Chapter 3
Business Intelligence Capabilities

Thiagarajan Ramakrishnan, Jiban Khuntia, Abhishek Kathuria, and Terence J.V. Saldanha

Abstract Business intelligence (BI) is emerging as a critical area of expertise for firms' value proposition. Firms are trying to leverage BI as an inherent capability to create value. Considering an organizational systems view, BI extends beyond a tool or artifact to include a number of capabilities. We draw on IT capabilities and prior research on BI to uncover potential capabilities that BI bestows to an organization. A three category BI capability classification is suggested: BI innovation infrastructure capability, BI process capability and BI integration capability. We discuss the attributes of these three BI capabilities to provide insights into how the capabilities help organizations. This taxonomy will help decision-makers take informed decisions on how to effectively implement BI within their organization to improve performance.

T. Ramakrishnan (✉)
College of Business, Prairie View A&M University, 805 A.G. Cleaver St.,
Agriculture/Business Multipurpose Building, Room 447, Prairie View, TX 77446, USA
e-mail: Ram@pvamu.edu

J. Khuntia
Business School, University of Colorado Denver,
1475 Lawrence Street, Denver, CO 80202, USA
e-mail: jiban.khuntia@ucdenver.edu

A. Kathuria
Faculty of Business & Economics, The University of Hong Kong, Pokfulam, Hong Kong
e-mail: kathuria@hku.hk

T.J.V. Saldanha
Carson College of Business, Washington State University,
Todd Hall, Pullman, WA 99164, USA
e-mail: terence.saldanha@wsu.edu

3.1 Introduction

Business Intelligence (BI) is referred to the techniques, technologies, systems, practices, methodologies, and applications that analyze critical business data to help an enterprise better understand its business and market and make timely business decisions (Ramakrishnan et al. 2012). BI helps transform large amount of data from disparate sources into meaningful information to support decision making. BI investment is estimated to grow from \$54.5 billion in the year 2012 to \$96.9 billion in the year 2016 (Tabbitt 2013). BI is being used in almost all industry sectors and is a top priority for organizations (Isik et al. 2013). The opportunities associated with business analytics in different organizations have helped generate significant interest in BI. In addition to the underlying data processing and analytical technologies, BI includes business-centric practices and methodologies that can be applied to various high-impact applications such as e-commerce, market intelligence, e-government, healthcare, and security applications.

The evolution of business intelligence has its roots in artificial intelligence and business analytics, and has entered into mainstream business and IT communities since the 2000s (Davenport 2006). Further, the database related technologies advanced avenues for data collection, extraction, and analysis in the business intelligence areas (Chaudhuri et al. 2011; Turban et al. 2008; Watson and Wixom 2007). Currently, BI involves both structured and unstructured (big) data analysis and intelligence gleaning. Very large (from terabytes to exabytes), real time (feeds and tweets) and complex (from sensor to social media) data is emerging central tenet to recent BI developments. In addition, BI involves analytical techniques in applications that require advanced and unique data storage, management, analysis, and visualization technologies.

Recent developments in the internet, web, social media and mobile systems have offered unique data collection and analytical abilities to BI area. Large amounts of company, industry, product, and customer information can be gathered from the web and organized and visualized through various text and web mining techniques. Web analytics tools can gather customer clickstream data logs. Social media data analytics presents a unique opportunity for businesses to treat markets as avenues of business-customer relationship based co-creation (Lusch et al. 2010). Furthermore, mobile applications ranging from information advisories and ecommerce infomediaries and aggregators to gaming systems, often with billions of users, are changing the way intelligence and analytics fields are helping businesses and societal developments. It is noteworthy to mention that along with businesses, sectors such as healthcare, education, and governments have been benefitted a lot from business intelligence area. Emerging technologies and developments regarding Internet of Things (sensors, RFIDs, barcodes, tags), or drone based surveillance or monitoring systems are providing conduits for highly mobile, location-aware, person-centered, and context-relevant operations and transaction data. Indeed, many agree that both practice and academic communities face unique challenges and opportunities in understanding, developing, researching and educating the next generation BI students, researchers and professionals (Chen 2011).

Notwithstanding the increasing trend in BI adoption and implementation, the return on investments from BI remains a complex puzzle for many organizations. Some practitioners note that only around 20% firms have been able to convert BI to tangible benefits (Henshen 2008). Although it sounds simple, but initiation, implementation and development of a set of capabilities that can leverage on BI is not an easy task, and often needs integration of a set of distinctly different capabilities, ranging from information infrastructure to analytical mindsets. Once developed and used to its best extent, BI can be influential in organizations, and helpful in decision making or efficiency enhancements (Popovic et al. 2012; Wixom and Watson 2001). Furthermore, some even suggest that BI capabilities can be an important strategy within organizations forming their position in a competitive landscape (Thamir and Poulis 2015). Thus, given the wide applications and understanding of BI, it is important that BI capabilities be explicated in a simple yet holistic manner. In addition, given a firm wants to move towards BI implementations, managers should have an understanding on what capabilities need to be developed, or which directions need to be taken with an integrated perspective of BI capabilities.

The goal of this chapter is to highlight a typology of BI capabilities in organizations. We provide three categories of classification for BI capability in organizations: (1) *BI innovation infrastructure* consists of the foundational ability to mobilize and deploy BI functionalities to support innovation in the organization through infrastructure, culture and technological improvements; (2) *BI process capability* is the penetration of BI into the firm's customer centric and business-to-business (B2B) centric processes, and (3) *BI integration capability* refers to how the organization builds and integrates such capability and develops ways to acquire and convert business intelligence towards organizational improvement. Salient features and components of each type of BI capability are suggested to help in understanding in practice and further research prospects. The next section focuses on the understanding of BI capability, followed by the approach to develop the taxonomy and detailed description of each type of capability. Finally, suggestions on how to use the taxonomy, including managerial and research implications are discussed.

3.2   What is BI?

Several definitions of BI reflecting on different perspectives have been suggested. Moss and Atre (2007) define BI from a technological perspective as "an architecture and a collection of integrated operational as well as decision support applications and databases that provide the business community easy access to business data." However, Olszak and Ziemba (2003) define BI from an organizational perspective as "a set of concepts, methods and processes that aim at not only improving business decisions but also at supporting realization of an enterprises' strategy."

The effectiveness of BI is situated in its ability to support decision-making within an organization and providing decision-makers with timely and relevant information (Buchanan and O'Connell 2006; Massa and Testa 2005; Ramakrishnan et al. 2012).

Researchers have examined the benefits of implementing BI (Cooper et al. 2000; Watson et al. 2004), implementation factors (Hwang et al. 2004), and decision making (Park 2006). Organizations are struggling to make sense of the growing variety, velocity, and volume of data; demanding development of BI capabilities to deal with the data produced by internal and external sources, and leverage it to improve performance. Prior work on BI capabilities focuses mainly on the technical and organizational aspects of BI. For example, Sukumaran and Sureka (2006) examine BI capability as the ability of BI to manage quantitative and qualitative data. Similarly, BI capability has been seen in terms of a tool that can manage internal and external data (Harding 2003; Hostmann et al. 2007; Isik et al. 2013). From an organizational perspective BI capability has been examined as the ability of BI to provide support for decision making under conditions of uncertainty (Harding 2003; Gebauer and Schober 2006; Isik et al. 2013). An overarching view of the capabilities that BI endows in organizations in terms of supporting innovation, integration, and different process is still a gap in the BI literature; this chapter tries to fill in this gap.

3.3   Classification of BI Capabilities

We draw on prior work of IT capability and BI capability to propose that BI capabilities help orient a firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments; using business intelligence as a tool, artifact, and process level integrative capabilities. IT capability has its roots in the resource-based view that suggests that organizations' gain competitive advantage through the application of a combination of resources that are non-substitutable, scarce, difficult to imitate, and economically valuable (Barney 1991). Bharadwaj (2000) define IT capability as a firms' "ability to mobilize and deploy IT-based resources in combination or co-present with other resources and capabilities," (p. 171). Early studies with regards to IT capability started with viewing IT capability within single dimension in terms of either technological capability (Sabherwal and Kirs 1994) or managerial capability (Sambamurthy and Zmud 1997) and has now evolved to comprise three dimensions: technological dimension, human dimension, and organizational dimension (Kim et al. 2011; Schaefferling 2013). The technological dimension refers to the configuration and structure of all the technological elements in a firm such as hardware, software, networking and telecommunications, and different applications; the human dimension of IT capability discusses the knowledge and skill sets of the IT worker in a firm to manage and leverage IT to achieve a competitive advantage for the firms. Similarly, the organizational dimension examines the influence of organizational resources and the IT/business partnership that can provide the organization with a competitive advantage (Melville et al. 2004; Bhatt and Grover 2005; Rockmann et al. 2014).

BI as a capability is more so justified as a process or operational capability (Isik et al. 2013). Following prior work we conceptualize that BI capability overall is a culmination of different process or operational capabilities, and in addition, provides

a second layer or integrative capability in the organization. This integrative capability is manifested through the three underlying three dimensions: (1) integrate BI within the organization (integration of data and intelligence), (2) align BI towards innovation (infrastructure frontier), and (3) use BI to improve customer centric and business partner centric processes (process orientation) (see Table 3.1). These three dimensions translate to the three BI capabilities: BI innovation infrastructure capability, BI process capability (consisting of customer centric and B2B centric process capabilities) and BI integration capability. We elaborate on these three dimensions further in the next sub-sections.

3.3.1   BI Innovation Infrastructure Capability

BI Innovation capability is the ability to marshal and use the functionalities of BI to sustain innovation in organizations through technological, cultural, and infrastructure improvements. In order to support BI technology the proper infrastructure and the right data collections strategy for BI is needed (Ramakrishnan et al. 2012). Further, in order to leverage BI technology, it is imperative to have the appropriate organizational structure that can facilitate sharing and collaboration. Along, the same lines, culture also plays an important role in facilitating sharing and leveraging of information generated by BI. BI technology plays a crucial role in supporting decision-making within any organization (Isik et al. 2013).

BI innovation infrastructure capability constitutes technical, structural and cultural elements. First, BI technology refers to the degree and extent of technological readiness to adopt BI in the organization. The technology dimension may also include business intelligence, collaboration, distributed learning, discovery, mapping, opportunity recognition and generation as well as aspects related to security and privacy of the data and analytics. The structural element of BI innovation infrastructure refers to the modular organizational design that helps facilitate the technical architecture and subsequent functions and innovations relevant to BI. BI culture facilitates a firm's ability to manage data, knowledge and intelligence; and espouses interaction between individuals and groups is a basis of the creation of new ideas and innovation.

Technical, structural and cultural elements associated with BI innovation infrastructure provide the abilities to a firm that help in managing data, knowledge and intelligence through embedded routines and processes of the organization. Technology plays an important role in the structural dimension needed to capture, store, and analyzed data in a firm. The various communication systems and information systems can be linked in an organization to integrate the previously fragmented flow of data and information (Teece et al. 1997). These linkages can eradicate the hurdle to communication between different business units and enable collaboration among them. Further, BI technology can endow firms with the ability to engender information and knowledge regarding their external fiscal environment and their competition (Gold et al. 2001). Effective utilization of BI technology can help organizations deal with competitive and institutional pressures that firms face within an industry (Ramakrishnan et al. 2012).

Table 3.1 Conceptualization of BI capabilities and dimensions

Category	Core	Description	References
Infrastructure Frontier	Codification, connectivity and flow of data and information to derive intelligence	• Codification of specialized data and information from different organizational elements to be used by qualified staff or personnel • Detection, classification and planning of organizational data and information to be accessed by others • Provider formal access and provision to staff and employees to contextually use the data and information • Creating a culture or practice of intelligence based decision making.	Sukumaran and Sureka (2006), Parikh and Haddad (2008), Hostmann et al. (2007), Harding (2003).
Process Orientation	Exploitation of infrastructure and integration for crating organizational value through workflow and process coordination levels	• Conceptualize and execute BI as essential dimensions at each and every process and workflow levels • Realization that the actions related to BI can be used to create and facilitate economic and strategic values for the organization • Exploitation of BI as a capability-asset to produce income and maximize profit	Li et al. (2008), Sahay and Ranjan (2008), Elbashir et al. (2008), Isik et al. (2013), Wixom et al. (2011)
Integration of Data and Intelligence	Design and integration of spaces, practices and connectivity to foster the activities around data, information and intelligence gathering and conversion	• Design and use of organizational structures or networks • to acquire expertise and skills for intelligence generation • to acquire data and information from external sources • to convert the data and information to intelligence by using the gathered expertise and skills • seamless integration of the acquisition and conversion process within the organization	White (2005), Hostmann et al. (2007), Gebauer and Schober (2006), Petrini and Pozzebon (2009)

BI structure establishes an organizational framework and readiness to accommodate and leverage this foundation, while BI technology provides the foundation. Structure examines the distribution of tasks, coordination, flow of information, and decision-making rights within an organization (Pugh 1990). Further, firms with rigid structure may have the unintended effect of inhibiting the sharing of information and knowledge across internal boundaries (Gold et al. 2001), rather than enabling communication and collaboration. Therefore, we argue that in order to leverage BI technology it is important to have BI structure in place that encourages the sharing and exchange of information and intelligence. Organizations need to promote collective intelligence rather than individualistic acumen. Firms need to facilitate the transfer of intelligence across internal boundaries. Thus, BI structure plays an important role in supporting BI technology, and hence, is an important element in BI capabilities taxonomy.

Finally, BI culture espouses interactions between individuals and groups as a basis of the creation of new ideas and innovation. Thus, a more interactive and collaborative culture is a precursor for converting the data or fact based tacit information to more explicit intelligence, and move it from an individual to an organizational level. Employees in such a cultural glue within the organization can develop an ability to self-organize their knowledge and practices to facilitate solutions to new or existing problems.

To establish the value proposition of BI innovation infrastructure capability, we suggest that a firm can foster innovation using the technical, structural and cultural elements of BI capabilities. Structural element of innovation infrastructure will allow data and information to be exchanged seamlessly between different business units, thus improving the effectiveness of BI towards higher performance. Further, having a culture that will facilitate interaction between individuals and groups to exchange information and intelligence generated by BI to come up with new innovative ideas will make the BI more effective.

3.3.2   BI Process Capabilities

BI process capabilities is the ability of BI to penetrate into the firms' business processes. This capability examines the functionalities of BI that can sustain both B2B centric and customer centric activities. We argue that BI helps organizations by supporting the business processes that give a firm a competitive advantage. Business processes in a firm help orient its activities towards value creation. To create value, a firm needs to do at least three activities; first, operations that can convert goods to products or services (i.e., operations); second, relationship with other firms who supply materials and products to the firm (e.g., firms in the supply chain), and third, orienting its operations to deliver products and services to the customers (i.e., customer oriented activities). As noted previously in this paper, the operational BI capabilities are embedded within infrastructural development related to BI, or, in other words, the infrastructural BI development caters to the operations. On the

contrary, supply chain and customer oriented BI activities need to be explicitly developed; and included in the firm's value chains as two sets of capabilities to cater to the two ends of the value chain, i.e., supply chain partners and customers. Based on these concepts in the existing literature, we propose that for an organization to achieve competitive advantage, two explicit BI capabilities need to either exist or be developed—the customer centric and a business to business (B2B) process related BI capabilities elements. Although BI adoption and implementation is oriented predominantly towards customer centric data-information-knowledge-intelligence paradigm, similar process oriented approach of BI can also be found in leveraging B2B relationships or supply chain visibility areas. For example, BI in the B2B or supply chain can eliminate waste by providing demand aggregation or reducing the 'bullwhip effect' associated with distribution.

Because processes are not unilateral directives in an organization, and often consist of a multitude of orientations, we conceptualize the two dimensions of BI process oriented capabilities as multi-dimensional constructs. For example, customer centric BI process capability consists of the way BI is oriented to meet the firms' customer needs and serve them, elements that enhance customer satisfaction and loyalty by providing insights regarding customers' long term goals and requirements, and ability to absorb customer oriented information/intelligence into the organization using BI. Similarly, B2B centric BI process capability consists of BI applications related to supply chain integration, engage new partners and improve coordination with existing partners, and using BI for process coordination and operational improvements. Inherently, these dimensions relate to and influence organizational performance due to responsiveness to customer needs, awareness of customer goals and the ability to learn from information generated during customer interactions. Furthermore, B2B centric BI process capability aids activities with B2B partners due to insights through visibility of goods and information, business level integration, and process-level coordination across channels. Together, BI process capabilities provide firms with the capacity to derive analytical insights in its business processes which in turn enhance organizational effectiveness.

3.3.3 BI Integration Capability

Prior studies recognize BI integration to be very important and critical for the successful utilization of BI (Isik et al. 2013). Integration refers to combining different types of explicit data and information into novel patterns and relations (Herschel and Jones 2005). Based on the existing literature, we posit that organizations need to develop ways to acquire and convert business intelligence towards organizational performance.

We argue that BI integration capability has two dimensions that are effective towards organizational performance, albeit in an interconnected manner. First, BI acquisition consists of gathering data from different types of sources across the organization and beyond, in addition to data aggregation, rollup and partitioning. Data extracted from operational systems need to be cleansed and transformed in

order to make it suitable for use without errors (Ramakrishnan et al. 2012). Second, the data need to be converted to usable patterns and schemas to help an organization to glean more insights from the data. Thus, BI Integration consists of the acquisition of data from various sources, followed by the conversion of data to the right format and quality in order to be used effectively in the organization.

As much as the acquisition and integration of business intelligence from various sources is a prerequisite for the utilization BI capabilities; the outcome of the acquisition and conversion through integration helps to achieve higher organizational performance. For instance, customer centric activities require acquisition of business intelligence regarding customer behavior and experience, which in turn provide insights regarding goals and requirements. Second, the gathering and aggregation of data from different types of sources across the organization and beyond enables the organization to leverage BI to adequately respond to market and environmental changes. Hence BI can provide insights regarding the nature of change to which the organization needs to adapt, as well as the internal changes required to do so. Third, aggregation, cleansing and transformation of this data can make this data more substantive and insightful, thereby making subsequent decisions faster and more effective. Thus, integration capability of BI that facilitates the gathering and cleaning of data from disparate data sources and providing the decision-makers with timely and usable information will make the BI more effective.

3.4   Using the Taxonomy

With the advent of business intelligence, organizations are somewhat moved by a 'fad' effect around this tool. In practice, while the buzz around BI is very high, BI perspectives and viewpoints vary across firms, with differing concepts, definitions and applications. While eliminating the differences would be a herculean task, integrating BI perspectives into holistic models can certainly be a fruitful approach. The intention of this chapter is to provide such a holistic view around BI integration in an organization, albeit with a bias towards a capability perspective. Taking the capabilities perspective helps to highlight the fact the BI is 'not just a fad' or buzz' in the practice and academic discourse, but it can be helpful in garnering higher organizational performance. Indeed, the theoretical concepts and model developed in this chapter are oriented towards establishing the relationships between different dimensions of BI capabilities, their integrated schema, and the influence of these dimensions on organizational performance.

The classification schema can be helpful in further research. A line of research that can be pursued is relating the BI capabilities in a causal way. For example, a relationship model can test whether a BI innovation infrastructure capability can lead to a higher BI integration capability, and a higher BI integration capacity can lead to a higher process capability as suggested in a conceptual diagram in Fig. 3.1. Further research can explore relationships between capability types and organizational performance or BI effectiveness.
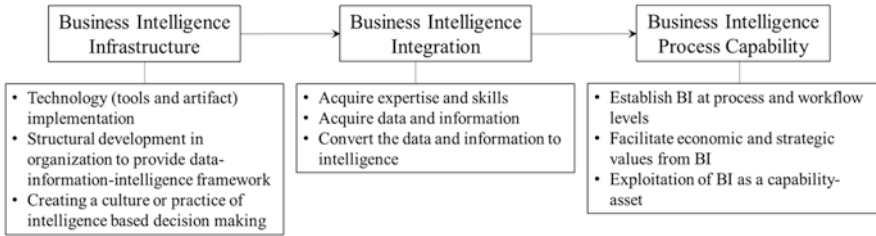
Fig. 3.1 A suggested relationship model between types of BI capabilities

The integrative model provides two theoretical contributions. Although existing studies note that BI helps in improving organizational decision making, the proposed model goes a step beyond to disentangle various dimensions of BI enabled capabilities. As a result, granular insights into BI orientation in a firm in relation to improving its capabilities are drawn. In addition, it is suggested here that BI is not a single directional or unilateral tool or perspective that just helps in siloed decision making; instead BI can be taken as a process-integrative organization wide framework that helps in improving firm performance.

The BI integrative model and dimensions have implications for managerial practice. The model provides directions to a step wise approach starting from acquisition to conversion and process integration for BI tools and applications. Furthermore, focusing on BI capabilities and integrating them into the functionalities of the organization may help in improving performance.

A number of factors might be unintentionally missing in the integrative model discussed here. For example, different industrial sectors might be leveraging on BI differently; indicating a variance in the model. In addition, early adopters and laggards may show variations with respect to BI capability and performance relationships. Additional research is warranted to extend this body of knowledge and related relationships. Future studies may focus on extending the model to other contexts by developing specific testable hypothesis on particular settings.

In conclusion, this chapter takes an integrative approach to BI. The central tenet of the chapter focusses on three dimensions of BI capability and relates it to organizational performance. The concepts proposed here are expected to provide a capability-integrative framework for BI implementation and motivate managers to see BI from organizational performance improvement perspective.

Biographies

Thiagarajan Ramakrishnan (Ram@pvamu.edu) is an Assistant Professor in the College of Business at Prairie View A&M University. He received his doctorate from the University of North Texas, Texas in 2010. His research interests include business intelligence and data mining, Information Systems discipline, disaster

management, and Ecommerce. His work appears in such journals as *MIS Quarterly, Decision Support Systems*, and *Computers in Human Behavior*.

Jiban Khuntia (jiban.khuntia@ucdenver.edu) is an Assistant Professor in the Business School at University of Colorado, Denver. His research is in the areas of digital service innovation and digital health. He has published in *Decision Support Systems, Communications of the Association for Information Systems, Health Policy and Technology* and *International Journal of E-Business Research*. He received his Ph.D. from University of Maryland, College Park in 2013.

Abhishek Kathuria (kathuria@hku.hk) is an Assistant Professor of Innovation and Information Management at The University of Hong Kong. His research, teaching and consulting interests lie in the areas of business performance improvement, business & IT strategy, emerging technologies and technology entrepreneurship, with a focus on emerging economies. His work has been published in the Communications of the Association for Information Systems and nominated for and received best paper awards at the International Conference on Information Systems and the Annual Meeting of the Academy of Management. Abhishek received his Ph.D. from Emory University and a graduate degree in management from the Indian Institute of Management Indore.

Terence J.V. Saldanha (Terence.saldanha@wsu.edu) is Assistant Professor of Information Systems at the Carson College of Business at Washington State University, Pullman. He received his Ph.D. in Information Systems from the University of Michigan in 2012. His research interests include the business value of Information Systems (IS) and the role of IS in innovation. His research has appeared or is forthcoming in *MIS Quarterly, Journal of Operations Management, Journal of Organizational Computing and Electronic Commerce, Journal of Information Technology Theory and Application*, and in various academic conference proceedings. Prior degrees include an M.B.A. from S.P. Jain Institute of Management (Mumbai, India), and a Bachelor's of Engineering from University of Mumbai (India). Prior to his graduate studies, he spent about 4 years working in the IT industry.

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