Data Supply Chain (DSC): development and validation of a measurement instrument

Data Supply Chain (DSC): development and validation of a measurement instrument

Konstantina Spanaki (k.spanaki@imperial.ac.uk)
Department of Innovation and Entrepreneurship,
Imperial College Business School,
South Kensington Campus
London SW72AZ, United Kingdom

Richard Adams (r.adams@surrey.ac.uk)
Surrey Business School,
University of Surrey,
Guildford GU2 7XH, United Kingdom

Catherine Mulligan (c.mulligan@imperial.ac.uk)
Department of Innovation and Entrepreneurship,
Imperial College Business School,
South Kensington Campus
London SW72AZ, United Kingdom

Emil Lupu (e.c.lupu@imperial.ac.uk)
Department of Computing,
Imperial College London,
South Kensington Campus
London SW72AZ, United Kingdom

Abstract

The volume and availability of data produced and affordably stored has become an important new resource for building organizational competitive advantage. Reflecting this, and expanding the concept of the supply chain, we propose the Data Supply Chain (DSC) as a novel concept to aid investigations into how the interconnected data characteristics relate to and impact organizational performance. Initially, we define the concept and develop a research agenda on DSC coupling theoretical background of strategy and operations literature. Along with the conceptualization, we develop a set of propositions and make suggestions for future research including testing and validating the model fit.

Keywords: Data Supply Chain (DSC); Supply Chain Management (SCM); Survey research

Introduction

Big Data as a 'paradigm-shifting phenomenon' (George *et al.*, 2014; LaValle *et al.*, 2013; Chen *et al.*, 2012) has triggered great interest amongst both academic and practitioner communities especially because of the multiple opportunities and challenges it constitutes. Big Data's initial conceptualisation as unprecedented volumes of data, beyond the capacity of extant tools and analytics to manage (Manyika *et al.*,

2011), has been superseded by more comprehensive views (Boyd and Crawford, 2012). Current conceptualisations propose three (Laney, 2001), four (Lycett, 2013) or even five (Erevelles *et al.*, 2016) Vs. In addition to Volume, these include: Variety, Velocity, Veracity and Value. Due to its disruptive and transformatory potential (Yoo *et al.*, 2012; Normann, 2001), it has become clear that this data revolution offers new challenges – such as developing new organizational capabilities (Davenport *et al.*, 2012) - and opportunities for organizations to innovate, create strategic advantage and generate new business value (Koutroumpis and Leiponen, 2013). As an organizational resource, data has grown in importance and the effective management of data streams, originating both endogenously and exogenously from the focal firm and exhibiting the characteristics of big data, has become a critical strategic and managerial concern (Mulligan, 2011).

This paper proposes the concept of the Data Supply Chain (DSC) to capture and describe the emergent collaborative strategies across organisational boundaries for the integration and use of data combining internal and external sources. These data supply chains are created across organizations and therefore there is interest of how organizations can gain strategic advantage through their use. Exploring the emerging concept of Data Supply Chains and the promising role of Big Data in this revolution, can give a further insight of how these supply chains are formed and how organizations mobilize their capabilities and capacities around them.

Our primary research question is: *What is the impact of Data Supply Chains on organizational performance?* The aim of the study is to uncover the nature of data supply chain and explore its relationship with conventional types of supply chains based on the associated value for the organizations. Following Croom et al. (2000) we take a content-oriented approach to conceptualize DSC and Crook et al (2005) with a growth-oriented approach to understand the DSC links with organizational performance. Specifically, we draw on the largely conceptual work in the supply chain literature to develop a definition of DSC and a measure of organizational performance conceived in terms of value. We conceive organizational performance as enhanced strategic advantage and consequently enhanced value creation. The objectives of this research are therefore to: a) introduce the concept of the data supply chain, b) extend previous research on supply chains into the context of the knowledge economy and big data, c) propose a research agenda on the relationship between data supply chains and organizational performance.

Theoretical Foundations

A literature review of the 'Big Data' term (Wamba *et al.*, 2015) illustrates the different perspectives on the definition of the phenomenon. For example, McKinsey reports Big Data as those datasets whose size is beyond the ability of typical database software tools to capture, store, manage, and analyse (Manyika *et al.*, 2011), this approach gives a specific focus on the size of the data which makes them 'big' and varies in different sectors and industries as well as while technology evolves. Thus, Chen et al (2012) describe Big Data as "the data sets and analytical techniques in applications that are so large (from terabytes to exabytes) and complex (from sensor to social media data) that they require advanced and unique data storage, management, analysis, and visualization technologies" (Chen *et al.*, 2012) and mostly perceive big data in terms of their implications for Business Analytics. Within this context, Big Data is a term coined to describe this quantity of data though it is something of a slippery concept: a generalized, imprecise term (Crawford and Schultz, 2014) and usually normal data becomes Big Data when it exceeds our ability to process and analyse it with traditional tools (Chen *et*

al., 2012). Big Data has introduced an evolution in the world economy taking a fundamental position, as the data streams pouring out of different devices and in different formats are produced on massive scale on a daily basis and introduce a vast amount of opportunities and challenges for organizations and individuals (Wamba *et al.*, 2015).

The concept of a Data supply chain, introduced in this paper, is based on the theoretical background of supply chain management (Cao and Zhang, 2011; Li *et al.*, 2006; Li *et al.*, 2005; Chen and Paulraj, 2004), however we extend Supply Chain Management literature in a different direction of that introduced by Waller and Fawcett (2013) within the notion of Big Data context. Our claim is that there is a new supply chain where the data itself, gathered from different sources, is used as a resource in order to create new 'information products' (Mulligan, 2011) and services (Maull *et al.*, 2014). These information products/services are based on data combined in any number of ways improving internal and external organizational processes; this change presented by the digital economy introduces new business strategies around data and more importantly disrupts existing business models. The increasing availability and quantity of data can now be realised through Resource- Based View (RBV) theory as a new form of resource for companies improving efficiency and effectiveness and introducing new products (Teece *et al.*, 1997; Teece and Pisano, 1994; Barney, 1991).

Supply Chain Management (SCM)

As defined by the Supply Chain Council, a supply chain encompasses every effort involved in producing and delivering a final product from the supplier's supplier to the customer's customer (Stephens, 2001). Council of Logistics Management defines Supply Chain Management (SCM) as the systemic, strategic coordination of the traditional business functions and tactics within a particular organization and across businesses within the supply chain for the purposes of improving the long-term performance of the individual organizations and the supply chain as a whole (Global Logistics Research Team, 1995). SCM has been defined to explicitly recognize the strategic nature of coordination between trading partners and to explain the dual purpose of SCM: to improve the performance of an individual organization, and to improve the performance of the whole supply chain (Croom *et al.*, 2000). The goal of SCM is to integrate both information and material flows seamlessly across the supply chain as an effective competitive weapon (Li *et al.*, 2006; Stephens, 2001).

The concept of SCM has received increasing attention from academics, consultants, and business managers alike (Storey *et al.*, 2006). Many organizations have begun to recognize that SCM is the key to building sustainable competitive edge for their products and/or services in an increasingly crowded marketplace. The concept of SCM has been considered from different points of view in different bodies of literature (Croom *et al.*, 2000) such as purchasing and supply management, logistics and transportation, operations management, marketing, organizational theory, and management information systems. This paper focuses on the theoretical background of SCM as this is developed by Storey et al (2006) and specifically on the characteristics summarized in a taxonomical approach (Storey *et al.*, 2006), which will assist in understanding the similarities and differences between conventional supply chains and DSC and how studying DSC can extend the theoretical background of SCM.

Data in Supply Chain Management (SCM)

Big Data analytics in logistics and supply chain is defined as Supply Chain Analytics (SCA) by Wang et al (2016). That is focusing mostly on 'developing supply chain *strategies* and efficiently managing supply chain operations at tactical and operational levels' with the use of Big Data analytics functions (2016). This literature direction focuses on how the analytics can applied to strategic decisions related to SCM (Wang *et al.*, 2016; Wamba *et al.*, 2015), how efficiency and effectiveness of supply chains can be improved through the use of Big Data (Waller and Fawcett, 2013) as well as the data strategies and servitization around supply chains (Opresnik and Taisch, 2015). The current direction of Supply Chain Management (SCM) literature is focusing mostly on research on the use of data in supply chains, however this research will focus on the supply chains of data.

Research Design and Approach

To address the over-arching research question, we identify the following sub-set of questions that define a 3-step approach (Table 1). First, we will explain the emergence of data supply chain through a literature review of the digital economy landscape putting data strategies on the core of attention alongside the resource-based view of the firm and dynamic capabilities. Building on this, we conceptualize and explore the dimensions of the phenomenon to underpin our investigation of its relation with organizational performance. Next, we develop propositions relating data supply chain with organizational performance.

Table 1: 3-step approach

Question	**Step**
What is a Data Supply Chain?	Define the concept of Data Supply Chain compared to a traditional supply chain
What are the key dimensions associated with Data Supply Chains?	Identify the characteristics of Data Supply Chains compared to the characteristics of s traditional supply chain.
What is the relationship between Data Supply Chains and Organisational Performance?	Understand the links between the constructs and evaluate the structural model

The 3-step approach

As discussed in the previous section, Big Data era has introduced an evolution in the world economy, introducing a vast amount of opportunities and challenges for organizations and individuals. Systems can now integrate data and workflows at increasing speed and precision, informing the digital economy with new rules and models through the creation of data-driven strategies. Through combining data streams together from different companies, information products/services are created as a result of combined data.

Definition of Data Supply Chain (DSC)

We define a data supply chain (DSC) as a supply chain created from data that is formed *across* organisational boundaries. Where traditional supply chains allow for the exchange of physical goods, which are transferred between companies (e.g. cocoa beans transferred along a supply chain becomes coffee, which is finally sold to an end-user), DSC exchange data between one another in order to either:

1) Create new information products that can be used for decision making within the company itself

2) Create new data or information products that are for resale to other companies
3) Have third parties combine the data from several sources together into a new product/service or even a new company

A key difference between a traditional supply chain and a DSC is that a traditional supply chain deals with *physical goods*, while a DSC deals solely with data. Traditional supply chains may be complemented with increased use of data and analytics, however, those supply chains that are related to the application of data to improve processes within existing physical supply chains are not DSC. Figure 1 below illustrates the difference between a DSC and a traditional supply chain:

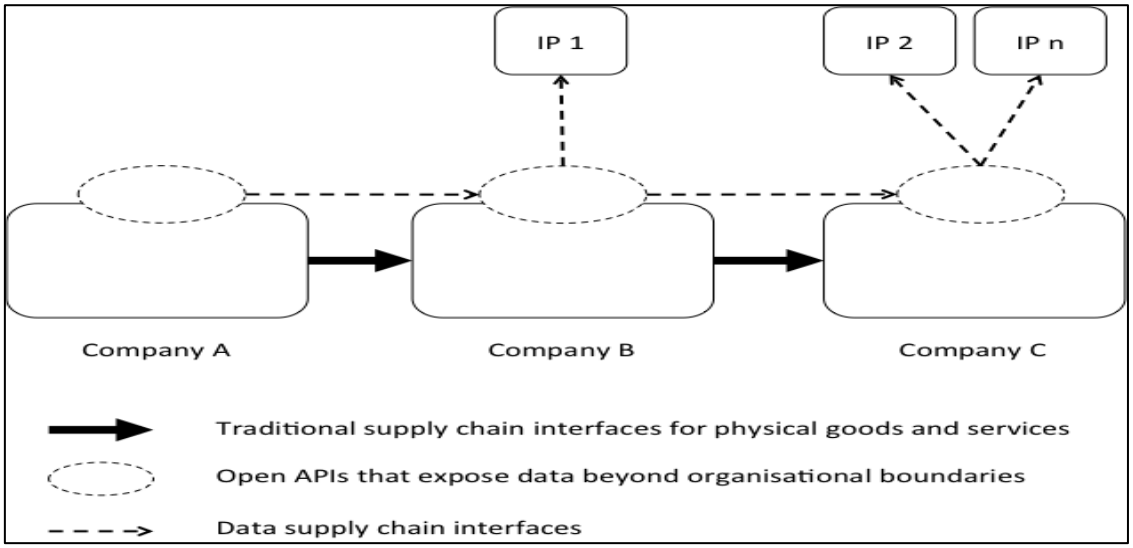

Figure 1: Data Supply Chain versus Traditional Supply Chain Interfaces

Data has always existed; however with the advances of technology with open APIs (Mulligan, 2008) cloud computing, the cost to store this data is considerably lower that for an extremely long period of time. It is now possible, therefore, for information and digital systems to be packaged, bundled and exchanged between economic actors with greater ease than previously (Holler *et al.*, 2014; Mulligan, 2011). Value is no longer solely measured through "value-in-use" or "value-in-exchange", but there is now also a "value-in-reuse", specifically because the asset, data, is not consumed within the processes of production as with previous generations of resources (Vargo and Lusch, 2004).

Data collection, storage and processing are forming the basis of what may be viewed as a Data Supply Chain: a supply chain where the raw material is data and meta-data. The information product/service as the output of the Data Supply Chain can be valued, and therefore priced depending on how it is combined and how it is re-used within the value chain (Holler *et al.*, 2014). The level of analysis described above requires aggregation of data from many different people and its collation into an information product, one that may be used as input into corporate and end-user decision-making processes.

Key dimensions of Data Supply Chain (DSC)

Supply Chain Management (SCM) as it was previously described (in theoretical background section) involves a huge amount of theories and propositions around this field and mostly these relate to topics of supply chain alignment and integration (Cao and Zhang, 2011; Li *et al.*, 2006; Bowersox *et al.*, 2003; Croom *et al.*, 2000).

Storey et al (2006) support that the theoretical lens around Supply Chain Management is usually based on idealized schemas of optimal routes and quantities for demand fulfillment when considered from a network or chain perspective. These idealized perspectives of SCM share some relatively common elements which are presented in Table 2 (adopted by Storey et al (2006)) and they are expanded to represent the respective characteristics of the Data Supply Chain (DSC) introduced in this paper. Table 2 summarizes the characteristics of an ideally managed Supply Chain and a Data Supply Chain. The dimensions/ characteristics presented in Table 2, are explained as follows:

- *The element of exchange* – what is the supply chain exchanging (content-oriented approach)
- *The level of analysis* - the interaction of the supply chain with the environment (endogenous and exogenous)
- *The unit of analysis* - the focus of the supply chain, the flow that each supply chain follows.
- *Strategy* - the goals each supply chain has to fulfil and in a general approach the motivation that formed this specific supply chain
- *Use of information and knowledge* - how each supply chain applies knowledge and information management.
- *Partner relationship management* - what relationships are maintained from each supply chain.
- *Technological enabler* - the technological context applied for each supply chain.
- *Output* - what is the final outcome of the supply chain process.
- *Scope* - the focus of the supply chain's actions and practices
- *Manufacturing approach* - the method the supply chain's manufacturing system follows.
- *Customization level* - the possibility of the output to be customized.
- *Market* – where each supply chain targets to sell the outputs.
- *Scope of attention* – the behaviour the members of the supply chain follow.

The taxonomical approach is presented in Table 2 highlighting each characteristic/dimension for the conventional supply chains and DSC respectively. By putting the characteristics together in an organized manner, we can understand the similarities and differences these can share, and how (in what sense) DSC can introduce a new research area within Supply Chain Management.

Table 2: Taxonomy of Supply Chain Characteristics (Storey *et al.*, 2006) *and DSC Characteristics*

Dimensions/ Characteristics	**Supply Chain**	**Data Supply Chain (DSC)**
1. Element of exchange	Assets; Information; Knowledge; Relationships	Data; Information; Information Products/Services
2. Level of analysis	Dyadic; Chain; Network	Chain; Network
3. Unit of analysis	Exchange flow	Value creation flow
4. Strategy	Demand-led	Innovation-led
5. Use of information and knowledge	Information & knowledge sharing practices	Product development

6. Partner relationship management	Collaboration; partnership	Collaboration; partnership & co-creation
7. Technological enabler	IT- enabled	Data analytics- enabled
8. Output	Product	Information product; service
9. Scope	Market responsive	Product/Service Innovation
10. Manufacturing approach	Agile; lean	Agile; lean & sustainable
11. Customization level	Mass customization	Personalisation
12. Market	segmentation	mass
13. Scope of attention	Expansive knowledgeable behaviour (not role specific)	Data Analytical behaviour (focusing on data analytics skills)

Research agenda on DSC - Propositions

The necessary condition for data supply chain is that the supply chain partners are able to expand the total gain due to the collaborative use of data (Waller and Fawcett, 2013). The data supply chain partners will gain financial benefits by increasing responsiveness, especially for innovative products (Maull *et al.*, 2014; Vargo and Lusch, 2004). The literature also supports the ability of partnerships to achieve cost savings and reduce duplication of efforts by the firms involved (Lado *et al.*, 1997). In particular, cooperation among competitors can foster greater knowledge seeking and result in more effective data supply chains (Waller and Fawcett, 2013).

In the short term, firms will see operational improvements (e.g., productivity, operational efficiency) as the primary benefits. In the long run, firms expect the supply chain collaboration to pay off through more competitive products (Opresnik and Taisch, 2015) and quicker product development that will transform into possible competitive advantage and increased profits (Opresnik and Taisch, 2015; Wamba *et al.*, 2015). Thus this study proposes:

- ***Proposition 1:*** *Data Supply Chain has a significant positive effect on Organizational performance.*

Data supply chains can introduce a pervasive business strategy among collaborating supply chain partners, enabling them to undergird their strategic position and advantage (Waller and Fawcett, 2013; Cao and Zhang, 2011; Manyika *et al.*, 2011; Chen and Paulraj, 2004). By collaborating through data supply chains, organizations can exploit the opportunity arising from combined Big Data and supply chain management (Maull *et al.*, 2014; Mulligan, 2011). Through the appropriate strategy, based on the data analytics capabilities and skills of each organization (Wang *et al.*, 2016), new revenue streams can be created, while using different streams of data through data sharing, using and selling/ reselling (Wamba *et al.*, 2015; Opresnik and Taisch, 2015).

In a data collaboration environment organizations following their data supply chains can differentiate themselves from their competitors or partners by exploiting and generating data based on their own strategies(Cao and Zhang, 2011; Cao *et al.*, 2010) . By using their core capabilities they can increase their competitiveness among their supply chain partners through product innovation, closer interactions with consumers and higher customer retention rate and business model innovation (Opresnik and Taisch, 2015). Data strategies enable firms to create new products and services, enhance existing ones,

and invent entirely new business models (e.g., use of data obtained from the use of actual products to improve the development of the next generation of products and to create innovative after-sales service offerings) while sharing and using/selling their data for their data supply chains. Therefore, organizations are following different data strategies in order to be competitive and innovative in a data collaboration environment.
Supply chain collaboration can deliver benefits to all partners, for example, reducing risk and cost and increasing productivity and profit (Cao *et al.*, 2010). However, collaborating with partners can also cause increased costs of coordination, compromise, and inflexibility. Potentially, there are many other factors that might impact firm performance including environmental or contextual variables such as the level of data collaboration between the data supply chains. The level of data collaboration can depend on the fact that the organization uses mostly or only internal data, if organization uses both internal and external data, the level the organization collaborates on data use (small, medium, large data collaboration).
Organizations with different level of data collaboration might have different data supply chains, achieve different levels of strategic advantage and benefits, and thus attain different levels of organizational performance. Thus, this study proposes that data collaboration can intensify the relationships of the framework. Specifically,

- ***Proposition 2:*** *Data Collaboration intensifies the relationship between Data Supply Chain and Organizational performance.*

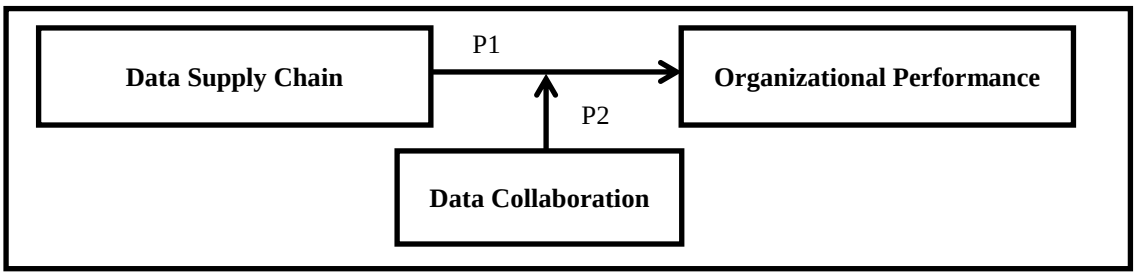

Figure 2- Impact of Data Supply Chain on Organizational performance

Contributions

The results will test the proposed model and will contribute to our knowledge on data supply chain by providing theoretical insights and empirical findings. The research also intends to develop reliable and valid instruments linking data supply chains with organizational performance.
Besides contributing to the literature in terms of a conceptual foundation for Data Supply Chains (DSC) the paper presents a number of other contributions. A definition of the Data Supply Chain is provided, presenting an interesting yet challenging field of research within the notion of big data evolution and knowledge economy which focuses lately on the use of data in supply chains (Wang *et al.*, 2016; Wamba *et al.*, 2015). Without neglecting the important role of data in supply chain management, we draw specific attention on the supply chains of data, which is an area that should be further explored. Such research highlights the value of exploring beyond the boundaries of a company to a collaborating pattern of using data and creating value opportunities and disrupting the already existing business models.

Future research directions

Future research must begin with testing the validity of the proposed framework through an online survey of data-intensive organizations in a cross-section of selected industries. This will provide the empirical validation of the framework fit through structural equation modelling techniques (SEM)

Further exploratory, qualitative research is required to explore the model and determine if the proposed constructs are indeed most representative of the Data Supply Chains (DCS). The framework then requires assessment in a variety of settings to determine generalizability and validity. This includes deducing and testing null hypotheses for each of the propositions stated in this paper. Analytical techniques such as structural equation modelling will enable assessment of the value of each of the constructs and dimensions.

Then, the impact of DSCs on organizational performance will finally provide empirical evidence about these relationships. As a result of exploring the literature, we predict that the existence of data supply chain collaboration intensifies these relationships and can provide a basis of the use of data from both internal and external sources.

Acknowledgements

The authors would like to acknowledge Grants EP/ K039504/1 and EP/L022729/1from Engineering and Physical Sciences Research Council (EPSRC), which funded this research.

References

Barney, J. (1991) "Firm resources and sustained competitive advantage", *Journal of management,* vol. 17, no. 1, pp. 99-120.

Bowersox, D.J., Closs, D.J. and Stank, T.P. (2003) "How to master cross-enterprise collaboration", *Supply chain management review,* vol. 7, no. 4, pp. 18-27.

Boyd, D. and Crawford, K. (2012) "Critical questions for big data: Provocations for a cultural, technological, and scholarly phenomenon", *Information, communication & society,* vol. 15, no. 5, pp. 662-679.

Cao, M., Vonderembse, M.A., Zhang, Q. and Ragu-Nathan, T. (2010) "Supply chain collaboration: conceptualisation and instrument development", *International Journal of Production Research,* vol. 48, no. 22, pp. 6613-6635.

Cao, M. and Zhang, Q. (2011) "Supply chain collaboration: Impact on collaborative advantage and firm performance", *Journal of Operations Management,* vol. 29, no. 3, pp. 163-180.

Chen, H., Chiang, R.H. and Storey, V.C. (2012) "Business Intelligence and Analytics: From Big Data to Big Impact.", *MIS quarterly,* vol. 36, no. 4, pp. 1165-1188.

Chen, I.J. and Paulraj, A. (2004) "Towards a theory of supply chain management: the constructs and measurements", *Journal of Operations Management,* vol. 22, no. 2, pp. 119-150.

Crawford, K. and Schultz, J. (2014) "Big Data and Due Process: Toward a Framework to Redress Predictive Privacy Harms", *Boston College Law Review,* vol. 55, no. 1, pp. 93.

Crook, T.R., Combs, J.G. and Shook, C.L. (2005) "The Dimensionality of Organizational Performance and its Implications for Strategic Management Research", *Research Methodology in Strategy and Management,* vol. 2, pp. 259-286.

Croom, S., Romano, P. and Giannakis, M. (2000) "Supply chain management: an analytical framework for critical literature review", *European journal of purchasing & supply management,* vol. 6, no. 1, pp. 67-83.

Davenport, T.H., Thomas, R.J. and Cantrell, S. (2012) "The mysterious art and science of knowledge-worker performance", *MIT Sloan Management Review,* vol. 44, no. 1.

Erevelles, S., Fukawa, N. and Swayne, L. (2016) "Big Data consumer analytics and the transformation of marketing", *Journal of Business Research,* vol. 69, no. 2, pp. 897-904.

George, G., Haas, M.R. and Pentland, A. (2014) "Big data and management", *Academy of Management Journal,* vol. 57, no. 2, pp. 321-326.

Global Logistics Research Team (1995) *World class logistics: the challenge of managing continuous change*, Council of Logistics Management.

Holler, J., Tsiatsis, V., Mulligan, C., Avesand, S., Karnouskos, S. and Boyle, D. (2014) *From Machine-to-machine to the Internet of Things: Introduction to a New Age of Intelligence*, Academic Press.

Koutroumpis, P. and Leiponen, A. (2013) "Understanding the value of (big) data", *2013 IEEE International Conference on Big Data*.

Lado, A.A., Boyd, N.G. and Hanlon, S.C. (1997) "Competition, cooperation, and the search for economic rents: a syncretic model", *Academy of Management Review*, vol. 22, no. 1, pp. 110-141.

Laney, D. (2001) "3d data management: Controlling data volume, velocity and variety", *Gartner*, .

LaValle, S., Lesser, E., Shockley, R., Hopkins, M.S. and Kruschwitz, N. (2013) "Big data, analytics and the path from insights to value", *MIT Sloan Management Review*, vol. 62, no. 4.

Li, S., Ragu-Nathan, B., Ragu-Nathan, T. and Rao, S.S. (2006) "The impact of supply chain management practices on competitive advantage and organizational performance", *Omega*, vol. 34, no. 2, pp. 107-124.

Li, S., Rao, S.S., Ragu-Nathan, T. and Ragu-Nathan, B. (2005) "Development and validation of a measurement instrument for studying supply chain management practices", *Journal of Operations Management*, vol. 23, no. 6, pp. 618-641.

Lycett, M. (2013) "'Datafication': Making sense of (big) data in a complex world", *European Journal of Information Systems*, vol. 22, no. 4, pp. 381-386.

Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C. and Byers, A.H. (2011) "Big data: The next frontier for innovation, competition", *Technical report, McKinsey Global Institute*, .

Maull, R., Godsiff, P. and Mulligan, C. (2014) "The Impact of Datafication on Service Systems", IEEE, , pp. 1193.

Mulligan, C. (2008) "Open API standardisation for the NGN platform", *Innovations in NGN: Future Network and Services, 2008. K-INGN 2008. First ITU-T Kaleidoscope Academic Conference*IEEE, , pp. 25.

Mulligan, C.E. (2011) *The communications industries in the era of convergence*, Routledge.

Normann, R. (2001) *Reframing Business: When the Map Changes the Landscape*. Wiley, Chichester.

Opresnik, D. and Taisch, M. (2015) "The value of Big Data in servitization", *International Journal of Production Economics*, vol. 165, no. C, pp. 174-184.

Stephens, S. (2001) "Supply chain council & supply chain operations reference (scor) model overview", *Supply Chain Council, Inc., Pittsburgh, USA*, .

Storey, J., Emberson, C., Godsell, J. and Harrison, A. (2006) "Supply chain management: theory, practice and future challenges", *International Journal of Operations & Production Management*, vol. 26, no. 7, pp. 754-774.

Teece, D.J., Pisano, G. and Shuen, A. (1997) "Dynamic capabilities and strategic management", *Strategic Management Journal*, vol. 18, no. 7, pp. 509-533.

Teece, D. and Pisano, G. (1994) "The dynamic capabilities of firms: an introduction", *Industrial and corporate change*, vol. 3, no. 3, pp. 537-556.

Vargo, S.L. and Lusch, R.F. (2004) "Evolving to a new dominant logic for marketing", *Journal of Marketing*, vol. 68, no. 1, pp. 1-17.

Waller, M.A. and Fawcett, S.E. (2013) "Data science, predictive analytics, and big data: a revolution that will transform supply chain design and management", *Journal of Business Logistics*, vol. 34, no. 2, pp. 77-84.

Wamba, S.F., Akter, S., Edwards, A., Chopin, G. and Gnanzou, D. (2015) "How 'big data'can make big impact: Findings from a systematic review and a longitudinal case study", *International Journal of Production Economics*, vol. 165, pp. 234-246.

Wang, G., Gunasekaran, A., Ngai, E.W. and Papadopoulos, T. (2016) "Big data analytics in logistics and supply chain management: Certain investigations for research and applications", *International Journal of Production Economics*, vol. 176, pp. 98-110.

Yoo, Y., Boland Jr, R.J., Lyytinen, K. and Majchrzak, A. (2012) "Organizing for innovation in the digitized world", *Organization Science*, vol. 23, no. 5, pp. 1398-1408.