# Exploring Business intelligence capabilities for supply chain:a systematic review

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**Abstract**

Many organisations have effectively used BDA capabilities in the era of Big Data to extract value from data and boost performance. For a firm to flourish, BDA competencies for supply chain management must be developed. In order to create the capabilities maturity model for SCM and to offer a thorough literature evaluation of BDA capabilities in the context of the supply chain. In this research, a conceptual framework linking BDA capabilities with various stages of added value generation and assimilation is suggested. This study makes a contribution to the theory of BDA capabilities and offers ideas for further investigation.

**Keywords:** Big Data Analytics, Supply chain, literature review.

## Introduction

Big Data Analytics (BDA) may be a key factor in altering and enhancing supply chain operations as a useful tool for decision-making. Corporate executives prefer to make judgments in this dynamic business climate by using data-driven insights rather of their gut feelings (Davenport 2006). Organizations are highly driven to increase their technological and organisational capacities to extract value from data due to the perceived benefits of BDA. However, practitioners have a very difficult time comprehending the skills needed to turn data into value. Utilizing BDA technology might enhance an organization's capabilities in the dynamic, quickly changing market climate of today (Meredith et al. 2012). Organizational and behavioural concerns related to BDA adoption and practise must be addressed if supply chain BDA technologies are to be effectively managed. To fully reap the rewards of big data, a thorough analysis of BDA capabilities is necessary due to the paucity of research on BDA capabilities in supply chains. There are not many empirical studies analysing the influence of BDA capabilities on SCM, according to the literature study conducted for this research. Additionally, there is a dearth of academic research on BDA maturity models, hence this work aims to fill in these gaps. By synthesising the literature, this review aims to summarise, characterise, and conceptualise the body of existing research as well as the aspects of BDA capabilities. Finally, a conceptual model and propositions are constructed.

## Research approach

In this article, the literature review methodology suggested by Mayring (2003) is used. Gao et al. (2016) and Seuring and Müller (2008) also analyse prior research publications using a similar methodology. The four sequential phases of this review technique are material collection, descriptive analysis, category selection, and material assessment. To further conceptualise BDA capabilities, theme analysis is utilised to examine BDA practise in SCM. By recognising themes and classifying them during the review process, the conceptual framework and its dimensions have changed as a result of the study. It is a growing topic, thus a deductive method is needed since new codes must be created in an adaptable manner as they are revealed by the data (Saunders et al. 2016, p.582).

The literature on Big Data analytics in SCM is searched using a number of phrases linked to BDA as keywords. By encompassing all conceivable keywords linked to BDA practise in organisations, this study uses a comprehensive approach in contrast to other Systematic Literature Reviews (SLRs) in this field. Similar to this, several SCM-related terms are also

found. These phrases are combined in various ways to search for pertinent research publications. For the purpose of review, similar peer-reviewed publications are searched using the Scopus and Web of Science (WoS) databases. The number of publications obtained during the initial search is shown in Table 1 along with the keywords selected for the literature search. Additionally, only journal articles written in English are included. In line with conference papers, articles published in for-profit periodicals, and book chapters from Fahimnia et al. (2015) The first round of shortlisting generated 619 articles. The complete text of the remaining papers is studied in order to further weed out unnecessary papers once the duplication has been removed and verified in the Endnote programme. Only papers that clearly explain the use of BDA in SCM are chosen for the present review. This ultimately led to 82 publications that covered the years 2008 through 2016. 13 maturity models are also shortlisted for the assessment process from academic and commercial sources. The content of the chosen articles is next examined and categorised using a variety of criteria, including the distribution of publication years and research methodologies. The use of bibliometric analysis—to summarise prior research—and theme analysis—to conceptualise the content of literature—complements the analysis and assessment process.

*Table 1: Initial search results*

| Search terms | SCOPUS | WoS |
|---|---|---|
| **"Big Data" and "Supply chain"** | 104 | **65** |
| **"Big Data" and "logistics"** | 101 | **30** |
| **"Big Data" and "operations management"** | 15 | **8** |
| **"Big Data" and "operational performance"** | 1 | **1** |
| **"Big Data" and "operations research"** | 6 | **3** |
| **"Business Analytics" and "supply chain"** | 10 | **13** |
| **"Business Analytics " and "logistics"** | 6 | **4** |
| **"Business Analytics" and "operational performance"** | 2 | **2** |
| **"Business Analytics" and "operations management"** | 3 | **3** |
| **"Business Analytics" and "operations research"** | 4 | **5** |
| **"Business Intelligence" and "supply chain"** | 64 | **35** |
| **"Business Intelligence" and "logistics"** | 39 | **17** |
| **"Business Intelligence" and "operational performance"** | 7 | **4** |
| **"Business Intelligence" and "operations management"** | 3 | **3** |
| **"Business Intelligence" and "operations research"** | 6 | **3** |
| **"Business Intelligence" and "operational performance"** | 7 | **4** |
| **"Supply chain analytics"** | 8 | **4** |
| **"Supply chain" and "predictive analytics"** | **16** | **13** |

**Findings of literature review**

Findings indicate that there is a rising trend in the volume of papers published in the area of business decision analysis in supply chains. The majority of the 82 articles that were chosen were published within the previous four years, indicating that scholars are becoming increasingly interested in studying the phenomena of BDA in the context of supply chains. Using the BibExcel tool, the top 10 authors were retrieved. Gunasekaran, who has seven publications, comes in first on the list, followed by Childe, Huang, Hazen, Papadopoulos, Wamba, and Zhong. However, the h-index and citation counts were used to assess the effect of writers further. In these criteria, it is discovered that Fawcett and Waller predominate, followed by Chae and Gunasekaran. The most popular ideas that have been put out to explain the phenomena of BDA adoption and use are also reviewed. 38% of research publications make considerable use of the Resource-Based View (RBV). In addition, additional theories such the dynamic capability theory (19%), information processing perspective (15%), contingency theory (8%), and social capital theory (4%), are commonly used. In addition, frameworks like Technology Organization Environment (TOE) are used to examine how organisations implement BDAs (Chen et al. 2015). To examine the phenomena of BDA practise, there is enough room for the application and validation of a number of additional theoretical lenses, including knowledge-based perspective, absorptive capacity, systems theory, institutional isomorphism, and agency theory. Furthermore, a review of numerous theories that might be used in this field is offered by Hazen et al. (2016). There is also a summary of the research techniques employed in the chosen publications. The conceptual method has been employed in the majority of studies, followed by case studies and survey-based research. A combined, analytical, and experimental research strategy has been applied in certain articles. It's interesting that a brand-new academic research methodology has evolved to solve supply chain problems: social media research. In particular, recent studies by Bhattacharjya et al. (2016), Mishra and Singh (2016), Papadopoulos et al. (2016), Chae (2015), and Chan et al. (2015) have concentrated on the use of social media data and text mining approach to address issues related to food supply chain, customer service, and operations management. These studies used data from Twitter and Facebook. This modification of research techniques demonstrates how the BDA has affected the academic sector as well. Hu et al. (2014), Trkman et al. (2010), and Waller and Fawcett (2013 b) have earned the most citations out of the chosen publications. The influence of business analytics on supply chain performance was first quantitatively examined by Trkman et al. (2010), then by a number of additional scholars.

## Conceptual model development

The examined articles are further categorised using theme analysis into five major aspects from the standpoint of capabilities: Data Generation (DG), Data Integration and Management (DIM), Advanced Analytics (AA), Data visualisation (DV), and Data-Driven Culture (DDC). Additionally, research demonstrated the need of cloud computing and absorbtive capacity as supporting the essential BDA skills.

- *Data Generation (DG) capability* is the ability of organisations to seek, identify, create, and access data from heterogeneous data sources across organisational boundaries.
- *DIM capability* is the ability of organisations to utilize tools and techniques to collect, integrate, transform and store data from heterogeneous data sources. The level of data integration, and ability to integrate different types of data gathered across organisational boundaries in real-time constitutes DIM capabilities.
- *Advanced Analytics capabilities* is defined as the ability of organisations to utilise tools and techniques to analyse supply chain data in batch wise, real-time, near-time, or as it flows and extracts meaningful insights for decision making.
- *Data Visualisation capability* is the ability of organisations to utilise tools and techniques to render information visuals and deliver the data-driven insights intuitively in a timely manner to the decision makers.
- *Data-driven culture* is an intangible resource that represents the beliefs, attitudes, and opinion of people towards data-driven decision-making.

Further, a conceptual model is developed to explain the role of BDA capabilities maturity and organisational absorptive capacity in enhancing organisational performance. Consequently, two propositions are discussed in this paper based on the model shown in figure 1.

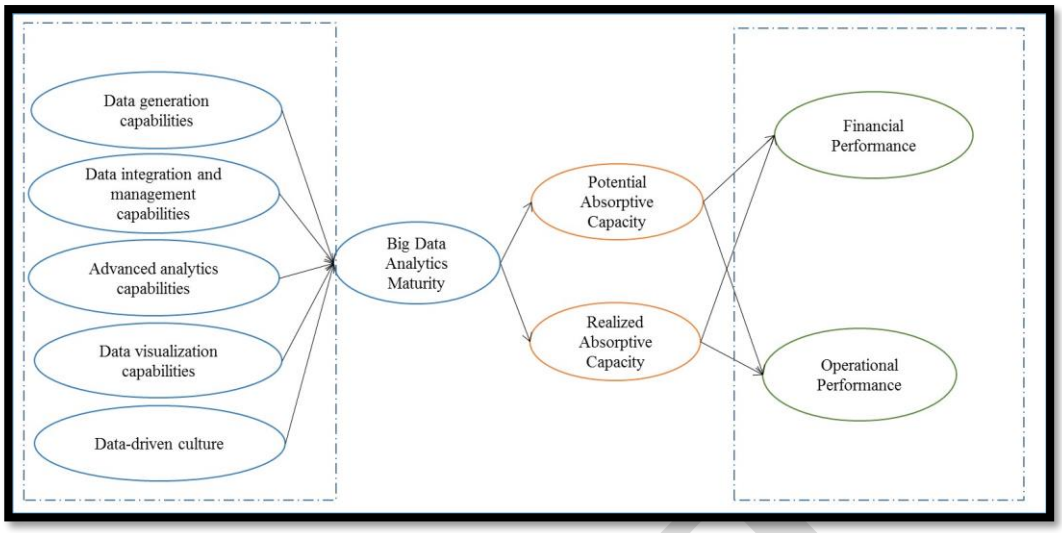


*Figure 1: The conceptual model*

*Proposition 1: The level of BDA maturity is positively associated with the degree of data quality and the level of organisational performance.*

The earlier-discussed 5 essential BDA capability characteristics add up to an organization's overall BDA maturity. Data is dispersed in the context of a supply chain and can be obtained from a variety of sources. Enterprise information systems (EIS), which are mostly organised and transactional in nature, are the main suppliers of data. IoT, sensors, and RFID technology may, however, transform the real world into a virtual one, creating a massive amount of unstructured data in the process. For instance, a manufacturing facility that has installed 1000 RFID readers and 10,000 tags may be able to produce Terabytes of data in only one operational day (Zhong et al. 2015). Additionally, a sizable amount of supply chain data is dispersed across a variety of sources, and the integration. A 360-degree perspective of industrial processes and improved visibility, responsiveness, and performance of material management are two benefits of data integration capabilities (Xiong et al. 2015). Wamba et al. (2015) used a typical case study to comment on the significance of combining intra- and inter-organizational data to enhance service delivery. The advantages of combining data from many sources, such as internal customer data, social media data, and multimedia data to produce creative goods, have been demonstrated by Tan et al. (2015). Every hour, millions of transaction data are created by Walmart and are combined into a single system (Sanders 2016). Real-time access, integration, and scalability of data storage are essential skills to have since supply chains are dynamic. In addition, a study conducted by Sanders (2016) illustrates real-world BDA applications in various areas of SCM including but not limited to inventory optimisation, labour

scheduling, route optimisation, price optimization and micro-segmentation in marketing has found to be create economic value. Moreover, the accuracy of demand forecasting, one of the critical aspect of SCM, can be improved using advanced predictive analytics techniques outperforming historical data based statistical techniques (Blackburn et al. 2015). Predictive analytics capability enables organisations to consider both endogenous and exogenous variables while forecasting demand. The unstructured customer reviews have variables that can predict sales nowcasting (See-To and Ngai 2016). Traditional forecasting depends on aggregated data, but by deploying real-time analytics capabilities organisations can analyse demand data in real-time increasing accuracy and can reduce bullwhip effect (Hofmann 2015). Increasing robustness of demand forecasting via predictive real-time analytics can eventually improve other functions such as production planning and inventory optimisation which rely on forecasted demand. Moreover, since a huge volume of spatiotemporal data is generated from GPS and RFID devices, predictive and spatiotemporal analytics can be used to analyse these unique data types, for instance, to predict truck arrival time (van der Spoel et al. 2015) and optimising blood supply chain (Delen et al. 2011). Information access and content quality is empirically found to increase by leveraging data integration and analytics capabilities (Popovič et al. 2012). It is also found to increase organisations information processing capabilities (Cao et al. 2015) and supply chain planning satisfaction (Chae et al. 2014). Besides, data visualisation capability is equally important compared to other BDA capabilities. Park et al. (2016) have developed visual analytics based decision support system (DSS) incorporating predictive analytics capabilities and experimented with supply chain network data. They argued that interactive visualisation would enhance human cognition level while decision-making. Similarly, GIS-based analytics and visualisation capabilities are found to be beneficial to effectively manage blood supply chain (Delen et al. 2011). Zhang et al. (2013) used data visualisation techniques to identify sources of contamination in food supply chain. Brandau and Tolujevs (2013) experimented with visualisation techniques and clustering algorithms to manage irregularities in real-time sensor data and improve logistics performance. Finally, Cao et al. (2015) argued that presence of the data-driven culture would facilitate organisations to make data-driven decision and rely on fact-based decision to develop new products and services. According to Aho (2015, p.284) “The transformative potential of Big Data lies in treating data as an asset.” Real-world case examples have suggested engagement of implementation team and top management support are significant for developing BDA capabilities (Wamba et al. 2015). Certainly, organisations who possess advanced analytics capabilities could not extract full value if not effectively integrated into the business decision-

making process and not accepted as a decision-making tool (Blackburn et al. 2015).Hence, it can be argued possessing BDA capabilities would enhance the decision-making and organisation performance.

*Proposition 2: The greater the level of BDA capabilities maturity, the more enhanced is the organisations absorptive capacity.*

Absorptive Capacity (ACAP) as an organisational capability can play a significant role in both assimilation and extraction of value from BDA. Cohen and Levinthal (1990, p.128) defined Absorptive capacity (ACAP) as "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends is critical to its innovative capabilities." Malhotra et al. (2005, p.145) perceive it as "the set of organizational routines and processes by which organizations acquire, assimilate, transform, and exploit knowledge to produce dynamic organizational capabilities." Moreover, Zahra and George (2002), reconceptualised ACAP into potential ACAP (PACAP) and Realised ACAP (RACAP). According to Roberts et al. (2012), in the context of technology assimilation, ACAP is treated as an asset in the form of prior knowledge possessed by organisations which foster innovation. BDA as a knowledge infrastructure could enhance knowledge transfer from supply chain partners and increase recipient firm's ACAP. On the other hand, in relevance to extracting value from technology like BDA, ACAP can be conceptualised as a dynamic capability, which could complement BDA capability in generating business value. In supply chain context, the critical information needed to improve supply chain performance is mostly available in external sources (Dobrzykowski et al. 2015), not readily accessible for decision-making. However, BDA can provide that critical information in real-time and enhance the organisational capability to acquire, assimilate, transform, and exploit the information and knowledge for commercial ends.

## Conclusion

In conclusion, BDA has the ability to improve upon and change conventional SCM techniques. 82 research publications on the Big Data and SCM fields were examined for this investigation. This article emphasised the need to define BDA capabilities in supply chain to extract value from big data. In the past, BDA has mostly been investigated from a technology viewpoint to justify its economic advantages. The literature review's organised methodology highlighted the BDA and SCM research's past contributions. Results indicate that the number of articles published in recent years has significantly increased. Academic study of social media has become a significant subject in supply chain management. According to research, BDA could be advantageous if organisations can build the necessary skills to use big data successfully.

This paper's conceptualization of BDA capabilities is comprehensive and data-driven, in contrast to earlier studies. It begins by addressing how important it is to comprehend the origins of big data in the supply chain and to optimise the data generating process. Second, it implies the significance of integrating and standardising data from diverse sources to provide analytics systems with more coherent data sets. Third, various analytics are covered, along with the significance of incorporating the results into the business process. Fourth, the importance of data visualisation and a data-driven culture in boosting flexibility and adaptation is examined from the viewpoints of value generation and users. Future research will address the few propositions mentioned in this study. As a result, this work significantly advances both theory and practise. Academic scholars would benefit from conceptualising BDA capabilities when they began fresh empirical study in this area. It promotes a thorough knowledge of this developing technology from the systematic literature study and conceptualization of important capabilities, which adds to the ongoing discussion of BDA in the context of SCM. Additionally, this paper will help practitioners understand their existing level of BDA maturity and create a path for developing BDA capabilities while taking potential assimilation process problems into consideration.

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