the extent to which each factor affects labour productivity. Nothing was mentioned in this part about management by any means. Hence, it indicates that management was dropped out and not included on the list presented to the respondents. Therefore it should not have been included in the report in the first place. Furthermore, it has been misleading to the reader of that report. It would have been better to provide an explanation to the reader of their report.

4. Planning is one of the crucial issues and actually it was totally dropped out by both the European Construction Institute's Task Force and the Construction Management Research Unit.

   Finally, it has been concluded by Price(10) in 1986, through an extensive research study that the quality of site management and level
of site supervision are important variables affecting site productivity. Price(10) has also cited an earlier research by Horner(11) published in 1981. One of Horner's main findings, cited by Price(10), was that at low levels of management control, there was a positive relationship between productivity and the degree of control.

Nevertheless, many authors have elaborated on the important role of management as one of the major factors for productivity improvement.

6. THE NEED FOR CHANGE IN THE UK CONSTRUCTION INDUSTRY

The UK construction industry enjoys many potential advantages such as(12):

• a wide and long experience of working overseas;
• the English language;
• the industry's professionalism, reliability and objectivity;
• its flexibility of organisation;
• its great technical experience.

Nevertheless, various weaknesses have also been identified, in 1991, as(12):

• its fragmentation;
• its domination by short-term expediency;
• the short-term horizon of shareholders;
• inadequate innovation;
• its failure to integrate technical and managerial competence;
• the inadequacy of its training arrangements, particularly of skilled and semi-skilled artisans;
• the low and probably inadequate spending on R & D;
• the inflexibility and high cost of its labour;
• relatively low productivity;
• confrontational attitudes of its participants and frequent resort to litigation.

It has been concluded by the Major Projects Association, in 1991(12), that if the industry is to thrive in open global markets and not just in the home
market or markets where the UK sphere of influence is strong, these weaknesses must be reformed. Even the home market is no longer exclusively a British preserve (12).

The first impression is that everything seems to be against the construction industry in this country. Fundamental changes are needed. Many of the major UK contractors have been urging the government for intervention to get them out of the crisis. In my opinion, the government is only one source of many major sources required to bring about the changes needed desperately for this struggling industry. The following is a brief discussion of what is required by some of these sources:

- Companies must start with themselves to review and implement the changes necessary. These changes are required to cover many fundamental aspects of their activities such as:

  - Long term strategic planning.
  
  - Short term planning policies ensuring flexibility to encounter the changes of variables outside their control.
  
  - Effective training and educational programmes to update and enhance the knowledge and skills of their human resources.
  
  - Extra attention to R & D programmes. This to include cooperation with the specialised educational and research institutions. Large companies are to some extent prepared to do so; but smaller companies can join their efforts and resources for such moves.
  
  - Adopting the appropriate techniques and policies to bring changes into their productivity. Improving productivity is not a one way exercise. It must be reviewed and updated on a cyclical basis continuously. Records of achievements and standards must be updated in the light of the new observed data.
  
  - Ensuring effective and timely feedback procedures from the sites. The introduction of computer terminals and telex systems
has greatly simplified the collection of feedback (4). The latest changes have introduced new techniques for data transfer such as the facsimile and the modem etc.

- In an American study, in 1979, on two hundred construction supervisors (6), the following areas were felt to be in need of improvement to increase their project's productivity:

1. motivation;
2. communication;
3. policies and procedures;
4. teamwork;
5. planning.

These findings must also be included on the agenda in order to improve productivity.

- Aim to minimize the amount of measurement of past performance (4). Thompson (4) has also indicated that this activity consumes far too much effort on many jobs. He added "effort that would be far better expended on the consideration of future problems" (4).

This list is rather endless, but what I aim to do is to highlight that the companies have got a major role to be carefully adopted in order to bring changes and achieve successful business mission.

- Educational and research institutions must get out of their shell. Many of these institutions, in my opinion, are not participating in the marketplace where their major product (the graduates) are going to be despatched for the whole of their careers. The following are but a few of what they can do:

  - Approach the industry, represented by contracting companies, consultant and clients; seek the investigation of their problems and offer support. Obviously the costs involved are high, but through the industrial placement of the undergraduates or the postgraduate research programmes, academic supervisors are
responsible to identify the needs and hence suggest new research programmes.

- Lack of industrial experience for some academics may render this policy void. Hence, policies for recruitment must be reviewed to ensure quality, qualifications and experience.

- Invite representatives from industry to talk to the students and to the academic staff. This will enhance the cooperation between the industry and the institution and build better links.

This is a brief list of the things that might be done. The dilemma remains associated with the freedom of these educational institutions.

My discussions in the previous chapters 4 and 5 have included many of the changes needed, especially by the government.

Therefore, changes are needed from all parties in the construction industry in order to improve productivity and enhance the performance for this industry and for the nation in general.

7. A UK CONSTRUCTION SITE REPORT

This part discusses the main causes of low productivity at a very large construction site in the UK. Mr O'Connor\(^{(13)}\) of the Business School, the writer of a research report at Loughborough University of Technology, has agreed to provide a copy of this report to be used in our study without disclosing any names. The report was prepared in 1991. It investigates the causes of low productivity at a large construction company in the UK. This site is one of the largest construction sites in Europe after the Eurotunnel. The study was conducted on the basis of face to face interviews with the key personnel at the site, followed by further interviews with key personnel from the contractor and the client head offices.

The major findings of this report are:

- Constant design changes have limited the capacity of contractor's personnel to manage effectively, difficulty of communication between
the contractor and the consultant, who was in another country, added to this, therefore the management staff were not managing but reacting to these changes.

- Many managers felt that their inability to plan activities on a day to day basis left them exposed to errors and misjudgements on other critical areas of the job. This problem was also highlighted by Thompson(4) as a major cause for low productivity.

- There was a constant need to respond to the client in order to extract information to link day to day activities with the broad outline of the plan. This will highlight the crucial role that should be played by the project manager in order to ensure smooth and efficient links with the client.

- Quite often information was slow or late in coming back which procrastinated decision making and action at the site level. We have discussed earlier the need for quick information. But, even now, and with the facility of efficient communication facilities, this problem is still existing. Therefore the human factor remains as one of the major dilemmas of communication effectiveness.

- Many managers felt that the site manager did not spend enough time in cultivating and developing teamwork within all levels of management personnel. This will highlight the leadership role of the site manager. Furthermore, it explains the problems faced by other team members. Their morale and motivation will be down the drain unless the project manager is aware of such issues. Also it was found that, in the absence of strong leadership, individuals seem to operate in a singular fashion and do not support the efforts of the team as a whole.

- Many supervisors had had difficulty with getting job-related information from certain managers. Quite often they explained that the client could inform them quicker and more accurately. This emphasises the technical competence of the concerned staff within the organization. This competence is more likely to be present, but what is really lacking is the ability to communicate the technical information required by staff on the site.
Remote location of storing facilities from the main area of operation was highlighted as totally unsatisfactory. Also the inability of stores to communicate stock arrivals and shortages was viewed as very unprofessional. The proper planning of site, the lack of trained staff and the lack of quick flow of information explain the causes of this problem.

The tight budgetary controls were felt to be serving no meaningful purpose. This will indicate the need for simple and effective budgetary controls that might be implemented on the construction site. Individuals responsible for such activity must be trained and updated in order to ensure their complete understanding of the employer's policy. They have to be motivated and given a chance to contribute to such policies. They have to commit themselves as a result of proper motivational strategy, not forced to do so by autocratic management style.

The lack of clerical back-up staff made the managers submerged under the flood of paperwork. Availability of such staff will free the manager's time for more important activities.

The site manager was spending most of his time on technical details. It was stated that the site manager spends 80-90% of his time on solving technical problems. This, on one hand, indicates the necessity of the technical background of the site manager. On the other hand, when will he find time to manage his team? The need of background in delegation is paramount to the project manager.

Many managers felt they would benefit from short training courses in:

- time management;
- report writing skills;
- effective delegation; and
- work planning.

Often meetings went beyond the time thought to be reasonable with a resultant loss of interest and commitment. A plea was made to tighten
up on meetings' agenda, time allocation and involvement of the appropriate staff.

- Several people referred to the lack of overall coordination of the various disciplines on site. These disciplines varied and include civil, mechanical and electrical engineering plus the commercial aspects. Accordingly, this calls for a broader knowledge required for the project manager to ensure coherence of activities on site, within the organization and with all other parties concerned with the project at hand.

- More than one planner feared a disaster if the imbalance continued between the tender outline forecasts and the true nature of cost as generated at the site activity. This indicates the importance of effective cost estimate centres supported by quick feedback from both the site and the planning department. The project manager must be aware of the basis on which plans and cost estimation were made in order to be able to evaluate the profitability and progress of the project at hand.

- Visits by personnel from head office created confusion on site and added to the list of leadership and teamwork problems. Such visits should have been coordinated with the project manager in order to reduce intrusions.

Although this report has highlighted many of the causes of low productivity, it reflects an encouraging sign of the role of the educational institutions toward providing support to the industry and the attitudes of this major contractor towards the cooperation with these educational institutions in order to enhance performance and investigate the causes of low productivity.

8. THE LINKS BETWEEN SKILLS AND PERFORMANCE FACTORS

The aim of this part is to investigate the relationship between the skills required for the construction project manager and the factor or variables that affect the performance of the projects. From the literature review in this chapter and the earlier discussion of variables and factors contributing to the successful completion of construction projects in Chapter 2, many factors
were identified as major contributors to the performance of construction projects. Table 6.4 lists the variables contributing to the performance of construction projects. These factors are not listed in any order.

From our data in Chapter 3, Table 6.5 lists all the skills rated as highly relevant by more than 30 percent of the participating project managers.
Table 6.4 Performance factors

| 1. Optimum use of resources and facilities | 24. Procurement strategy and activities |
| 2. Predicting the implications of courses of action | 25. Site storage facilities |
| 3. Availability of skilled human resources | 26. Planning of work activities |
| 4. Availability of equipment and machinery | 27. Estimation of costs and man-hours for the project at the tender stage |
| 5. Design complexity of the project | 28. Site meetings and reporting |
| 6. Design completeness of the project | 29. Coordination of various site disciplines |
| 7. Proper assignment of workforce from task to task | 30. Site visits by senior members |
| 8. Site working conditions | 31. Budgetary and cost controls |
| 9. Regulations of public authorities | 32. Industrial relations |
| 10. Availability of temporary site facilities | 33. Weather conditions |
| 11. The quality of the site manager and his team | 34. Health and safety regulations |
| 12. Site organization and layout | 35. Timely feedback on progress |
| 13. Team motivation and spirit | 36. Performance of sub-contractors & suppliers |
| 14. Level of skills and flexibility of team members | 37. Economic and market conditions |
| 15. Incentive schemes | 38. Contractual arrangements |
| 17. Organizational know-how and working experience | 40. Level of unemployment |
| 18. Education and training of human resources | 41. Size and duration of project |
| 19. R & D programmes | 42. Quality of site supervision |
| 20. Planning activities on a day to day basis | 43. Total quality management techniques |
| 21. Flow of information within the project site and the concerned parties | 44. Prefabrication and standardization |
| 22. Leadership and team working skills | 45. Worker motivation programmes |
| 23. Technical competence of the team members | 46. Buildability of design |
| | 47. Construction methods adopted |
| | 48. Long term strategic planning |
| | 49. Communication |
| | 50. Delegation |
| | 51. Design changes |
| | 52. Quality control |
Table 6.5 Skills of more than 30% ratings of relevancy

<table>
<thead>
<tr>
<th>Skills</th>
<th>Rating</th>
<th>Skills</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Planning and scheduling</td>
<td>97.3</td>
<td>27. Cash flows</td>
<td>65.1</td>
</tr>
<tr>
<td>2. Construction management activities</td>
<td>89.1</td>
<td>28. Investment appraisal</td>
<td>33.0</td>
</tr>
<tr>
<td>3. Basic technical and knowledge in own field</td>
<td>94.5</td>
<td>29. Project management software</td>
<td>75.6</td>
</tr>
<tr>
<td>4. Productivity and cost control</td>
<td>82.7</td>
<td>30. Spreadsheet software</td>
<td>59.3</td>
</tr>
<tr>
<td>5. Forecasting techniques</td>
<td>74.5</td>
<td>31. Computer aided design</td>
<td>55.8</td>
</tr>
<tr>
<td>6. Quality control</td>
<td>72.7</td>
<td>32. Data base software</td>
<td>34.9</td>
</tr>
<tr>
<td>7. Estimating and tendering</td>
<td>70.9</td>
<td>33. Information technology tools</td>
<td>33.7</td>
</tr>
<tr>
<td>8. Material procurement</td>
<td>65.5</td>
<td>34. Draft contracts and negotiations</td>
<td>92.4</td>
</tr>
<tr>
<td>9. Reading and understanding drawings</td>
<td>62.7</td>
<td>35. Health and safety law</td>
<td>76.2</td>
</tr>
<tr>
<td>10. Design activities &amp; background</td>
<td>59.1</td>
<td>36. Industrial relations</td>
<td>57.1</td>
</tr>
<tr>
<td>11. Site layout and mobilization</td>
<td>54.5</td>
<td>37. Preparation of claims and litigation</td>
<td>55.2</td>
</tr>
<tr>
<td>12. Technical writing</td>
<td>49.1</td>
<td>38. Trade Unions and public authorities</td>
<td>33.3</td>
</tr>
<tr>
<td>13. Leadership skills</td>
<td>98.2</td>
<td>39. General law background</td>
<td>35.2</td>
</tr>
<tr>
<td>14. Delegation</td>
<td>96.4</td>
<td>40. Presentation skills</td>
<td>95.3</td>
</tr>
<tr>
<td>15. Negotiation techniques</td>
<td>95.5</td>
<td>41. Correspondence and memo writing</td>
<td>90.6</td>
</tr>
<tr>
<td>16. Decision making techniques</td>
<td>91.8</td>
<td>42. Report writing</td>
<td>88.7</td>
</tr>
<tr>
<td>17. Motivation and promotion</td>
<td>90.0</td>
<td>43. Public speaking</td>
<td>74.5</td>
</tr>
<tr>
<td>18. Team working skills</td>
<td>90.0</td>
<td>44. Chairing meetings</td>
<td>96.1</td>
</tr>
<tr>
<td>19. Time management</td>
<td>82.7</td>
<td>45. Understanding of organisation</td>
<td>84.5</td>
</tr>
<tr>
<td>20. Top management relations</td>
<td>81.8</td>
<td>46. Marketing and sales skills</td>
<td>50.5</td>
</tr>
<tr>
<td>21. Human behaviour</td>
<td>76.4</td>
<td>47. Public relations</td>
<td>49.5</td>
</tr>
<tr>
<td>22. Strategic planning</td>
<td>60.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23. Recruitment</td>
<td>44.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24. Establishing budgets</td>
<td>94.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25. Reporting systems</td>
<td>90.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26. Project finance</td>
<td>74.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The respondents have also contributed to our survey by highlighting the following skills:

- quality assurance;
- set goals on what is needed from computers;
- insurance;
- financial cost control;
- enthusiasm;
- safety management;
- total quality management (TQM);
- change control;
- spelling and English grammar;
- listening skills;
- personal skills (i.e. communications, diplomacy, common sense);
- budget risk;
- reference books.

By comparing the factors listed in Table 6.4, then relevant skills of the project manager obtained from our survey, as listed in Table 6.5, and the contributions of the participants, we can notice the strong association between the performance factors and the skills required by the successful project manager. This association implies the following:

1. In order to enhance performance the construction project manager must acquire most of these skills. This was very clear from the comparisons of performance factors and skills.

2. Management skills were highly relevant to the construction project manager's job. This was strengthened by the findings of the literature review and the findings of our survey.

3. Skills and factors discussed earlier could be divided to cover the following areas of knowledge:
   - technical;
   - managerial;
   - financial;
   - legal;
   - communications; and
Accordingly, we can conclude that our earlier arguments are valid. Generally speaking, one of these arguments was concerned with the need for general education, training and experience of construction project managers. As we have seen the case with the large construction site. The strong technical background can affect the role of the site manager. He spends most of his time on technical matters and ignores other important aspects of his job. Nevertheless, this does not mean that the technical background of the project manager is secondary, but it shows that there is a balance which must be achieved between the technical and managerial background.

4. This relationship provides other supporting evidence to reliability of our survey and the reliability of its contents. It also proves the validity of the contributions provided by the successful project managers.

5. All the concerned parties must take these performance factors and the skills required for project managers into their consideration for successful performance and more importantly for better qualified human resources. The crucial message is that the human resources are the most valuable assets for the organizations and for society at large.

9. CONCLUSIONS

1. The need for management knowledge and skills is of paramount importance for the construction project managers.

2. The need for technical knowledge and skills is not diminished at all the stages of the project manager's career. There are crucial technical decisions to be taken by the project manager. Accordingly, he/she should competently understand the likely consequences of his/her decisions. Furthermore, these decisions and anticipated consequences are not evaluated on the technical basis alone. Other issues must be taken into consideration. These issues are very broad but could include the following aspects:
   - management;
   - financial;
- environmental;
- social;
- legal, etc.

3. Construction project managers have a very complex role. Hence, this role requires a broad base of knowledge and skills. Throughout the discussions in this chapter it was evident that in order for the construction project manager to achieve successful performance records, he/she must possess a large number of skills and knowledge. Our survey has established the portfolio of skills and knowledge required for the successful construction project managers provided by successful project managers employed by successful organisations.

4. It was evident from the research report\(^{(13)}\) that there is a great demand for management education and training. Our survey shows that the larger proportion of full-time and part-time training records were geared towards management and business issues. Engineering educational establishments and professional Institutions must take this into their consideration in order to produce better, competent and qualified engineers. These engineers, as it has been established in our survey, are the most likely people to occupy the posts of construction project managers. Employers must ensure that their engineers are prepared early enough in their career for a later highly demanding and leading job. Employers must also ensure that their employees' knowledge and skills are regularly updated. In one study, published in 1991, it has been emphasised\(^{(12)}\) that it is necessary to improve technical and managerial competence, recognizing the two capabilities as being interwoven and complementary.

5. The research report\(^{(13)}\) has provided another supporting evidence that UK construction companies are not offering enough education and training programmes to their employees. This was the case for a large construction company in the UK, similar in size to most of the organizations employing our successful project managers. The question raised is "if this is the case for one of the largest construction companies, is the situation better for the smaller companies?" Unfortunately, the picture is not clear and an answer is desperately needed. Other countries, such as France, are in a better situation to
answer this question. At least France has a law to ensure that employees are offered the chance to obtain further education and training. This was previously discussed in Chapter Five.

6. Educational establishments are able to contribute to the construction industry. But we lack the appropriate links to build a firm base of cooperation and collaboration. This is a two way learning process. The industry will benefit from the research findings and, accordingly, educational establishments will benefit from the valuable experience of the industry and vice versa.
REFERENCES - CHAPTER 6


13. O'Connor, M.J., "Research report on a large construction site", Loughborough University of Technology, Business School, 1991. A copy of this report was provided to be used in this thesis on the basis of research use only.
CHAPTER 7

IN SEARCH OF EXCELLENCE

1. INTRODUCTION

This chapter comprises a further investigation of the factors contributing to the successful completion of construction projects.

Following the previous discussions in Chapter two, the findings of our survey, and the discussion of performance in construction in chapter Six, it was decided to carry out an analysis of the key factors that have contributed to the successful completion of six recently completed major projects.

The aims of this analysis are:

- to highlight the key factors that have contributed to the successful completion of these projects on the basis of comparative study;

- to achieve a firm base on which skills and knowledge, required for construction project managers, can be identified.

This is another attempt to verify the findings of our survey. Accordingly, we can draw a firm conclusion on the most required skills and knowledge for construction project managers.

This chapter is organised in a structured way, to highlight briefly the key factors that have contributed to the successful completion of the projects.

I was given the chance to attend a conference in Germany as a delegate from Loughborough University of Technology. This was a great opportunity offered to me by the European Construction Institute. This gave me the opportunity to discuss these factors with the delegates who delivered the papers. Some of the comments included were obtained from the discussions in the conference. Other comments were obtained through the European Construction Institute.
2. BACKGROUND TO THE STUDY

The European Construction Institute's second international conference was held at Wiesbaden in Germany on 7-8 November 1991. A main feature of the conference was the critical examination of six recently completed major projects. The projects were examined from both the Client and Contractors' viewpoint and the respective presentations highlighted the critical success factors in each case.

The following appraisal sets out to review the key factors in each case, analyse the reason for their importance and to determine the conclusions which can be drawn for the successful completion of similar projects in the future.

The projects presented for review were:

(a) Lavera Cracker Expansion Project: constructed in France for Naphthachemie by Technip.

(b) Melamine 3 Project: constructed in Holland for DSM Chemical by ABB Lummus Crest BV.

(c) Ethyl Benzene Project: constructed in England for Shell UK Ltd by Fluor Daniel Ltd.

(d) Refinery Expansion Project: constructed in France for Total by Sofresid-Heurtey Industries.

(e) LLDPE Plant: constructed in Germany for Erdol-Chemie by UHDE.

(f) Terephthalic Acid Plant: constructed in Holland for Amoco by Technologie Progetti Laveri SPA.

All of the above projects were completed in 1991.
3. **OVERVIEW**

The projects reviewed ranged in size from $54m to $116m, but all were of similar complexity and on average took some two years to complete from start of detailed engineering.

The need for care in the feasibility phase together with attention to the pre-planning of works was highlighted as a critical success factor in all cases.

Four of the projects were expressly executed utilising a 'fast track' approach highlighting the increasing trend towards the adoption of such a contract strategy where the Client has an urgent need to bring plant on stream at the earliest possible date to take advantage of a commercial opportunity for the product.

Two of the projects were executed on a lump-sum turnkey basis while the remainder were generally implemented on the basis of reimbursement for detailed engineering, procurement and construction management.

Extended relationships between Client and Contractor, whether or not within a formal partnership arrangement were highlighted by several presenters as being a key issue in the ultimate success of projects, together with good team work and a spirit of co-operation between all parties concerned, including sub-contractors and suppliers.

Safety awareness was given high priority in all the presentations, together with the means of encouraging safety at all levels by the introduction of safety bonus schemes. This trend is increasingly welcome in an industry which until now has not always had a satisfactory historical safety record.

The following is a resumé of success factors as they relate to the various phases of each of the projects appraised. For the purpose of analysis several essential factors associated with projects have been selected. These are:

3.1 Feasibility
3.2 Funding
3.3 Engineering
3.4 Contract
3.5 Planning and Procurement
3.6 Control
3.7 Safety

Each of these areas will be followed by the relevant key issues raised in the presentations.

Table 7.1 at the end of this chapter summarises the major key issues for all the projects undertaken in this study for each of the above mentioned key areas. Highlights of the major issues raised in each presentation are included in this table. The table also contains the approximate value of each project and the construction period. Construction periods for three projects were not included although several attempts were made to obtain them from the presenters.

3.1 Feasibility

Feasibility begins with an analysis of the strength and durability of the product market and extends to an analysis of all of the factors that might facilitate or constrain the completion of a plant in time to take advantage of the market. Among the factors to be considered will be the availability of finances; of a suitable site with little prospect for planning delay and adequately served with all necessary services and access, an availability of skilled labour, material and equipment.

To be successful the parties to any project must (except where the success has been merely a matter of good fortune) have conducted the feasibility analysis in a thorough and rigorous manner. The clear message from each of the projects considered here was that great emphasis was given to defining the basic pre-conditions to their successful completion. It is worth summarising salient features from three of the projects in illustration of this as follows:

(a) Lavera Cracker Expansion Project

Details not presented.
(b) **Melamine 3 Project**

- This was the first plant out of service for several years. Plant number 2 started up in 1970 with a design capacity of 30,000 tons/year and in the meantime has been debottlenecked to 40,000 tons/year.

- Plant number 3 was planned to be adjacent to Melaf-2 and to use a number of common services, such as control room, product storage and packaging facilities.

- Experience gained from the long-term involvement in the market, and in the industry generally, helped the client to take the lead and execute the projects. Accordingly the successful cooperation with contractors initiated a new era of partnership relations.

(c) **Shell Ethyl Benzene Project**

- The 400 hectare site in Stanlow had in excess of £1 billion of installed petrochemical plant in operation prior to the installation of the ethyl benzene project. Such congestion introduces many logistical problems. A further complication was the utilising of licence packages, provided by Badger but augmented by Shell technology.

Another significant factor was a temporary weakening of the product market which caused the budget for the project to be reduced by a significant amount.

This was however the fifth major project to be built on the site in a decade - the third to be executed by Fluor Daniel. The contractor's capability was well known to Shell and the characteristics of the labour force well understood.
(d) Refinery Expansion Project
- The complex was intended to supply a growing market for unleaded gasoline.
- Time for implementation was to be reduced to a minimum by utilising the latest technology in the process industry.

(e) LLDPE Plant
- The presenter stated that the feasibility studies are too frequently considered on the economical evaluation only. But there you have the first overlap time schedule of the project. The starting point is open and a number of uncertainties are included (especially the waiting time for the governmental approval).
- Preparing the process concept to find out:
  - which parts of the plant are connected with each other by product streams
  - which parts are necessarily operated together
  - which parts have the same products and risks
- Site connections are to be considered which might result in changes to the plant layout.
- Plant layout is essential. This layout will provide many benefits for the total life time of the plant as well as highlighting the parts of the plant which can be operated independently.

(f) Terrephthalic Acid Plant
As the review of this project was presented by the contractor, no highlights were given on feasibility projects.

Key Issues

1. Increasing demands, as a result of market study feedback of a certain product, creates opportunities for new ventures and consequently convinced clients and vendors to raise funds for the fast track implementation of projects to obtain maximum benefit from market opportunities.
2. The possibility to use common services such as control room, product storage and packaging facilities should be considered during the feasibility phase.

3. There is obviously a clear time scale advantage where the Client already owns or controls the proposed development site.

4. The time required for any Governmental approvals can be slow and time consuming and must be addressed early in the consideration of any project if delays are to be avoided.

5. Three major activities are essential at the feasibility stage, as follows:
   • process concept
   • inter-connection with existing facilities
   • agreement of plant lay-out

   It is important that these are taken into consideration at the feasibility study phase and it is also important to stress the fact that with minor modifications it could be successfully applied in the construction industry. Accordingly, it will enhance the effectiveness of long term planning strategy.

6. Using the latest available process technology, on the basis of off-the-shelf available packaging, to meet the realistic growing demand imposed by the market may result in considerable time savings.

3.2 Funding

It is obvious that projects of this nature require large amounts of funds to be made available. Accordingly, it is essential to identify the realistic cost of such projects beforehand, together with the range of the estimate. This cost estimate can be refined at a later stage but should be kept within the tolerance of the original estimate. The main sources of such estimates are the historical data coupled with an estimate of design, construction and commissioning manpower required for the implementation of the particular project, and should take inflation and market activity into account.

The main elements of the funding requirements are:
. Preliminary finance, to include feasibility study, design and other early phases.

. Construction finance, to include construction expenditure.

. Contingency finance, to pay for cost overruns.

The presentations raised the following issues:

(a) *Lavera Cracker Expansion Project*

This is a joint project involving BP Chemicals, Naphtachimie, and Atochem.

- The estimated and realised man-hours and quantities shown in the table give an idea of the anticipated variations.

- Budget update is frequently done and commitments outside the original budget were transferred from pure revamp work to new work.

(b) *Melamine 3 Project*

- The DSM MELAF 3 project execution involved a total investment cost for the Lummus part in the region of NLG 150 million.

- The project was awarded after a round of competitive bidding based on unit man hour rates and executed according to a tightly controlled budget.

(c) *Ethyl Benzene Project*

- Evaluation of the cost estimate provided by the central office to the regional office.

- Identifying the areas of savings. The two major ones were: reducing the management layers and avoiding duplication; and
improving erection contractor effectiveness. The result was an underrun of over £3 million on the total budget of £57 million.

- Shell have devised a system which produces quantified construction man hour data such as man-hours per cubic metre of concrete.

(d) **Refinery Expansion Project**

- This complex, with the off-sites, represents a total investment of 300 million French francs.
- Engineering proceeded along the S-curve planned.
- The cost of the construction represents about two or three times the price of the equipment.

(e) **LLDPE Plant**

- Investment around 200 million DM.
- Breakdown of investment amount will help as a database for future similar projects.
- Licence bought from BP.
- Contributions to keep the budget started with the proper calculation and continued with purchasing decisions.

(f) **Terephthalic Acid Plant**

- The total cost was over 100 million US$.
- Project expenses split among nine currencies.
- Overall cost within original budget.
Key Issues

1. Budget evaluation and updating throughout the project.

2. Identifying the areas of saving.

3. Building an effective database system for future projects and updated as appropriate. Feedback is an essential practice.

4. Implications of different currencies.

5. Cost of purchasing the required licence.

6. Proper calculation continued with adequate purchasing decisions.

7. Planned S-curve will help in producing a clear picture. An interactive approach is essential.

8. The cost of construction represents a substantial amount of the total cost of the project.

3.3 Engineering

In the construction industry, engineering represents an important issue for both the client and the contractor.

The conference raised many crucial issues and highlighted the major factors as prerequisites for successful completion of the construction projects as well as building the basic guidelines for further advancement in that industry, as follows:

(a) Lavera Cracker Expansion Project

- Manage the plant specification released from process control of process activities schedule by project.

- Reduce the pure revamping part as much as practicable.
• No significant impact on major equipment delivery as a result of late basic design.

• Drastically decrease the number of flange connections on the cryogenic lines by identifying the assembly requirements, carbon faced joints, control of lighting etc.

(b) Melamine 3 Project

• The implementation of some process improvements helped in upgrading the initial capacity of the Plant from 30,000 to 50,000 ton/year.

• Ensuring consistency and compatibility within the complex was required. DSM's own engineering have provided most of the engineering and construction specification, to ensure that.

• Continuous research and development in order to reduce maintenance, reduce corrosion and improve operating performance resulted in the application of duplex stainless steel.

• The integration of the design of a plant with an existing plant, which was operating continuously, highlighted an important feature. This was the effective utilisation of the planned maintenance shut-down for tie-ins.

• It was agreed that when the answer was dependent on a test to be performed, a tie-in still to be detailed, discussion not yet confirmed from a supplier etc, Lummus and DSM Engineering managers would make a decision based on their knowledge of the situation, and the most likely outcome. In this way, design progress was not hindered for changes had to be made at later stage.
(c) *Ethyl Benzene Project*

- Long term relationships are the basis for improvements. In the instrument areas alone, 140 items of improvement were identified leading to improved design, reduced work and cost savings.

- Continuity of people in the design and construction teams as a result of long term relationships helped in producing a cost-effective design.

- Detailed reviews of learning points from the previous projects contributed to performance improvements.

- Use of full 3D CAD systems in design as a direct result of the learning curve over three projects.

- Attention to plot layout to suit construction. This helped to save half the area anticipated to build this plant.

- Standards, procedures and specifications were jointly established and translated to the new project with resultant economies.

- In this framework, extensive participation of client specialists were welcomed in early design reviews, but as the design progressed, client changes were actively discouraged by Fluor Daniel and Shell project management.

(d) *Refinery Expansion Project*

- Installation of a proven system to reduce the equipment purchasing cycle to a minimum.

- High emphasis on the quality of engineering. Assessment of the difficulties must be made at the time of the invitation to tender.

- Clear identification and understanding of stipulated conditions in the specifications.
• Difficult construction due to the enclavement of the complex in the refinery.

• Very rainy area raising problems for final painting and thermal insulation work.

• An integrated task force in all disciplines in addition to personnel with recent experience with the client.

• Proven computer-aided design and computer drafting systems.

c) LLDPE Plant

• Comprehensive consideration of plant and site layout is crucial in identifying difficulties and ensuring the practicality of the design.

• Use of modularisation technique at the design stage, coupled with successful plant layout, enhanced the effective execution of the project throughout its stages. This will contribute to the operational life cycle of the plant.

• Effective feedback on anticipated uncertainties for the project to the responsible people to provide complete files to obtain the Government's approval.

f) Terephthalic Acid Plant

• The extensive use of various prefabricated, pre-assembled and pre-insulated items defined at the engineering stage. This was approached by maximising:

  - shop prefabrication of piping
  - use of forged steam and condensate manifolds to reduce welds
  - use of pre-insulated tracer feeders to reduce welds
  - pre-assembly of control room equipment and wiring
- shop priming of pipe and steel structures
- off-site prefabrication of foundations, ditches and concrete pits
- fireproofing shop installation

- Highly reliable detailed basic design by Amoco, right from project start.
- Flexibility in change order management to minimise their disruptive impact.

Key Issues

1. Long term relationships are the basis for improvements as well as being a key for success.

2. Review of learning points from previous projects.

3. Use of 3D CAD systems proven to be successful.

4. Complete plot-layout is essential.

5. Participation of client and contractor representatives at the design stage will reduce changes at later stages.

6. Clear identification of decision-making strategy among all parties involved.

7. Engineering design to minimise construction work on-site whenever applicable.

8. Use of modularisation concept at the design stage where applicable. Operational life cycle should be taken into consideration at the design stage.

9. Installation of proven systems according to time constraints.
10. Continuous search for areas of improvements in entire cycle of the project.

11. Ensuring consistency and compatibility within the complex.

12. The implementation of effective techniques or developments at the design stage in order to reduce maintenance, reduce corrosion and improve the operating performance according to the appropriate investment appraisal adopted.

3.4 Contract

Many circumstances will influence the type of contract to be chosen. Nevertheless, there is a clear indication of the growing concern for reimbursable contracts on a fast-track basis. The following are highlights of the presentation:

(a) *Lavera Cracker Expansion Project*

- Reimbursable contract well suited for plant revamping.
- Performance evaluation of suppliers, contractors and sub-contractors.

(b) *Melamine 3 Project*

- The project was awarded after a round of competitive bidding based on unit man hour rates for detailed engineering, procurement and construction management, and a proposed execution plan.
- The type of contract between DSM and Lummus was reimbursable services for engineering, procurement and construction management on the agreed scope of work, at a minimum rate per category of person.
- An incentive scheme was agreed, covering the following incentive:
- an incentive scheme for performance
- an incentive scheme for safety
- an incentive scheme for meeting the target budget

These special clauses were built into the contract to ensure that both parties cooperated to achieve efficient project execution.

- Although it was not specified in the contract, there was an agreement that minor changes would not be submitted, and consequently no change would be made to the budget estimate for such changes, with the exception of those relating to safety.

- The sub-contracts were awarded a lump sum based on an agreed scope, with unit rates for variations.

- Selection of sub-contractors was done by pre-qualifying at least four by means of a questionnaire and visiting the management and workshops.

The bidding was done in two stages:

Stage 1: An engineering package, with the most up-to-date information to allow bidders to quote fixed price and unit rates.

Stage 2: After evaluation, one or two bidders were asked to update their prices based on the more detailed package, which was by then available.

(c) *Ethyl Benzene Project*

- The project was managed on a fast-track basis.

- Fluor Daniel was engaged as the managing contractor who was responsible for detailing the project definition, engineering design, procurement and the management of construction on a cost reimbursable basis with profit related to target variables such as safety, industrial relations, productivity cost and time.
Design reviews and checks of the contractors’ work were carried by Shell people.

The contracts were set up with labour reimbursed at cost and contractor’s profit linked to performance on safety, quality, schedule and overall cost.

With the exception of the steelwork contract, all construction contracts were negotiated. All contractors used had previously worked with Shell and Fluor Daniel at Stanlow.

Incentives and penalties were included for quality performance in the field.

Proven suppliers/sub-contractors were employed, who had a known track record. They became part of the partnering concept as a result of using a ‘win-win’ contracting policy.

(d) Refinery Expansion Project

A lump-sum turnkey contract which represents 105,000 man-hours of engineering, to be completed in 18 months, including 12 months of construction.

The project organisation was set up for a fast-track project.

The assessment of the difficulties and risks were made prior to the time of the invitation to tender.

(e) LLDPE Plant

The suppliers have to accept detailed time schedules which include the allowances for the client’s own inputs. This should also include all their sub-suppliers’ schedules.
Terephthalic Acid Plant

Highlighting the required care by the client in transferring adequate understanding of scope of work to bidders on the basis of lump-sum turn-key contract type. The points discussed were:

(i) Detailed bid brochure, incorporating experience on previous projects.

(ii) Visit by the client management to bidders:

• to check correct approach with client’s requirements

• to discuss preparation of technical proposal

(iii) Verification of bid brochure content deferred to project execution phase.

(iv) Client questionnaire on critical and unclear areas.

• after an international competition among four bidders a lump-sum turnkey contract was signed with TPL

• TPL was responsible for detailed engineering, procurement, construction and pre-commissioning

Key Issues

1. Clearly agreed incentive schemes are to be agreed in order to ensure efficient execution of cost-reimbursable fast-track projects.

2. Client and contractor should highlight the major aspects of the projects and clearly approach a mutual agreement on the execution strategy.

3. Effective use of cost reimbursed contracts linked to performance on safety, quality, schedule and overall cost. The result was that adversarial relationships did not develop and the construction contractor’s objectives were aligned with the project objectives. Cost and time achievements versus targets would be valuable.
4. Keeping track records for contractors, sub-contractors and suppliers.

5. Reimbursable contracts are well adapted for plant revamping projects as well as for the process industry in general.

6. Transferring adequate understanding of scope of work to bidders.

7. Suppliers and sub-suppliers have to accept detailed time schedules which should include the client's allowances of input.

8. A lump-sum turnkey contract could be exercised on a fast-track basis.

9. An agreed strategy for urgently required decisions.

10. A clear strategy for handling the changes requested to avoid delays.

11. Ensuring open channels of communication among all the parties involved.

3.5 Planning and Procurement

Planning is one of the most important issues. It must be based on clearly defined objectives. Accordingly with proper planning, resources are available at the right moment, adequate time is allowed for each stage in the process, and all the activities start at the appropriate times.

Procurement strategy is closely linked to the success or failure of a project.

Timely delivery of material is risky and initiate disrupt to the plans. Procurement and planning were combined under one heading for emphasizing the importance and the close link between them.

Planning and procurement were the central themes of all the projects and all the presentations at the conference contributed valuable messages for the successful execution of these projects. It could be realised that planning and procurement were the most crucial activities that played an important role at all stages of the projects. The major issues discussed were:
(a) *Lavera Cracker Expansion Project*

- Process activity schedule has to be controlled by the project manager.
- Reduction of the pure revamping part as much as practicable.
- Make all the best efforts to maintain the 'Lavera spirit':
  - permanent top management support
  - personal commitment of everybody involved
  - common objectives for all parties

(b) *Melamine 3 Project*

- Engineering personnel of both parties worked very closely to ensure the completion of tie-ins during the two weeks maintenance shut-down.
- During the first bulk take-off, allowances for piping material were generous. This was enhanced by good delivery from suppliers to make sure that there was always material available for prefabrication. Computerised inventory control system monitored this availability on site and the sub-contractor was given a weekly report on disc to be used with his own automated pre-fabrication and erection planning system.
- The existing cooling tower had to be kept operating while additional steel, bracing was added and equipment installed around it.
- A detailed structural steel and equipment erection procedure was prepared defining sequence and provision for horizontal or vertical ingress of equipment. The procedure was translated into weekly schedules through weekly coordination meetings.
- Commercial provisions were made and applied in the piping sub-contract for 'late start' while maintaining completion dates.
The decision for late start was taken in order to ensure drawing and material availability.

- Overtime and weekend work took place as a result of serious craft and labour shortages.

- An acceleration programme was set up for one of the sub-contractors.

- A float of six weeks was built in in the planned curve used for monitoring progress. The final completion used a proportion of this float.

- Provision was made to ensure the availability of foundries who could meet the specification of the duplex stainless steel.

(c) Ethyl Benzene Project

- Soliciting input from the erection contractor contributed to cost savings.

- Completion of one significant step before commencing a second. Requirements for each and every activity were specified and only when accomplished the gates were opened for the next.

- Continuous feedback and improvements will lead to a shorter schedule and reduced costs.

- Allowing the construction contractors to review and plan on the basis of mutual trust.

- Accurate and early identification of critical path equipment and materials. Orders were placed prior to full project sanction with a cancellation charge provision.

- Timing and phasing of construction work.

- Planning of plant start-up.
The reduction in plot area allowed space for good temporary facilities adjacent to the construction site.

Access for heavy lifts to avoid complexity on-site. Accordingly, consideration of equipment scheduled to arrive late should be taken into account.

Using the 3D CAD system reduced the time for the drawings. The automatic generation of bills of material provided continuous review of material requirements and the ability to deliver materials to suit the construction schedule, with a minimum of surplus

Ensuring complete certification of material and equipment before their arrival on-site by arranging the required checks prior to works release.

Mobilising contractor is to be avoided until adequate materials are made available on-site. The assessment of material availability was detailed for each construction area.

The construction schedule planned to reduce contractor interfaces to a minimum.

The construction plan was consistent with Shell's start-up plan ('start-up driven' not just 'construction driven').

Identifying the test systems and the sequence of handover at the design stage so that construction schedules would take this into account.

(d) *Refinery Expansion Project*

- Tight 18 months schedule.
- Immediate orders for long delivery equipment.
• Extreme weather conditions. Sofresid-Heurtey had to gather daily information from the National Meteorological in order to adjust their planning accordingly.

• Holiday season and placement of orders.

• Clear identification of all the difficulties involved.

• Detailed planning schedule drawn immediately after the columns delivery date was known.

• Completion of the underground piping and civil works within the crane area.

• For the operation on the columns, the schedule was analysed day-by-day and task-by-task.

(c) LLDPE Plant

• Start the detailed engineering and purchasing of the main components and long delivery items.

• Erection time on-site should be extensively revised in the case of special machinery, delivered in the main process components. Additional measures are required for special optical alignment. In this case the influence the temperature fluctuation should be taken into account.

• Detailed time schedules should be given to suppliers and their sub-suppliers which should also include allowances for the client's construction plan, to ensure complete delivery.

• Identification of activities that could be done immediately without the governmental approval and according to the local legislation.

• A contribution to meet the budget is to get the freezing point for the project as early in the schedule as reasonable.
**Terephthalic Acid Plant**

- Highly reliable detailed basic design by Amoco right from project start.

- Heavy backlog at equipment suppliers: potential delays in site deliveries.

- Shortage of qualified construction labour in Antwerp area due to numerous site start-ups.

- Prevalence of special materials for equipment and piping.

- Plant vertical configuration involving:
  - close concentration of equipment
  - non-standard civil structural steel design
  - limited flexibility for erection solutions

- Construction-driven project schedule.

- Comprehension of project priorities.

- Short cut procurement planning:
  - reduced vendor selection time by:
    - using proposals received during project bidding
    - direct negotiation with pre-selected vendors
    - pre-ordering of critical items
    - early Amoco indication of preferred/recommended vendors

- Flexibility in change order management to minimise their disruptive impact.

**Key Issues**

1. Effective feedback on all activities.

2. Participation of all parties involved in reviewing the plan.
3. Identification of critical path equipment and materials.

4. Placement of orders as soon as applicable.

5. Effective timing and phasing of construction work.

6. Consideration of plot layout area for all activities.

7. Application of computerised software to enhance efficiency.

8. Certification of material and equipment to be carried out as early as practically acceptable.

9. Ensuring availability of materials and equipment before mobilising contractors.

10. Reducing interfaces on-site.

11. Early identification of test systems and handover sequence for effective consideration at the planning stage.

12. Permanent top management support.

13. Personal commitment of everybody involved.


15. Generous allowances of materials during the bulk take-off.

16. Reliable detailed basic design.

17. Effective comprehension of project priorities.

18. Short cut procurement planning.

19. Consideration of all circumstances which are likely to cause disruption for the plan.
3.6 Control

Setting realistic objectives requires effective control systems. Right from the start of any project a successful approach to success is the establishment of realistic budgets and when these targets are approached updating procedures are essential to achieve excellence. They might be increased or decreased according to many different inputs within the organisation or from the world at large.

The lessons provided were:

(a)  *Lavera Cracker Expansion Project*

- Breakdown of project activities. Accordingly, comparison could be established. This included the realised man-hours and quantities against the estimated ones.

- Comparing erection progress against the established S-curve.

- Budget is updated and revised.

(b)  *Melamine 3 Project*

- Incentives for achieving the milestones were made to ensure that progress was maintained on or ahead of schedule. Incentive schemes for performance aspects were agreed, with the evaluation resting with the principal, DSM. These aspects covered such subjects as accuracy of engineering, the frequency and quality of inspection, the quality of expediting of suppliers, planning and finding ways to avoid delays, cost consciousness and smooth start-up.

- An agreed target budget price based on a control estimate covering the total cost of all work not done by DSM. The target was agreed mutually and there was a sharing in the underrun.
• Commercial provisions were made and applied in the piping sub-contract for 'late start', while maintaining completion dates.

(c) Ethyl Benzene Project

• Through the devised system, which procedures quantified man hour data, it was possible to compare actual production against plan and one plant against another.

• Using the physical progress method. This helped in giving a real indication of early warnings. Productivity data added another dimension, whereas cost data was the third basic yardstick.

• Detailed reviews of learning points from the previous project with action plans to continuously improve performance.

• Establishing a realistic control estimate and monitoring deviations. In order to get the project sanctioned early, the capex estimate was produced early. That entailed extensive use of in-house cost data and cooperation with contractors on anticipated field labour costs. Allowances for delivery incentive payments were included to reduce the uncertainty in the estimate.

(d) Refinery Expansion Project

• Proven project control programmes.

• Project audits every three months.

• Meetings were held monthly until completion detail engineering.

• Dynamic works supervision checked that every task was performed on time and at the required level of quality.
(e) **LLDPE Plant**

- A special programme made to integrate the authority's people at an early preparation stage of the files. Government approval was obtained after six months as a result.

- Proper calculation and purchasing decisions contributed to keeping to the budget.

- Adjustment of labour and hardware costs to eliminate deviations according to the realised rate of inflation.

(f) **Terephthalic Acid Plant**

- Overall cost within original budget.

- Completion under tight schedule.

- High quality.

**Key Issues**

1. Comparing the actual production against plan.

2. Physical progress method helped in giving an indication of early warnings.

3. Review of learning points from the previous projects to improve performance.

4. Establishing a realistic control estimate and monitoring deviations.

5. Updating of budget as applicable.

6. Implementing incentives to enhance performance.

7. An agreed target budget based on a control estimate provides an additional incentive in cost reimbursed contracts.
8. Commercial provisions are to be made and applied to maintain completion on time.

9. Quality awareness throughout the project.

10. Proper calculation and adequate purchasing decisions are indispensable to keep to the budget.

11. Inflation awareness.

12. The implementation of proven control systems whenever applicable.

3.7 Safety

The construction industry has a grim history regarding safety on-site. The following are issues raised:

(a) *Lavera Cracker Expansion Project*

- The hot work during the plant run before the shut-down.

- Intensive work on scaffolding or high level platforms during the shut-down.

- 27 safety agents for prevention of accidents.

- Safety challenge for contractors during the shut-down period.

(b) *Melamine 3 Project*

- The agreed incentive scheme was that Lummus should manage the construction contractors on-site to ensure a safe construction programme and achieve an excellent safety record throughout the construction of the project.

- Educate safety in all workers and contractors.
Promote safety awareness.

Give incentives for safe working.

Each person working on-site has a safety instruction period prior to receiving an entry badge.

There was a weekly meeting on safety with all supervisors of the contractors, and daily contact with the safety officers of the large contractors.

A permanent safety officer was required from any contractor having over 50 members of staff.

There was a monthly prize draw in order to increase safety awareness among workers. Small momentos were distributed to all workers. Seven draws were held and senior management participated to emphasise the importance of safety.

(c) Ethyl Benzene Project

A target was set to achieve no serious injuries, no lost working days, and not more than five medical treatment cases.

Cleanliness of the site.

Safety was planned proactively. Induction videos and safety booklets were produced and updated monthly for every employee on-site. Regular toolbox meetings were held. Special measures were taken to achieve excellent housekeeping. Regular audits were undertaken and any near misses were thoroughly analysed.

The involvement of the labour force, which became increasingly excited by the success.
• Positive reinforcement at individual, company and project levels were maintained using shield competition posters, bonuses and peer group pressure.

• The electronic records were used for payroll and could give an accurate record of employees on the site in emergencies.

(d) Terephthalic Acid Plant

• Total safety throughout.

• Safety record: over 400,000 safe man-hours.

(c) LLDPE Plant

Meetings with individual employees responsible for the judgement of safety concepts and other critical areas.

(f) Refinery Expansion Project

Observance of safety rules.

Key Issues

1. Setting of safety targets and promote awareness.

2. Cleanliness on the site.

3. Safety education for all.

4. Regular meetings for safety officers.

5. Effective channels for communication among safety people.

6. Understanding of safety highlights and anticipated risks for each project.
7. Incentives for safe working.


4. CONCLUSIONS OF THE STUDY

While all projects are unique a number of key issues were identified which contributed to the success of all the projects.

These may be summarised as follows:

a) Careful planning at the feasibility stage.

b) Preparedness to learn from past experience by updating of databases.

c) Clear definition of client's requirements.

d) Clear contract strategy and execution plan appropriate to the project.

e) Cooperation between Client and Contractor to ensure the achievement of mutual aims.

f) Good project team work and communication with the project team at all levels.

g) Attention to safety aspects. The use of incentive schemes where appropriate.

h) Identification of potential problem areas.

i) Firm change control procedures and a preparedness to challenge change to ensure fitness for purpose.

j) Progress measurement to ensure completion on time.
Table 7.1 Comparison of key issues raised in the presentations

<table>
<thead>
<tr>
<th>Discussed Factors</th>
<th>Lavera Cracker Expansion Project</th>
<th>Melamine 3 Project</th>
<th>Ethyl Benzene Project</th>
<th>Refinery Expansion Project</th>
<th>LLDPE Plant</th>
<th>Terephthalic Acid Plant</th>
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<tbody>
<tr>
<td><strong>Feasibility</strong></td>
<td>N/A</td>
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<td>Highlighting</td>
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<td>study</td>
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<tr>
<td><strong>Funding</strong></td>
<td>Updating of budget</td>
<td>Tightly controlled budget</td>
<td>Efficient updating of budget</td>
<td>Planned S-curve</td>
<td>Licence from BP</td>
<td>Project expenses split among nine currencies</td>
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<tr>
<td><strong>Engineering</strong></td>
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<td>Effective feedback on uncertainties anticipated</td>
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<tr>
<td><strong>Contract Type</strong></td>
<td>Reimbursable contract well adapted for plant revamping</td>
<td>Reimbursable on a fast-track basis</td>
<td>Reimbursable on fast-track basis highlighting the long relationship</td>
<td>Lump-sum turnkey contract</td>
<td>Detailed time schedule for suppliers and sub-suppliers</td>
<td>Lump sum turnkey Fast track</td>
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<tr>
<td><strong>Planning &amp; Procurement</strong></td>
<td>Process activity schedule to be controlled by the project manager</td>
<td>Decisions taken based on engineers knowledge of the situation</td>
<td>Identifying the test system and the sequence of handover</td>
<td>Immediate orders for long delivery equipment</td>
<td>Involvement of all parties</td>
<td>Identification of project schedule milestones</td>
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<td><strong>Control</strong></td>
<td>Breakdown of project items to highlight deviations of the estimated and realised quantities and man-hours</td>
<td>Incentives made to ensure progress</td>
<td>Establish a realistic cost control and monitor deviations</td>
<td>Proven project control programmes</td>
<td>Proper calculation and purchasing decisions</td>
<td>Overall cost within original budget</td>
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<td><strong>Safety</strong></td>
<td>Highlighting the major aspects of the project</td>
<td>An incentive scheme for safety</td>
<td>Safety planned proactively</td>
<td>Observance of safety rules</td>
<td>Meetings with the individual employees</td>
<td>Total safety throughout</td>
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<td><strong>Highlights</strong></td>
<td>The basis for good team spirit</td>
<td>A successful partnership</td>
<td>Aligned objectives</td>
<td>Highlighting of difficulties faced</td>
<td>Government approval complexity</td>
<td>Short cut procurement planning</td>
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<td>Common objectives for all agents</td>
<td>Effective communications enhanced the successful execution of this project</td>
<td>Long-term relationship</td>
<td>Updating plan according to the National Meteorological information</td>
<td>Preparing the process concept</td>
<td>Transferring adequate understanding of scope of work to bidders</td>
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<td>116</td>
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<td>70</td>
<td>55</td>
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<td><strong>Construction period</strong></td>
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<td>N/S</td>
<td>23 months</td>
<td>25</td>
<td>N/S</td>
<td>N/S</td>
</tr>
</tbody>
</table>
5. **Association of success factors and skills**

The presentations have identified many crucial factors that have contributed to the successful completion of these projects.

The following is a discussion of the key factors for success:

1. The fierce competitive markets have affected the normal procedures of conducting the feasibility studies. Clients are becoming more aware of time. As we have discussed earlier, four of the projects were executed on a 'fast track' approach. This highlights the increasing trend towards the adoption of such a contract strategy where the client has an urgent need to bring plant on stream at the earliest possible time to take advantage of the commercial opportunity for the product.

2. This strategy explains the important role of the project manager. Without competent background in the implemented contract strategy, the project manager is less likely to achieve the objectives. Therefore, this presents further evidence of the importance of legal skills and knowledge to be acquired by the project manager. This was clearly established in our survey.

3. In my view the early participation of the project manager at the feasibility stage will ensure that he is more aware of his role, as well as he is going to be more committed to achieve the objectives of the project.

4. The approach of partnership arrangements highlighted by several presenters as being a key issue in the ultimate success of project, together with good team work and a spirit of co-operation between all parties concerned, including both sub-contractors and suppliers, calls for the important role of the project manager in charge of the project. This emphasizes the need for different skills and knowledge to be acquired by the project manager and his team. These skills and knowledge are:

   - communication skills, both formal and informal;
   - team working skills;
leadership skills;
- effective planning and scheduling;

beside many other managerial, financial and technical skills. This is further evidence of the validity of our findings in the survey of project managers.

5. The need for technical skills and knowledge was highlighted in all the presentations. It is evident that it was required at all the project phases from start to finish. This emphasizes one of our main conclusions in this thesis that the need of technical knowledge and skills is not diminished throughout the project manager's career life. Designers, estimators and planners also require a strong technical background, but the project manager is the one in charge to orchestrate the team. This implies the need for broad technical knowledge for the project manager in order to communicate and appreciate all the needs of his team members besides other members from associated parties such as the client, consultant, to mention but a few.

6. Accordingly this raises the issue of broader technical engineering curriculums. Project managers are associated with many engineering disciplines such as civil, mechanical, electrical, etc. Therefore, broader engineering curriculums must be adopted in order to ensure that engineers are able to understand, appreciate and communicate on a broader basis with other associated colleagues from different disciplines.

7. The temporary weakening of the product market causes the budget to be reduced by a significant amount. This could affect the project throughout its phases. Therefore, engineers' decisions, whether they are designers, estimators, planners, site managers, project managers, etc. are going to be affected. One one hand, this highlights the importance of good financial and economical awareness for every member in the team. On the other hand, the project manager is the one likely to be affected most. We have shown in our survey the low financial and accounting course contents in the engineering curriculum. If this is the case for our engineers, then there is no wonder of the likely consequences that will be experienced by the
industry. An accountant will be better prepared to deal with such financial changes, but will he be prepared to take this into consideration in the design and construction procedures? How can he ensure that all the project activities will take into consideration such consequences? Even though some might believe that he can do this through an effective leadership role. The answer is simply No. What I believe is that if engineers are made aware of the likely consequence of their decisions, from the financial, managerial, legal, etc. point of view then they are able to achieve better performance throughout all the project's phases.

The arguments are endless, but the message is that project managers are in desperate need of a broader base of skills and knowledge. This was highlighted in the findings of our survey as well as many previous ones.

This is another important aspect of the planning of the construction activities. Adequate technical knowledge for the project manager is indispensable to achieve successful planning activity throughout the project's phases.

8. Throughout all the presentations the clear message was that the technical background associated with awareness to other aspects such as financial, market demand, etc. is essential for the project managers. From the findings of our survey and throughout the discussions of this thesis, it is very clear that the technical background must be associated with other financial, managerial, legal and social aspects.

9. Budget and schedule update was frequently exercised. This reflects one of the characteristics of the construction industry projects. Without effective and timely feedback from the site, this update is useless. Therefore, this will call for our previous discussions in Chapter Six. This is mainly concerned with the expected role of the project manager to ensure that this task is dealt with properly and effectively. Without the appropriate knowledge and skills, the project manager will hardly achieve success. Our survey has established that this knowledge is highly relevant to the project managers.
10. Budget controls involve many different activities. In addition to what was mentioned earlier, it calls for the evaluation of the cost estimate provided by the central office to the regional office (as in the case of the Ethyl Benzene Project). This implies that the project manager must be capable of drawing up an overall estimate of the likely cost of the project and evaluating the chances of achieving the targets provided by the head office. Accordingly, this emphasize the importance of budgetary control skills and knowledge required by the project manager. This was shown in our survey and the discussion in Chapter Six.

11. One of the important messages delivered in the presentation of the Ethyl Benzene Project was the identification of the areas of savings. The two major areas were:
- reducing the management layers and avoiding duplication; and
- improving erection contractors' effectiveness.
The result was significant as they achieved an underrun of over £3 million on the total budget of £57 million.

This emphasizes our earlier discussion in Chapter Six and the findings of our survey. Briefly, it emphasizes the importance of effective management skills and knowledge for all members of the organization and the role of the project manager in cultivating his team members and other associated companies in the site in order to enhance performance.

Shell has provided a good example through their devised system which produces quantified construction man hour data as man-hours per cubic metre of concrete. This system is excellent to provide a base for measuring performance. It provides an excellent tool for the people concerned to evaluate performance on site by using this system.

12. The considerable high cost of construction as compared to the price of equipment shows the great need for effective budgetary control. This is also another evidence of the importance of this background to the project manager.
13. The importance of budget controls was highlighted in almost all the presentations. Our survey results are in line with this. But will this issue be adopted by the concerned educational establishments?

14. The importance of previous experiences was highlighted in almost all the presentations. This shows the importance of experience as a major source of learning not for the organization alone but also for all the people involved, especially for the project managers. This is another evidence for the validity of our earlier conclusion in the survey of the project managers. The question which is raised is 'If it is accepted that experience is a major source of knowledge, then why is it not adopted by the educational institutions?'

15. Practicality of academic or training courses was frequently criticised and considered by most of the project managers who have participated in our survey as a failure. Why don't we adopt a new approach by utilizing the Experience Factor in most of our courses? This dilemma is likely to remain until we change our attitudes towards education.

16. The adaptation of incentive schemes in many of the contracts makes the role of the project manager more complex. He has to acquire a wide range of skills in order to fulfil his role effectively. This implies that our previous arguments regarding the broad base of skills and knowledge required for the project manager is true. We have seen much evidence that has supported our survey findings.

17. Throughout these case studies we have seen strong indications of the crucial need for a very broad base of skills and knowledge required by the project manager. All the presentations have highlighted many crucial areas for success. But the message was and still is that the project manager is the central figure in the industry. He is the commander who must possess broad technical, managerial, financial, legal, to mention but a few of the skills that are necessary for him in order to succeed in his role and achieve the objectives.

18. The association between the factors, that have contributed to the successful completion of these projects, and the skills and knowledge required for the project personnel in general and the project manager
in particular is very clear, evident and supports the conclusions of our survey of project managers. Our survey has established the skills and knowledge required for the successful project managers, delivered by successful project managers.
REFERENCES - CHAPTER 7

CHAPTER 8

CONCLUSIONS, RECOMMENDATIONS AND FURTHER RESEARCH

1. INTRODUCTION

The major aim of this research is the effective formation of construction project managers. In order to achieve this the following issues were investigated:

- the major characteristics of construction projects and the variables affecting the construction industry;

- the education, training and experience of construction project managers;

- major skills and knowledge required for the construction project manager;

- comparisons of the general educational policies in France, Germany, United States of America and Japan;

- performance in construction;

- factors affecting the successful completion of construction projects.

The conclusions and recommendations, included in this thesis, are the opinion of the author based on the information obtained.

2. THE RESEARCH

The research comprises the following:

- a literature review of the major characteristics and phases of construction projects, and the variables affecting the construction industry;

- A survey of successful project managers by mailed questionnaire investigating:
  - the educational background;
  - further education qualifications obtained;
• the effectiveness of major sources of knowledge contributing to the knowledge and skills;
• training achievements;
• major knowledge and skills required for the construction project manager; and
• the effectiveness of academic courses, formal training and on-the-job experience in contributing to these skills and knowledge.

- A literature review of the major issues related to the effective formation of construction project managers and the education and training of engineers in the United Kingdom;

- A comparative study of engineering and management education and training in France, Germany, USA and Japan;

- A literature review of performance in construction aimed at investigating the factors affecting the performance and the relationships between these factors and the skills and knowledge required for the project managers;

- A case study of six major European projects highlighting the factors contributing to the successful completion of these projects and investigating the relationship between these factors and the skills and knowledge required for the project managers.

3. CONCLUSIONS

The main objective of this research was the effective formation of construction project managers. Throughout this thesis we have been able to investigate many of the issues related to the successful formation of construction project managers.

The main conclusion is that the majority of these construction project managers are engineering graduates. These graduates are of a very strong technical background, but of low managerial, financial and legal basic academic backgrounds. The construction project managers require a mix of technical, managerial, financial and legal skills and knowledge. The conventional pattern is to take the engineering graduates and graft on the
conventional pattern is to take the engineering graduates and graft on the other required knowledge and skills at a later stage in their careers. Nevertheless, the need for management and other knowledge and skills is of paramount importance to the project manager's job. Engineering educational institutions have failed to address this issue. Employers are looking for broadly education graduates capable of understanding and appreciating the consequences of the decisions to be taken not only from the technical point of view, but also from other socio-economical points of view.

It is now well established that further educational qualifications are of value to the employers and the individual employee. 49 out of 110 of today's successful project managers have had their basic academic qualifications considerably extended. About 70 percent have had further educational qualifications. This was found to be significant across the other age groups.

On-the-job experience was rated as the best means of acquiring knowledge and skills.

We have been able to investigate the relevancy of 56 skills and knowledge required by the project managers. Furthermore we have been able to assemble the top 20 highest rated skills required for the project managers at all stages of their career.

The highest percentage of training obtained by the project managers was for management and business studies. The need for technical knowledge and skills is not diminished throughout the project manager's career life. Project managers require a diversified knowledge and skills to cover many aspect and disciplines such as technical, managerial, financial and legal.

The significance of our research is supported by the following:

- the high response rate achieved by the survey;
- the successfullness of the participating project managers;
- the views of the leaders from the industry.

In order to clarify some of the major findings derived from our research, the following headings will be used:
3.1 Educational backgrounds of the project managers

It was concluded in Chapter Two that managers in the construction industry must have the appropriate knowledge, skills and qualifications in order to overcome the obstacles created by the project phases, characteristics of construction projects and the variables affecting the industry as a whole.

From the discussion and analysis in Chapter Six of the factors affecting the performance in construction industry and their relationships with the skills required for the construction project managers, it was concluded that the need for management knowledge and skills is of paramount importance for the construction project managers. Also, it was concluded that the need for technical knowledge and skills is not diminished. There are crucial technical decisions to be taken by the project manager. Hence, the project manager should competently understand the likely consequences of his/her decisions. Furthermore, it was concluded that these decisions and anticipated consequences are not evaluated on the technical basis alone. Other issues must be taken into consideration. These issues are very broad and include the following aspects:

- management;
- financial;
- environmental;
- social;
- legal, etc.

Hence the role of the construction project manager is very complex and requires a broad base of knowledge and skills.

The previous conclusions were strengthened by the findings of the case studies in Chapter Seven. One of the major concluding remarks in Chapter
Seven was that the need for technical knowledge and skills is of paramount importance to the project managers besides the other managerial, financial, legal and communication skills.

Our survey of project managers has shown that the majority of construction project managers are engineering graduates. More than 90 percent of the participating project managers have had engineering and technical basic academic qualifications.

From the analysis of our survey it was found that:
- these project managers are of very strong technical and scientific academic backgrounds;
- management course contents, obtained by the participating project managers, at the basic academic degrees are low;
- accounting and finance course contents were even lower than management;
- computer subjects course contents are low, but the trend is increasing for the younger project managers.

Accordingly, it was concluded that today's project managers are of very strong technical based academic qualifications and of shallow or very shallow managerial, financial and legal academic background. Hence, the conventional wisdom is to take the graduate with an engineering degree and graft on management, financial, legal and other skills to produce our project managers. But the route of engineering first and management later is long and has the unfortunate by-product of implying that the management skills acquired at a second stage are secondary.

Our survey shows, as others before it have shown, when project managers rate the skills they require, management skills are rated as the highest.

3.2 Further educational qualifications

The comparative study of engineering education in France, Germany, USA and Japan has revealed the following issues regarding the further educational qualifications:
Most managers in the USA, the Federal Republic of Germany, France and Japan have been educated to a higher level than in the UK. Moreover, many managers in these four countries have had the benefit of formal and systematic policies for continuing education and development.

The French have a law requiring every organisation with more than 10 employees to spend a minimum of 0.5 percent of their wage bill on initial formation and 1.1 percent on continuing formation of their employees. If they do not spend it all the balance goes to the National Exchequer. Such a law does not exist in the UK.

The French organisations are also required by law to supply statistics in their training activities and to prepare a formal development plan for the organisation.

About 10 - 25 percent of all the French engineers go on to do postgraduate studies after obtaining their diploma.

Many of the major French 'écoles' are developing large programmes of in-service training for updating and re-cycling working engineers. For the development of these programmes they can benefit from state funds through a national levy on industry which in some cases can be paid direct by the firm to the individual 'école'.

Every individual has the right to individual training leave in whatever subject he/she chooses. The leave may not exceed one year if full-time.

The employee may receive up to 100 percent of his/her previous salary upon completion of such a programme.

The large number of Germans obtaining doctorate degrees emphasises the importance given to post-graduate education by the Germans, and reflects the appreciation of the industry of such qualifications.
- German firms employ more people with higher formal qualifications, especially technical qualifications, than the British firms across all the different sizes of companies studied.

- A high emphasis is given by the Americans on MBA's programmes. The output of MBA's has grown from 58,000 in 1981 to 70,000 in 1987. Also, large amounts of money are spent by the Americans on formal education and training.

- The use of university programmes by all sectors of the American industry is very high. In a survey of the 300 top corporations, in 1986, it was stated that all these companies have used university programmes. The minimum percentage was above 50 percent.

- The Japanese employment policy works on the basis of a lifetime career in the same organisation, therefore employers are encouraged to invest in their human resources.

In our survey of successful project managers it has been found that 49 out of 110 participating project managers had obtained further educational qualifications. That is 44.5 percent of the total number of project managers in the survey. The qualification obtained were:

- 16 MSc’s
- 2 PhD’s
- 2 Postgraduate studies incomplete;
- 7 Diplomas;
- 9 MBA’s;
- 8 Qualifications in Business Administration;
- 5 Other educational qualifications.

This is regarded as particularly encouraging that 49 out of 110 of today's successful project managers have had their basic education considerably extended.

The percentage of the young project managers obtaining higher educational qualifications was found to be 69.6%. The Chi-square test of association between the further educational qualifications obtained and the age groups of
the respondents has shown a very significant association ( = 7.5, P< 0.05). Accordingly, it is now well established that further educational qualifications beyond the basic degree are of value to the individual and to the employer.

3.3 Experience

Our survey has investigated the experience of the participating project managers. This investigation, as reported in Chapter Three, has covered the following issues:

- total number of projects before becoming a project manager;
- number of projects the project manager has been directly responsible for;
- number of projects the project manager is currently responsible for;
- overseas working experience;
- number of posts held during the project manager's career.

Some of the major findings were as follows:

1. The distribution of the number of projects the project managers have been associated with before becoming project managers is as follows:

   63.6% - Upto 10 projects;
   25.5% - 11 to 20 projects;
   9.1%  - 21 to 50 projects;
   1.8%  - More than 50 projects.

2. 83 out of 110 project managers have had overseas working experience. This is 75.5 percent.

3. The distribution of the posts held during career was as follows:

   24.5% - Upto 5 posts;
   56.4% - 6 to 10 posts;
   14.5% - 11 to 20 posts;
   4.5%  - More than 20 posts.
The interviews with some of the leaders in construction industry have revealed the follows:

- experience plays an important role in the formation of project managers;

- the project manager is expected to spend about 10 to 15 years working to be assigned the responsibility of managing the projects;

- the project manager has to obtain the right experience to qualify him for the job he is expected to do;

- employers believe that it is vital to monitor the project manager's performance on the assigned jobs, hence the achieved records will qualify him for the appointment of the next task;

- employers also believe that experience is associated with the time the project manager has spent with the organisation to ensure loyalty to the organisation;

- the working experience of the project manager at the concerned organisation will contribute to his understanding of the associated organisational issues such as the relationship with senior people and colleges, company's ethos, etc.

We have also seen that the organisational know-how and working experience was one of the performance factors, as discussed earlier in Chapter Six. This highlights the role of experience for the concerned project managers as well.

3.4 The importance of the major sources of training

Our survey has established how the project managers have rated the major training sources as contributors to their knowledge and skills. The major findings were:

- on-the-job experience was rated as the best means of acquiring knowledge and skills;
- off-the-job training was rated second;
- academic training courses were rated third;
- secondment to other departments was rated fourth.

Participants have contributed to this issue by highlighting some of the sources contributing to their knowledge and skills. The major related issues were as follows:

- working for a contractor;
- a variety of posts;
- other jobs in different fields;
- experience;
- mistakes.

Throughout the general comments, listed in Appendix 7, experience was repeatedly mentioned as a major source required for the successful construction project managers. Some of the obtained messages were:

- there is no substitute for experience;
- apart from two management courses all skills were derived from on-the-job experience;
- job experience is the major contributor to one's training;
- vertical learning curve job experience is invaluable.

From the analysis of the effectiveness of sources in contributing to the skills and knowledge, listed in the Skills Portfolio of our questionnaire, job experience was considerably given the highest rating.

Accordingly, from the previous findings, we can conclude that on-the-job experience is very essential and invaluable for the formation of successful construction project managers. This raises a very important issue of establishing the links between on-the-job experience, academic courses and formal training courses.

3.5 Skills and knowledge required

The literature review in Chapter Four has revealed that to effectively implement a project the manager should possess the following:
• technical expertise;
• management expertise;
• business expertise;
• leadership qualities;
• effective communication capabilities;
• legal background;
• health and safety laws;
• public authorities expertise.

From the literature review of performance in construction, in Chapter Six, it was noticed that there is a strong association between the performance factor and the knowledge and skills required by the project managers. It was concluded:

- the need for management knowledge and skills is of paramount importance for the construction project managers;
- the need for technical knowledge and skills is not diminished at all stages of the project manager's career;
- construction project managers have a very complex role, hence this role requires a broad base of knowledge and skills.

From the case studies of the six major European projects, it was found that there is a strong correlation and association between the success factors and the skills and knowledge required by the project managers.

Our survey has investigated the relevancy of 56 listed skills to the successful construction project managers. The high response rate achieved has added to the validity of our achievement. The skills portfolio was divided into seven major parts as follows:

- technical;
- managerial;
- financial;
- computers;
- legal;
- communication;
- general.
The well structured layout of the portfolio has contributed to the high rate of responses achieved by the survey. Through this we were able to assemble the extensive statistical analysis of this part in the survey. Accordingly we were able to measure the relevancy of skills required by the participating project managers. We have been able to identify the top 20 highest rated skills. These skills are listed below with their associated percentages.

<table>
<thead>
<tr>
<th>Skills</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Leaderships skills</td>
<td>98.2</td>
</tr>
<tr>
<td>2. Planning and scheduling</td>
<td>97.3</td>
</tr>
<tr>
<td>3. Delegation</td>
<td>96.4</td>
</tr>
<tr>
<td>4. Chairing meetings</td>
<td>96.1</td>
</tr>
<tr>
<td>5. Negotiation techniques</td>
<td>95.5</td>
</tr>
<tr>
<td>6. Presentation skills</td>
<td>95.3</td>
</tr>
<tr>
<td>7. Establishing budgets</td>
<td>94.3</td>
</tr>
<tr>
<td>8. Draft contracts and negotiations</td>
<td>92.4</td>
</tr>
<tr>
<td>9. Decision making techniques</td>
<td>91.8</td>
</tr>
<tr>
<td>10. Financial reporting systems</td>
<td>90.6</td>
</tr>
<tr>
<td>11. Correspondence and memo writing</td>
<td>90.6</td>
</tr>
<tr>
<td>12. Motivation and promotion</td>
<td>90.0</td>
</tr>
<tr>
<td>13. Team working skills</td>
<td>90.0</td>
</tr>
<tr>
<td>14. Construction management activities</td>
<td>89.1</td>
</tr>
<tr>
<td>15. Report writing</td>
<td>88.7</td>
</tr>
<tr>
<td>16. Basic technical knowledge in own field</td>
<td>84.5</td>
</tr>
<tr>
<td>17. Understanding and organisation</td>
<td>84.5</td>
</tr>
<tr>
<td>18. Productivity and cost control</td>
<td>82.7</td>
</tr>
<tr>
<td>19. Time management</td>
<td>82.7</td>
</tr>
<tr>
<td>20. Top management relations</td>
<td>81.8</td>
</tr>
</tbody>
</table>

Furthermore, we have investigated the association between the skills required and the different age groups of the participating project managers. Tables, 3.37, 3.38 and 3.39 list the top 20 skills required by the young, middle and mature project managers respectively (see Part 3, Chapter 3). From these tables it was found:

planning and scheduling and leadership skills were the top two highly rated skills by project managers at all the three age groups;
- the need for the understanding of basic technical knowledge in own field was found to be slightly decreasing for the older project managers;

- all the project managers from the three age groups have indicated the need for a mixed set of knowledge and skills; this covers the following areas of skills and knowledge:
  
  • managerial;
  • technical;
  • financial;
  • legal;
  • communication.

The volume of the obtained replies shows and emphasises that an authoritative view of the skills required by project managers, as judged by project managers, is available for the first time. This information is exceptionally valuable in the planning of education and training courses and programmes for the development of the next generation of even better project managers.

3.6 Training achievements

The literature review in this thesis has revealed the following major issues regarding the training:

- the Engineering Council’s Policy Statement draws broad guidelines for the training of engineers in the United Kingdom;

- the Working Party of the Institution of Civil Engineers (Ref. 14, Chapter 4) has recognised the issues of training, in 1992, and stated that it would be necessary to recognise that the Institution’s training programme would need to be reviewed;

- the rigidity of the training guidelines has been highlighted in 1986 (See Ref. 17, Chapter 4);
lack of effective laws and regulations to ensure proper and effective training for engineering graduates in the UK;

graduates from engineering schools are not granted their professional status until they spend a relatively long time in employment under training agreement. Those employed by smaller employers might not succeed in getting this type of approved training. Hence they are going to spend considerably longer time before they are granted their professional status.

Article 3.2 in this chapter discusses other issues as revealed from the comparative study of engineering education in France, Germany, USA and Japan.

Nevertheless, our survey has been successful in identifying some of the crucial training issues. These issues are:

- full-time training achievement;
- part-time training achievement;
- further training the project managers are hoping to take in the future.

The following are the major findings in these aspects:

1. Full-time training
The full-time training achievements of our project managers, on the basis of at least one training course were as follows:

- The highest percentages of training obtained by the participating project managers were in management. These percentages were 73.9, 80.0 and 75.7 percent for the young, middle and mature age groups respectively. This highlights the great need for management and shows that management backgrounds of the project managers were very shallow at the graduation level.

- Training in business studies was the second highest type of training obtained by the project managers. The percentages for the young, middle and mature age groups were 56.5, 50.0 and
45.9 percent respectively. Training in business studies came third for the mature aged group.

- Percentages of the training obtained by the young, middle and mature groups in own technical fields were 34.8, 42.0 and 48.6% respectively. This comes as the third highest training obtained by our project managers from the middle aged group.

- Training in marketing and sales was the third highest type of training obtained by the young aged group, 39.1 percent of project managers from the young group have obtained training in this field. The percentage for the middle and mature groups were 20.0 and 18.9% respectively.

- None of the project managers from the young group have had training in languages. The percentages for the middle and mature groups were 22.0 and 5.4% respectively.

- Percentages of training in new technology were 8.7, 28.0 and 27.0% for the young, middle and mature project managers.

2. **Part-time training**

The part-time training achievements of our project managers on the basis of at least one training course were as follows:

- Training in new technology is the highest type of training achieved by the young group of our project managers. 69.6 percent of the young group have had this type of training. The percentages for the middle and mature groups were 44.0 and 27.1% respectively.

- Part-time training in languages is more popular for the young and mature groups. The percentages were 21.7 and 24.3% respectively. Only 14 percent of the middle group have obtained training in languages.

- Training in management and business studies remains relatively high for the project managers in the three age groups. The
percentages for training in management were 39.1, 30.0 and 43.2 for the young, middle and mature groups respectively. The percentages for training in business studies were 26.1, 26.0 and 24.3% for the young, middle and mature groups respectively.

- Training in own technical field was relatively high for the young and middle groups. The percentages were 30.4 and 34.0% respectively. Only 16.2 percent of the mature group have had this type of training.

3. Further training
The willingness of the participating project managers in our survey has revealed the following:

- The willingness of our project managers to obtain further training in management and business studies remains relatively high for all the three age groups.

- The young and middle age groups have shown greater willingness to take training in languages than the mature group. The percentages for the young and middle groups were 21.7 and 28.0% respectively. Only 2.7 percent of the mature group have indicated so.

- The mature group has shown a very low willingness for future training in own technical field and in new technology. Only 2.7 percent of the mature aged group have indicated to do so for these two types of training. This shows that project managers at this level, 51 - 63 years of age, have a very low interest in further technical training.

4. RECOMMENDATIONS

The basic recommendation in this thesis is that it is important to bring fundamental changes into the United Kingdom’s educational system in general and in the engineering educational policy in particular. Many fundamental changes must be implemented at all educational levels. Broader education is
Engineering educational establishments must review their curriculums in favour of broader ones. The curriculum must be geared towards the fulfilment of the employers needs not towards the rigidity of the guidelines issued by the professional institutions. Freedom must be given back to the engineering educational institutions as they are capable to handle such issues. It must be taken into consideration that employers are in favour of broadly based graduates. Hence, course contents must cover some of the important subjects such as management, financial, legal and other required subjects besides the basic technical knowledge. It must be emphasised that practicality of these courses must be given high priority. Closer links between the educational establishments and employers are crucial in order to integrate the effectiveness of the educational system.

It is very important to review the training policy of the engineering graduates. The concerned authorities must issue new regulations, similar to the French regulations, to ensure that employees are getting proper education and training throughout their careers. The process of updating the knowledge and skills of the individuals is of paramount importance to the prosperity of the society.

The contents of the training courses offered by all the concerned educational institutions and/or in-house training schemes must be reviewed in the light of what is required not of what could be taught. Accordingly, the effectiveness of self-learning courses is questionable. Hence, the concerned bodies producing such courses must ensure the compatibility and effectiveness of their courses and make them more user-friendly.

The contents of construction project management post-graduate courses must be reviewed in the light of our survey's findings to ensure that the needs are fulfilled. High priority must be given to management subjects and in particular the leadership related issues. It must cover other important issues such as finance, legal and communication skills. Table 3.37 lists the top 20 skills and knowledge rated as the highest relevant to the young project manager's job, and provided by successful project managers from the construction industry.
This thesis has discussed, investigated and recommended many of the required changes that ought to be brought sooner not later for the effective formation of successful construction project managers.

Finally, I would like to highlight the fact that engineers are able to occupy the highest managerial posts and play their roles more effectively, given that they are adequately and properly equipped with the fundamental requirements of technical, managerial, financial and legal knowledge and skills.

5. FURTHER RESEARCH

This research has investigated the education, training, experience of the construction project managers. It has identified the major knowledge and skills required by the successful project managers and provided by successful project managers from the construction industry. It has also discussed many of the issues, variables and factors contributing to the successfulness of the industry and to the formation of construction project managers. Furthermore, it has investigated the educational policies of many of the world's leading nations such as France, Germany, United States of America and Japan. We were able to see how these nations are educating and training their most valuable human resources.

From the views of the leaders of the construction industry in the United Kingdom we were able to investigate the validity of our findings. Nevertheless, we continued this investigation on the factors affecting the performance in the construction industry, and we have seen how these factors are associated with the skills and knowledge required by the construction project managers.

From the case studies of the six major European projects we were able to highlight the factors that have contributed to the successful completion of these projects and also we have investigated and discussed the association between these factors and the knowledge and skills required for the construction project managers.

It would be highly appreciated if this research could be taken further by investigating the needs of the employers and what skills and knowledge they
are looking for in the new recruited engineering graduates. This could be conducted on the basis of mailed questionnaire followed by interviews.


Avots, I. 'Why does Project Management Fail?' California Management Review, 12, p.77-82.


Department of Civil Engineering, Loughborough University of Technology and University of Salford.


Finniston, M., Foreword for "Goals of Engineering Education" (GEEP), Project conducted by Leicester Polytechnic, CNAA Development Services Publication 2, January 1983.


Horner, R.M.W., "Collecting consistent productivity data from construction sites", SERC Research Grant No. GR/E 80206, Final Report, No date.


Institution of Civil Engineers, "Educational formation". Discussion paper. This paper has no date and was obtained and referred to by one of the senior members of the working party of the Institution during an interview with him in October 1992.


Litwin, G.H. and Stringer, R.A., 'Motivation and Organizational Climate', Harvard University, Boston, 1968.


"Management Education". Conference of University Management Schools, 1985.


Morice, P. "The UK point of view. The formation of engineers in an integrated European framework". Report on a conference held at the University of Southampton, 6-7 September 1988.


O'Connor, M.J., "Research report on a large construction site", Loughborough University of Technology, Business School, 1991. A copy of this report was provided to be used in this thesis on the basis of research use only.


APPENDIX 1

Sources of the literature review referred to in the planning of the survey of project managers (Chapter 3)
APPENDIX 1


   - J M Pettit, Director Graduate Phase of Study, Stanford University.
   - G A Hawkins, Director Undergraduate Phase of Study, Purdue University.


APPENDIX 2

A copy of the letter sent to the Board of Advisors of the European Construction Institute
Our Ref: TAA/CR

11 December 1991

Dear

I am a research student in the Civil Engineering Department at Loughborough University of Technology.

The subject of my research is the education and training of project managers. My supervisor is Professor Ronald McCaffer.

We are planning to carry out an investigation by questionnaire on the education, training and experience of managers of major projects in the construction industry, the results of which will be reported to the European Construction Institute.

I should be grateful if you would recommend five project managers' names who would be willing to respond to such a questionnaire.

Confidentiality is assured and all information provided will be used to assemble statistics, no reference will be made to individuals. There will also be a follow up interview for selected project managers.

I do hope you are able to assist and look forward to hearing from you.

Yours sincerely

Talal A Adham
APPENDIX 3

Questionnaire Form
LOUGHBOROUGH UNIVERSITY OF TECHNOLOGY
DEPARTMENT OF CIVIL ENGINEERING

SURVEY OF PROJECT MANAGERS

1. Name: ................................................................................ 2. Age:

3. Title of your Job: ................................................................

4. Years on this Job:

5. Employer's Name: ............................................................

6. Years with this Employer:

7. Approximate number of people in your organisation: A: as a whole

B: branch or division

8. Please write the title, date and major subject of your basic academic degree:

Title of basic degree Date Major subject of study

9. To help us assess the approximate contents of your basic academic degree, you are kindly requested to complete this table, by filling in a percentage of each item listed as compared to the total course content. (The total should add up to 100%).

<table>
<thead>
<tr>
<th>Contents</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Technical Subjects</td>
<td></td>
</tr>
<tr>
<td>- Science Subjects</td>
<td></td>
</tr>
<tr>
<td>- Management Subjects</td>
<td></td>
</tr>
<tr>
<td>- Accounting and Finance</td>
<td></td>
</tr>
<tr>
<td>- Computers</td>
<td></td>
</tr>
<tr>
<td>- Others</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>100%</td>
</tr>
</tbody>
</table>

10. In the space provided, please give details of your further educational qualifications (such as Diploma or postgraduate study, etc)

..........................................................................................................................

11. The following is a list of major training sources. You are kindly requested to indicate the importance of these sources as contributors to your skills and knowledge by using a rating scale of 1 to 9 for each source (1 indicating very low importance and 9 indicating very high importance).

- Academic training courses
- On the job experience
- Off the job training courses
- Self learning courses
- Lectures or Seminars
- Secondment to other departments
- Others: (Please give details)

..........................................................................................................................
12. The following table contains a list of general training courses. Please complete as follows:

- **Column A**: Circle the relevant number if you have ever had a full time training course.
  - Full time courses (courses lasting at least 3 days)

- **Column B**: Circle the relevant number if you have ever had a part time training course.
  - Part time courses (courses lasting less than 3 days, evenings or weekends)

- **Column C**: Circle the relevant number if you hope to take in the future.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full time courses</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Part time courses</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>In the Future</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

- Advanced technology in your own field
- Training in new technology
- Management and human resources
- Business studies
- Marketing sales
- Languages

- Others (please give details)

13. Are you satisfied with the opportunities for further training available to you?

(Please circle one number)

- Very satisfied
- Satisfied
- Fairly satisfied
- Not satisfied:
  - because there are no courses available
  - because you cannot get time off to attend
  - other reasons

Experience

14. Total number of projects you were associated with before becoming a project manager
15. Number of projects for which you have been directly responsible as a project manager
16. Number of projects you are currently responsible for
17. If you have had any overseas working experience please tick this box
18. Please give approximate number of posts you have held during your career
Skills Portfolio

The following table contains a wide range of skills and qualifications that are likely to be required for project managers. You are kindly requested to fill it as follows:

Column A: Please circle the appropriate number indicating how relevant this is to your job.
(5 indicating very relevant, 1 indicating low relevance)

Column B: You are kindly requested to use a rating from 1 to 9 indicating how effective was each of these given sources of academic courses, formal training and work experience were in contributing this skill to your knowledge.
(1 indicating very low level of effectiveness and 9 indicating very high level of effectiveness).

<table>
<thead>
<tr>
<th>Skills and Qualifications</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I. Technical skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understanding of basic technical knowledge in your field</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Forecasting techniques</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Site layout and mobilization</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Material procurement</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Operations research</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Technical writing</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Design activities and background</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Reading and understanding drawings</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Construction management activities</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Planning &amp; scheduling</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Estimating and tendering</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Productivity and cost control</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Work study (methods study)</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Plant and plant hire</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Quality control</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Others: .....................</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>II. Managerial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leadership skills</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Time management</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Decision making techniques</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Negotiation skills</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Delegation</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Skills and Qualifications</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>Relevance</strong></td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Very relevant</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Not relevant</td>
<td>2</td>
<td>1</td>
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</table>

### A. Effectiveness of Sources (1-9)

<table>
<thead>
<tr>
<th>Academic Courses</th>
<th>Formal Training</th>
<th>Job Experience</th>
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<tbody>
<tr>
<td>Strategic planning</td>
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<td>4</td>
</tr>
<tr>
<td>Human behaviour</td>
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<td>4</td>
</tr>
<tr>
<td>Motivation and promotion</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Recruitment</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Team working skills</td>
<td>5</td>
<td>4</td>
</tr>
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<td>Top management relations</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Others: ....................................</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

### III. Financial

| Reporting systems | 5 | 4 | 3 | 2 | 1 |
| Project finance | 5 | 4 | 3 | 2 | 1 |
| Investment appraisal | 5 | 4 | 3 | 2 | 1 |
| VAT and Taxation | 5 | 4 | 3 | 2 | 1 |
| Stock control and evaluation | 5 | 4 | 3 | 2 | 1 |
| Cash flows | 5 | 4 | 3 | 2 | 1 |
| Establishing budget | 5 | 4 | 3 | 2 | 1 |
| Others: .................................... | 5 | 4 | 3 | 2 | 1 |

### IV. Computers

<p>| Operating systems | 5 | 4 | 3 | 2 | 1 |
| Programming language(s) | 5 | 4 | 3 | 2 | 1 |
| Operating packages programmes | 5 | 4 | 3 | 2 | 1 |
| Spread Sheet softwares | 5 | 4 | 3 | 2 | 1 |
| Data base softwares | 5 | 4 | 3 | 2 | 1 |
| Main frame computers | 5 | 4 | 3 | 2 | 1 |
| Computer aided design CAD | 5 | 4 | 3 | 2 | 1 |
| Project management softwares | 5 | 4 | 3 | 2 | 1 |
| Information technology tools | 5 | 4 | 3 | 2 | 1 |
| Others: .................................... | 5 | 4 | 3 | 2 | 1 |</p>
<table>
<thead>
<tr>
<th>Skills and Qualifications</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Relevance</td>
<td>Effectiveness of Sources (1-9)</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Very relevant</td>
<td>Not relevant</td>
</tr>
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<td></td>
<td>Academic</td>
<td>Formal</td>
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<td>V. Legal aspects</td>
<td>Courses</td>
<td>Training</td>
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<td>New Zealand law background</td>
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<tr>
<td>Draft contracts and negotiations</td>
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<td>1</td>
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<tr>
<td>Health and Safety law</td>
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<td>1</td>
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<tr>
<td>Preparation of claims &amp; litigation</td>
<td>5</td>
<td>1</td>
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<td>Trade Unions and Public Authorities</td>
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<td>VI. Communication</td>
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<td>Communication skills</td>
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<td>Report writing</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Correspondence and memo writing</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Public speaking</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>VII. General</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Marketing and sales skills</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Public relations</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Understanding of organisation</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Chairing meetings</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Others:</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

THANK YOU VERY MUCH FOR YOUR HELP

* If you wish to be sent a copy of the report of this survey (at no cost) please tick the box:

AND

Write your name and address below

We would like to meet a few individual respondents to the questionnaire in order to discuss some of the questions and our interpretation of the answers.

We hope that you would be willing to be interviewed, at any place to your convenience, for this purpose. If you are willing to be interviewed please tick this box

and please give your telephone number

General comments:

(Please use the back of this page or an extra sheet if necessary)

After completion please return to:

Tatham
Department of Civil Engineering
Loughborough University of Technology
Loughborough
Leicestershire LE11 3TU, United Kingdom
APPENDIX 4

Covering letter of the Survey
TAVC

25 February 1992

Dear

Your name has been given to me by ?, your ?, together with other project managers in your company.

I am a research student in the Civil Engineering Department at Loughborough University of Technology.

We are investigating by questionnaire on the education, training and experience of managers of projects in the construction industry, the results of which will be reported to the European Construction Institute.

The enclosed questionnaire is designed to collect data as follows:

- General aspects of yourself, your job and your employer.
- The contents of your basic academic qualification (such as BSc, HND, HNC, etc).
- Details of your further educational qualifications (such as postgraduate studies or Diploma etc).
- Assessment of the importance of the major training sources as contributors to your current skills and knowledge.
- Your training history and the anticipated training courses you are looking forward to taking in the future.
- Your satisfaction with the opportunities for further training made available by your employer.
- General review of your experience background.
- Review of the relevance of wide spectrum of skills to your job and investigating the effectiveness of three major sources in contributing to these skills.

Although this questionnaire looks lengthy, it is expected to take less than half an hour to complete. You are kindly requested to fill it in and send it back using the self addressed envelope enclosed as soon as possible. Confidentiality is assured and all information provided will be used to assemble statistics; no reference will be made to individuals. There will also be a follow up interview for selected project managers.

I do hope you are able to assist and look forward to hearing from you.

Many thanks for your cooperation.

Yours sincerely

Talal A Adham

* In case of any difficulty or other enquiry I will be pleased to receive your call by phone as soon as possible. My direct line telephone number is 0509-265505.

Encs
APPENDIX 5

Follow up letter
TAA/VC

13 March 1992

Dear

My letter of 12 February 1992 enclosed a questionnaire regarding the education, training and experience of project managers. A total of 168 were sent out to specially selected project managers suggested by their own companies and to date 87 replies have been received.

For the survey results to adequately reflect the wide range of views and experiences in our industry it is necessary to have replies from as many of our original sample as is possible.

At the time of writing we have not yet received your response. If you have, in fact, responded recently please accept my apologies for writing to you again. If you have not responded I should like to encourage you to do so.

If you have some difficulty in completing the questionnaire please telephone me on 0509 265505 and I will be pleased to discuss it with you.

The response to the questionnaire is already substantial and we now know the conclusions will be of importance to the industry and higher education with respect to the training and development of future project managers. Your response will add weight to the survey results.

I should be very pleased to receive your response.

Yours sincerely

Talal A Adham
APPENDIX 6

Comments raised by the respondents
APPENDIX 6

The comments are listed below and they only reflect the opinions of the project managers.

The comments are reported as they were mentioned. Numbers are given for guidance for the discussions.

1. Due to my age and the fact that I came up through the Apprenticeship route and Day part time courses whilst working on live projects I believe I have received a more balanced view than many degree trained personnel.

This plus a period of national service give me:
- a more practical approach;
- better working relationships in a team environment;
- ease of communications, written or oral, with all types of personnel from top director to the lowest clerk;
- a balanced view of life.

However, concentration on the UK offshore industry may also have made me a bit blinkered!

2. You will note that little academic input was relevant to my activities. I am currently involved in a MSc course by distance learning. It has more relevance to many of my direct activities.

3. I think you will benefit more from an interview because some answers are not straightforward.

Also project management requires certain personal qualities/characteristics that need explaining.

In my case the optimisation of technology, time and cost has always been the essence of project engineering and management and requires "corporate thinking" opposite multi disciplines activities, i.e. civil, mechanical, instrumentation, electrical, process engineering, chemistry, etc..
4. It may not be obvious from my responses above but the first 15 years of my career was spent on detailed scientific research and development in the aerospace industry and was not relevant to the work of a project manager in construction and petrochemical engineering. Similarly my degree in Applied Physics may not appear relevant but, being a very fundamental degree, it has always enabled me to appreciate all technical matters to a level necessary for successful project management. I have been 15 years in the construction engineering industry, only the last 6 months with .......... and have not yet got to know them very well.

5. Please note that I completed my academic courses twentyeight years ago. At that time very little emphasis was put on management subjects with the exception of health and safety and industrial relationship. Obviously at that time, computer skills had not commenced. Those were the days of a slide rule.

6. Too many courses are geared to what can be taught not what is required.

7. Apart from two management courses all skills were derived from on the job experience.

Obviously computers are an essential part of project work but not a necessary tool for the project manager himself.

8. Bluntly - academic education (notably in universities) is far too "academic" - have said that I don't believe universities are the best places to learn things like project management - or management in general.

We start with an archaic system which says that people go from school to university to work - why don't we turn the whole thing round, i.e. - define what skills, knowledge, attributes, etc. are wanted; - think of the logical order of doing them; - think of the best environment for achieving each part effectively.
Hence determine the plan of action.

9. You will see from my response that job experience is the major contributor to one's training and a very wide range of knowledge and skills are required. I have been promoted to Senior Project Manager after 41/2 years as Project Manager. Thus my response to Q4. Previous to that I had 18 years experience as Project Engineer, Senior Project Engineer, Principal and Chief Project Engineer.

10. The point is that when I trained in the early '50's there were no degree courses available for RICS qualifications. The norm was to become a pupil and take correspondence and day release courses and then sit the RICS's own exams which were, and are, the top qualification.

The term 'project manager' simply did not then exist and only came into being in the late '70's. By that time I was long a qualified Q.S. and by accident became involved in the overall direction of construction projects at the specific request of my firm's clients. It was then very much a new role for QS's, which we approached with some wariness, but in fact I became a 'Project Manager' without knowing it before the species became recognised. I have learned by experience and attendance at lectures and seminars, mostly in my own time, over the years.

I believe I have some natural aptitude for the job and that Q.S. training is a good basic background for it. It does not follow that all QS's would necessarily make good project managers.

I would say there is no substitute for experience.

11. My project management experience has ranged from power station projects to petrochemical, civil and building projects. Generally the basic project management skills required have been the same on all the projects.

The syllabus of the basic academic qualifications I have obtained in the 1950's concentrated on technical subjects. The project management
skills I have acquired since have been from "on the job" experience and various company and external seminars and courses.

12. Although it is not possible to assess personal attributes using a questionnaire such as this, I feel that these play an enormous part in being an effective project manager.

Such attributes as objectivity, conciseness, enthusiasm, diplomacy, help greatly, whereas others often regarded as required attributes such as aggressiveness, arrogance, single-mindedness, are more often positive disadvantages.

13. This form has been a major imposition on my personal time. It could have been a lot simpler!

Be aware that the title 'Project Manager' applies in widely different contexts. Small companies use it for jobs of risk!

I have gained no feel for finance responsibility in your questionnaire.

Questions are too biased to civil engineering projects.

Want to get a global picture.

14. You are going to have a very hard job drawing a relationship and conclusion on the real effectiveness of job experience versus academic training!

I don’t think anyone is claiming that a strict academic course will equip an engineer with the necessary skills to be a project manager - in fact it is not intended to do so!

The question of relevance and effectiveness of the on the job experience is a tough one but, hopefully, you can get something from what I have indicated. It is very subjective.

15. It seems to me that there is no clear definition of the term project manager and the term is frequently misused as is the term engineer.
16. If the purpose of this questionnaire is to establish if academic courses are relevant to a business career I think it is a worthwhile exercise.

Academic courses do not address the main areas of business such as team work, management, presentation skills, etc. and a significant ? is expended by industry in having to retrain personnel to make them productive in a business environment. Much of this training could take place in an academic environment so that graduates would be more suitable for working directly in business.

17. As you can see I have been in project management for a number of years (more than 30 years) and have seen computers and systems grow from nothing. No academic training on computers. Not very computer literate but I do recognise their benefits (and disadvantages) and use them simply as tools operated by others who have the necessary skills.

18. 1. In the computer section it is worthwhile noting that many large organisations have an Information Systems Department and the project manager only need to know potential applications. What can be done etc. rather than how to do it. On large projects most of the software are driven by specialists.

   e.g. CAD
   Project control packages: scheduling: cost control
   spreadsheets
   Accounts
   Technical packages for calculations and design etc.

2. Our company has customised software (based on commonly available packages) which are used as standard throughout the company.

3. Literacy is still one of the most potent factors in management as it affects both client impressions and internal management effectiveness.
19. The main thing you have missed is the tutoring of more senior colleagues. This was the most important training source during my initial experience of project management.

20. To become a good project manager and be successful you must have some personal skills - you must have had a good academic background and an all round education. You have to be a leader and be approachable to both client and workforce. To become really successful you must continually practice your skills and while doing so you improve other weaker elements. You adapt, you recognise your own weaknesses and ensure that the total project team becomes a team in all senses. They get on well together and it has strong members in all the basic skills.

21. A very well laid out questionnaire. I'll be interested in the results. I would conclude as follows:

1. My BA (Hons) degree course did not focus in practical applications.
2. We do not do enough senior level in-house training.
3. Vertical learning curve job experience is invaluable.

22. My formal education (university degree) was technically oriented and provided a general problem solving technique. My project management education process started with a first entry level position within the engineering department of (large organisation). Therefore, my entire project management skills are based on the defined requirements of my employer.

23. A blend of academic training, formal training and on the job experience is necessary.

24. Some aspects of a project manager that are difficult to quantify are:

- Common sense
- Ability to stay calm and in control
- Sense of purpose and ability to identify what is important and what is not.
APPENDIX 7

Chi-square test of association
APPENDIX 7

In this thesis we have used the chi-squared test in the context of test for association. The set-up of this test is as follows:

Suppose that one factor with \( c \) categories and a second factor with \( r \) categories, considered as columns and rows respectively of an \( r \times c \) contingency table.

Let \( P_{ij} \) denote the probability that a sampled item is classified in the \( \text{ith} \) row category and the \( \text{jth} \) column category.

Let

\[
P_i = \sum_{j=1}^{c} P_{ij}
\]

express the marginal probability that an individual is classified in row \( i \)

and let

\[
P_{ij} = \sum_{i=1}^{r} P_{ij}
\]

denote the marginal probability that an individual is classified in column \( j \).

Notice that

\[
\sum_{i=1}^{r} \sum_{j=1}^{c} P_{ij} = 1
\]

If the classification of an individual according to one factor is not affected by it relative to the other category then the two factors are not associated, that is, they are not associated if the joint classification probabilities are the products of the marginal classification probabilities: \( P_{ij} = P_i P_j \)

Thus to test for association we test

\[
H_0: P_{ij} = P_i P_j
\]

Let

\[
n_i = \sum_{j=0}^{c} O_{ij} \quad \text{and} \quad m_j = \sum_{i=1}^{r} O_{ij}
\]

denote row and column totals as before, although the \( n_i \) are not fixed prior to the sample in this case.
Let

\[ N = \sum_{i=1}^{r} n_i \]

denote the total number of outcomes. Then

\[ P_i = \frac{n_i}{N}, \quad P_j = \frac{m_j}{N} \]

and under \( H_0 \), the expected number of outcomes to fall in the \((c_{ij})\) cell is estimated to

\[ e_{ij} = N P_{ij} = N P_i P_j = N \left( \frac{n_i}{N} \right) \left( \frac{m_j}{N} \right) \]

Thus the chi-squared statistic for measuring the agreement between the observed outcomes \( O_{ij} \) and the expected numbers under \( H_0 \), \( r_{ij} \) is computed exactly the same as before.

Asymptotic results show that approximately

\[ \sum_{i=1}^{r} \sum_{j=1}^{c} \left( \frac{O_{ij} - E_{ij}}{E_{ij}} \right)^2 \]

is distributed as chi-square on \((r-1)(c-1)\) degrees of freedom. Values of this last expression is compared against those in the standard tables for significance.

The implementation of this was through SPSS (a statistical package).

**Example** Further Education by Age

<table>
<thead>
<tr>
<th>Age groups (% of each group)</th>
<th>Young</th>
<th>Middle</th>
<th>Mature</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>No further qualifications</td>
<td>30.4</td>
<td>60.0</td>
<td>64.9</td>
<td>155.3</td>
</tr>
<tr>
<td>Further qualifications</td>
<td>69.6</td>
<td>40.0</td>
<td>35.1</td>
<td>144.7</td>
</tr>
<tr>
<td>Totals</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>300</td>
</tr>
</tbody>
</table>
\[ \chi^2 = \sum_{i=1}^{3} \sum_{j=1}^{2} \left( \frac{O_{ij} - E_{ij}}{E_{ij}} \right) = 27.9 \]

The critical value for 95% significance level is 5.99. Hence we conclude for example that there is very strong evidence at 95% of association between further education and age.
APPENDIX 8

INTERVIEWS WITH THE LEADERS OF THE CONSTRUCTION INDUSTRY
I. Mr Chappell, Powergen plc

1. The project manager should be of technical, business and management background.

Why technical background?
- As a starting point.
- You cannot take somebody from a non-technical background and ask him to manage engineering construction projects.
- Many companies have tried that but did not succeed.
- The technical knowledge is the foundation. Then he needs to supplement that by very strong business emphasis built on the engineering background.
- Universities should take a more business orientation. Things like project appraisal; looking at the investment rather than simply the engineering aspects. All those things are needed.
- Project managers are expected, these days, to be involved in investment appraisal schemes rather than simply the construction or project management.
- The problem is that having gained the basic technical business skills there isn't actually something that you can teach. Project management is not something that you can teach. You have to do it by experience and people progress either through an engineering role; maybe a cost control or a planning route, and they finish up managing the small portion that could be a small part of a major project or a small project and the only way to become acquainted is by experience.
- The people that we employ are former engineering graduates; we put them on business courses, we put them on project
management courses and we look for MSc courses in construction management or project management; we put them in specific tailor-made courses on things like cost estimate or planning and then we give them a job to do.

- The project manager is expected to spend about 10 to 15 years to be able to manage a multi-million pounds project.

- My youngest project manager is probably 34 to 35 years old.

- It is vital that project managers are given the responsibility as self-contained responsibility.

- The project manager has to obtain the right experience to qualify him for the job he is expected to do. This is to say what projects they have been involved with in what aspects they have been successful and then be given the job.

- The project manager has to be able to understand the technical issues. It is wrong to say that he can always call on some technical experts. He has got to make some technical judgements, i.e. variation, changes and he has got to be able to make some assessments on what he has been doing.
II. Mr H Bedelian  Balfour Beatty

- The project manager has got to be an engineer who has not only a technical background but also his understanding of the current management systems in advance.

- The management of construction is something that is not taught at universities and colleges as much as it should be. Therefore to be able to become a good project manager you have got to go through a period of planning, experience and training and so on.

- The educational establishments must obviously play their part in providing the courses with the actual construction companies and so on. If they need to provide training on safety or industrial relations or contractual forms of contract and so on there is no reason why the educational establishments can't link in with companies and provide them.

- During the education stage the schools and universities are responsible for these persons. Then they become part of a company. The company has to be responsible to make sure that they are trained and developed in the way the company wants them to be.

- The construction companies must input into the educational curriculum and the educational establishments must be able to provide some of the courses for the companies.

- There is no harm in having some of the highly analytical type courses for some people, and for some people you expect them to have more practical 'vocational' type courses.

- We, as Balfour Beatty, see how our engineers perform on jobs as they go up from engineers, assistant engineers, section engineers, sub-agents and we have yearly assessments of all our staff on which we can gauge who have got the management sort of capability. During this process, we select certain people and
put them on certain training courses, and we have some which are one month long: management courses. Some of our courses are in-house, some of them we go outside.

- On-the-job record is obviously the main area that they can show us that they are capable.
III. Mr R Broadhead - Taylor Woodrow Construction Holdings Ltd

- The technical background for the project manager is absolutely vital.

- I was a project manager a long time ago and after that I was a contracts manager: you still need to have technical and administrative knowledge because you need to understand what the project managers are doing. I think it depends on the way the company is organised, but certainly in our company, even when you are at 'director' level it is directors who have to identify signs of a contract bid. So he needs to understand his business, he picks up a lot of the skills with courses and experience along his route. He will pick up a bit about law, accountancy, contracts. At the end of the day, the fundamental thing is that the price rate we are offering is technically sound. He has to be able to judge that.

- There always has been a big debate as to whether one should have straight degree courses: 3 years or whether we should have sandwich courses. Inside our company the view is probably split down the middle; half prefer the sandwich course students and half prefer the straight 3 years. I prefer those who have the straight 3 years degree course. The reason I say that, is that by and large the people who are doing the straight 3 year degree at say Loughborough, London University or Manchester, generally have the higher intellect than those doing the four year sandwich courses who are usually polytechnics or similar. You can judge this purely on their 'O' level results and their 'A' level results. The reason there was a split view was that people used to say when you got a four year sandwich course graduate onto the site, he can start doing work right away. But I used to take the view that the fellow with a three year degree course within two or three months he has caught up with it anyway and from then on you got far more potential for a manager for the future, because he has got more intellect, simple. And you are looking for people with intellect because one day he has got to look after my pension.
I have a fundamental belief that in this country one of our problems is that we have messed around with the school education system, we have messed around with degree courses or there is a tendency to mess around with degrees. Certainly in the engineering profession with the Civil's we fiddled around with Chilvers, we got it wrong, we are going back now.

The quantity surveyors have done the same thing. At school level we started with Higher School Certificate then we went on to the 'O' levels and 'A' levels, then we went on to CSE, now we are going on to GCSE. Now we are generally talking about detaching apprenticeships and going into National Vocational Qualifications, we are also talking about NVQ's at level 4 and 5 for degree and upwards. The problem is we are wasting far too much time messing around with it. The one thing that the educational system wants in this country, in my view, is that leave it as it is, so that people can get on with teaching and training and educating rather than struggling to change things all the time. I don't mind a gradual change over years. All the changes we have had, I believe, have been detrimental. I am a civil engineer, when I came up, when anyone who has done part 'C' for the Civil's, then the junior engineer coming up under him, he knows how to help him because he has been through that system. When you change the system they can't do it and you have to remember that people like the managers and engineers have only got a limited amount of time for training because they have got the rest of the business to run. Then if there was the 5 or 10 percent of time they have got available for training, if this is going to be effective they have to be talking about something they already know about, not something they don't understand.

Currently you can qualify for professional status after 4 years if you have had a training agreement, without the training agreement it will take 6 years, so you can still do it.
You can get training with a large company under agreement but you get paid less than some other smaller companies. The individual engineer has to make his own choice.

In most of these instances that I know of that people have done this is because these small builders will pay more, but they don't give any training.

We would look for the engineer's experience on sites. I would look to see that this engineer has got great ideas, he has got to have that if he is going anywhere. In addition, I will be looking for someone who has worked for the company for quite a long time. I don't want to appoint a project manager tomorrow fresh from the street because when the things get rough he might pack his bags and go, so normally I would look for a project manager who had been with me for ten years, so I know he had been with me through the mill and I know he would stick at it when things got rough.

The project manager will be appointed normally at the age of 35 years after long working experience. By then you have got about 14 or 15 years experience of the company, you know how that company works, you know the company ethos, you know who to go to when you are in trouble, you know who will help you, you know who won't help you.
Mr I Reeves  
High-Point plc

- Universities and educational establishments in general over-emphasise the technical capability of people and under develop the personal qualities of people;

- There needs to be much more understanding of behavioural science, psychology, far more development of management skills, financial and legal understanding by managers. They have to have a better total self confidence of the total environment within which they are operating;

- We do enough about leadership, motivation and the importance of making decisions. Many project managers don't seem able to make decisions, take responsibility, and tend to hide in the system.

- In my view, we need to develop broad leaders. We need people with the self confidence and willingness to make decisions, to take responsibility for those decisions. We need people who understand about the relationships within their companies, understanding of legal and financial and administrative required knowledge, none of which, in my view, is adequately taught within the universities or their courses.

- We need to develop the people in the broader human sense.

- Half the technical expertise taught to these people (engineers) as thermodynamics and stresses and strain and everything else that we teach people, half of it is used. There is a lot of theory that they learn and no practicality. When I talk to people in Birmingham University or elsewhere they tell me that these things are changing and it is changing but the rate is slow. It is evolution rather then revolution.
V. Mr C Stanhope  John Brown Engineers & Constructors Ltd

- Having a technical degree is a better foundation for the project manager.

- Managing a project is a technical thing. If you are in a project management of a financial venture, like in a bank then it would be better if they were of a financial background.

- We should follow an intermediate, a transitional phase during which training is to be funded by the government. You cannot expect companies to pay for this themselves. It needs to be supported by some central funds. It could not happen at once.

- Project managers must have an awareness of all the other aspects such as financial, managerial and contractual. In a project you have experts who are doing the financial side, accounting, planning and economics. All the manager is doing is to manage those experts.

- If you look at the making of the project, probably about 60% is technical effort. 35 to 40 percent is the support efforts such as the administration, cost control, planning.

- Most of these required skills are delivered by short courses. Large companies will do it themselves.

- On-the-job experience gives you an awareness of what you are doing. That is why it is essential.

- Having and academic qualification demonstrates to the employer that he is capable of attaining a certain level of achievement.