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An Integrated Model of Business Intelligence & Analytics Capabilities and Organizational Performance

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Abstract:

The transformational power of business intelligence and analytics (BI&A) in organizations can be leveraged through a holistic integration process. Contrary to this proposition, many organizations approach BI&A implementation as stand-alone, independent of organizational strategies, or with ad-hoc plans for an organization-wide change. From a research point of view, an integrated framework that can inform both academics and practice about the constituents of an adroit application of business intelligence and analytics capabilities in organizations remains a gap. This study asks the question that what significant BI&A capabilities are essential to creating value from BI&A for organizational performance? We conceptualize second-order constructs that are important for the BI&A value creation process: Innovation Infrastructure Capability, Customer Process Capability, B2B Process Capability, and Integration Capability. We propose that these higher-order BI&A capabilities influence organizational performance through the mediation effect of BI&A Effectiveness. We develop a questionnaire instrument and collect data from 154 firms in India. Partial Least Squares analysis provides broad support for our hypotheses. Our contributions include identifying and empirically assessing key BI&A Capabilities that directly impact an organization's effectiveness of BI&A implementation.

Keywords: Business Intelligence, Analytics, Capabilities, BI&A Capabilities, India, Organizational Performance.

1 Introduction

Business intelligence and analytics (BI&A) broadly refers to the use of advanced data processing, analysis, management and intelligence applications for meaningful information to help an enterprise for decision making (Chen et al., 2012). Over the last decade, there has been tremendous growth in the BI&A area, and emerging global trends in big data analytics and newer applications such as deep learning, artificial and cognitive intelligence are driving further growth. BI&A, along with big data and analytics, is expected to reach a market size of more than \$200 billion by 2020, with more than 10% annual growth rate (Press, 2017). Accordingly, to realize the potential of BI&A, firms are increasing investments in corresponding hardware, software, services, hiring and training data scientists, and their continuing education (Azvine et al., 2006). Creating a data culture in organizations requires firms to understand, nurture, align, and cultivate a data-analytics based value chain and operational processes, including people skills. Broadly, all these elements to create and manage BI&A activities can be defined as a 'business intelligence analytics capability' of a firm (Popovič et al., 2012; Seddon et al., 2017).

While some firms have been able to realize value from their investments in BI&A, many are struggling to figure out how to strategically leverage from these investments, or are still at the 'tip of the iceberg' when it comes to applications of analytics in business or innovation activities across firms and industries (Ransbotham et al., 2017; Ransbotham et al., 2016). Reports that highlight that more than 70% of BI&A initiatives fail because of inadequate communications between IT and business users about the specific uses of the tools being implemented raise concerns when considering that business analytics is now at the forefront of firm activities (Elliott et al., 2008; Goodwin, 2011). Examples of failures of business and analytics integration is also replete in major companies such as Apple not being able to utilize information and visibility for shipping (Spence, 2016), and KFC closing branches due to lack of managing supply chain relevant information using analytics (O'Marah, 2018), amongst others (see Table A1 in Appendix for a representative list of failure cases that could have been avoided with proper implementation of analytics). The challenge has been predominantly to use business intelligence & analytics in a manner that is aligned to business strategies and value-chain activities (Elbashir et al., 2013). This suggests that effective initiation, implementation, and leveraging of BI&A is not an easy task, and often involves an integration of a set of distinctly different capabilities, ranging from information infrastructure to analytical mindsets. Thus, it is important to identify capabilities that can make BI&A effective.

BI&A is an unified term that encompasses data processing and analytical applications, technologies, systems, and business-centric techniques, practices, as well as methodologies, which transform large amounts of data from disparate sources into meaningful information to help an enterprise better understand business and support timely decision making (Chen et al., 2012; Ramakrishnan et al., 2012). In addition, BI&A involves analytical techniques in applications that require advanced and unique data storage, management, analysis, and visualization technologies. Given this wide definition of BI&A, it is important that BI&A capabilities be explicated in a simple yet holistic manner. In addition, for firms to move towards improving the effectiveness of BI&A implementations, managers should understand what capabilities need to be developed considering an integrated perspective of BI&A capabilities. However, from a capability perspective, the nuances of how BI&A impacts organizational performance remains a gap in the existing literature. For instance, BI&A helps organizations gain a better understanding of their operations, processes, and strategies (Lönnqvist et al., 2006), which helps in improving organizational performance. Likewise, BI&A helps in providing organizations with a single consistent view of business information that is very crucial for strategic decision making and efficient management of business processes (Watson et al., 2004). Though existing research has provided important insights into the importance of BI&A for improving the firm's performance, little is known about how organizations leverage BI&A to achieve their goals.

Furthermore, although research has established that BI&A capabilities are crucial for firm performance, the causal pathways through which these effects manifest are not clear. In this paper, we develop an integrated view of BI&A capabilities. Hence, in this study, we address the following research questions:

RQ1: How do BI&A capabilities influence the organizational effectiveness of BI&A?

RQ2: How do BI&A capabilities and effectiveness of BI&A influence organizational performance?

To address these questions, consistent with recent research that conceptualizes capabilities in the context of specific IT (Kathuria et al., 2018a), we draw on two inter-related concepts – the *capability hierarchy perspective* (Winter, 2003) and the *operand operant resource perspective* (Madhavaram et al., 2008), to

develop a theoretical model of the hierarchical relationships between BI&A capabilities, *BI&A Effectiveness*, and *Organizational Performance*. We conceptualize four BI&A capabilities that relate to four categories. First, *BI&A Innovation Infrastructure Capability* that consists of the foundational ability to mobilize and deploy BI&A functionalities to support innovation in the organization through infrastructure, culture, and technological improvements. Second, *BI&A Customer Process Capability* enables BI&A to accommodate customer-centric activities, such as customer needs, service requirements, and information. Third, *BI&A B2B Process Capability* refers to the use of BI&A to engage new B2B partners and improve coordination with existing B2B partners. Finally, *BI&A Integration Capability* that refers to how the organization builds and integrates such capability and develops ways to acquire and convert business intelligence towards organizational improvement. We posit that firms need to effectively deploy and leverage these four BI&A capabilities that reflect two levels of operand resources to employ BI&A, an operand resource, effectively and thus, influence *BI&A Effectiveness*. We define *BI&A Effectiveness* as the use of BI&A to help orient a firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments; using business intelligence as a tool or artifact, to achieve process level integrative capabilities (table 1 succinctly lists construct definitions, which are detailed in the following sections). Based on these theoretical arguments, we propose a research model (see figure 1) to highlight how the four BI&A capabilities influence *Organizational Performance*. The rationale for a hierarchical and integrated view of BI&A capabilities is that since BI&A consists of both technological as well as organizational components, different levels of BI&A capabilities need to be developed, coordinated, and integrated such that they provide business-wide solutions and that generate value for stakeholders (Winter, 2003). This integrated perspective would assist in guiding organizations towards the evaluation and identification of BI&A capabilities, which will further enhance scholarly and practitioner understanding of the impact of BI&A on the firm's performance.

Table 1. Construct Definitions

Construct	Definition / Description
BI&A Technology	The degree to which BI&A technology is implemented in an organization
BI&A Culture	The way the use of BI&A for decision-making has become the norm within an organization
BI&A Governance	The degree to which BI&A related rules, policies, procedures, processes, the hierarchy of reporting patterns and relationships are defined with the firm
BI&A Customer Orientation	The way BI&A is oriented to meet the firms' customer needs and serve them
BI&A Customer Application	The way BI&A is used to absorb customer-related intelligence in the organization
BI&A B2B Orientation	The way BI&A is oriented to address supply chain-related needs
BI&A B2B Engagement	The way BI&A is used to engage new B2B partners and improve coordination with existing B2B partners
BI&A B2B Compatibility	The degree to which BI&A has contributed towards process coordination and operational capability improvement through increased compatibility
BI&A Acquisition	The degree to which BI&A is used to procure and share intelligence within the organization
BI&A Conversion	The degree to which BI&A is used to make the intelligence gathered useful.
BI&A Effectiveness	The degree to which BI&A has contributed to making the organization effective in different dimensions – to meet market/innovation/coordination volatile demands
Organizational Performance	The degree to which organizational performance has improved
BI&A Innovation Infrastructure Capability	The ability to mobilize and deploy BI functionalities to support innovation in the organization through infrastructure, culture and technological improvements
BI&A Customer Process Capability	The capability that enables BI&A to accommodate customer-centric activities
BI&A B2B Process Capability	The ability of BI&A to penetrate the firms' business processes
BI&A Integration Capability	The ability to mobilize and deploy BI functionalities to acquire and integrate business intelligence within its systems

2 Prior Literature

The effectiveness of BI&A is situated in its ability to support decision-making within an organization and providing decision-makers with timely and relevant information (Massa et al., 2005; Ramakrishnan et al., 2012). Organizations develop BI&A capabilities to deal with the data produced by internal and external sources and leverage it to improve performance (Işık et al., 2013). Prior work on BI&A has examined this relationship between BI&A, competitive advantage, and performance. For example, Peters et al. (2016) suggest that BI improves management control systems, thereby augmenting performance measurement capabilities, which in turn provides a firm with a competitive advantage.

Similarly, studies indicate that BI&A helps organizations by improving their supply chain performance (Trkman et al., 2010). Further BI&A provides value to the business through the creation and use of BI platform and BI tools and by the usage of such tools by the end-users. The purpose of implementing BI&A in an organization is to analyze data to support decision-making. This makes BI&A effective and improving organizational performance. However, exploration of how different BI&A capabilities may help to achieve performance is still a gap in the literature. This study tries to address this gap.

We draw on prior work of IT capability and BI&A capability to propose that BI&A capabilities help a firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments. IT capability helps 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). Building upon the Resource-Based View (RBV) (Barney, 1991), Bharadwaj (2000) defines IT capability as a firm's "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 et al., 1994) or managerial capability (Sambamurthy et al., 1997) and has now evolved to comprise three dimensions: technological dimension, human dimension, and organizational dimension (Kim et al., 2011). 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 skillsets 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 IT/business partnership that can provide a competitive advantage (Bhatt et al., 2005).

Recent work in this stream of research has demonstrated that firms vary widely in developing unique IT-based resources and capabilities. However, what does not vary is the notion that IT infrastructure is not sufficient for organizational performance firm success. Though IT infrastructure is a foundation and precursor for value creation, the prior studies indicate that IT capabilities have an impact when they leverage underlying IT resources, data assets, skills and knowledge (Kathuria et al., 2018a).

Along similar lines, prior work on BI&A capabilities focuses on the technical and organizational aspects of BI&A. For example, Sukumaran et al. (2006) study BI&A capability as the ability of BI&A to manage quantitative and qualitative data. Similarly, BI&A capability has been viewed as a tool that can manage internal and external data (Işık et al., 2013). In the same way, Tremblay et al. (2007) note that the capabilities of BI&A tools such as online analytical processing helps individuals to leverage their abilities in improving their data manipulation tasks. From an organizational perspective, BI&A capability has been examined as the ability of BI&A to provide support for decision making under conditions of uncertainty (Gebauer et al., 2006; Işık et al., 2013). However, BI&A as a capability is more justified as an operational capability. Following prior work and the RBV perspective, we conceptualize that BI&A capability overall is a hierarchy of different operational capabilities, and also, provides a second layer or integrative capability in the organization. Thus BI&A capability can be demonstrated through three types of capabilities: (1) capabilities that integrate BI&A within the organization, (2) capabilities that align BI&A towards innovation, and (3) use BI&A to improve customer-centric and business partner-centric processes.

3 Theoretical Model and Hypothesis

Our theoretical model draws upon two inter-related concepts that build upon one another. The *capability hierarchy perspective* suggests that firms possess a hierarchy of capabilities. Lower order capabilities are competencies that provide basic functional capabilities. Higher-order capabilities extend lower-order capabilities and form the basis for higher firm performance (Winter, 2003). The *operand operand resource*

perspective also suggests that firms possess a hierarchy of resources. *Operand resources* are physical in nature, and *operant resources* perform an act on operand resources to leverage them to create value. Operant resources form a hierarchy consisting of basic, composite, and interconnected operant resources (Madhavaram et al., 2008). These two theoretical perspectives are consistent and complementary and hence serve as the theoretical edifice of our research model.

Our core argument is that BI&A comprises four key components: *BI&A Innovation Infrastructure Capability*, which speaks towards the technical aspect of BI&A capability; *BI&A Customer Process Capability* and *BI&A B2B Process Capability*, which are a techno-organizational aspect of BI&A capability; and, *BI&A Integration Capability*, which is an organizational aspect of BI&A capability. These four components of BI&A capability are conceptualized as higher-order capabilities, each of which is comprised of lower-order capabilities. The lower-order capabilities are conceptualized as the first level of BI&A resources and hence are *basic operant resources*. Hence, the higher-order capabilities are the second level of BI&A resources and are *composite or interconnected operant resources*. These four higher-order capabilities lead to firm performance via improved *BI&A Effectiveness*. Note that similar to a significant stream of prior literature, we build on the RBV. The four BI&A Capabilities are rare, non-imitable, immobile and valuable operational processes and stable resource configurations. Thus, our conceptualization differs from other recent work that proposes the dynamic capabilities perspective to explain the role of BI&A in improving *Organizational Performance* (Torres et al., 2018; Wamba et al., 2017).

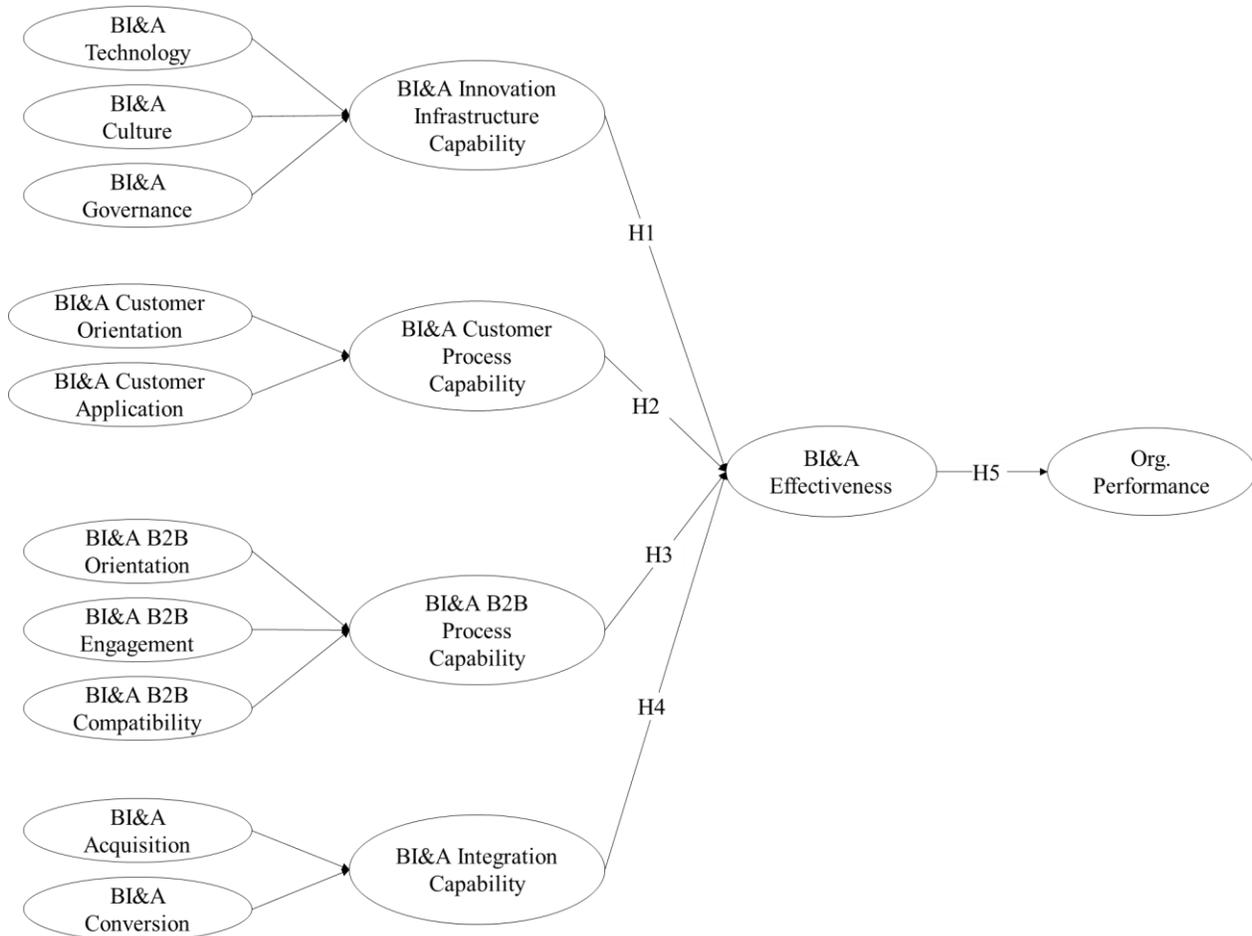


Figure 1. Proposed Research Model

3.1 BI&A Innovation Infrastructure Capability, Effectiveness and Organizational Performance

We describe *BI&A Innovation Infrastructure Capability* as the ability to marshal and use the functionalities of BI&A to sustain innovation in organizations. Organizations can sustain innovations either through

technological, cultural and infrastructure improvements. For example, the proper infrastructure and the right data collection strategy for BI&A are needed to support BI&A technology.

Further, it is imperative to have appropriate organizational governance that can facilitate sharing and collaboration to leverage BI&A technology. Culture also plays a vital role in facilitating the sharing and leveraging of information generated by BI&A. Thus, *BI&A Innovation Infrastructure Capability* plays a crucial role in supporting decision-making within any organization.

We conceptualize *BI&A Innovation Infrastructure Capability* as a second-order capability constituting of technological, governance, and cultural elements (see figure 2) and thus a composite operant resource (Madhavaram et al., 2008). First, *BI&A Technology Capability* refers to the degree and extent of technological readiness to adopt BI&A in the organization. The technology element includes 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 governance element of BI&A innovation infrastructure refers to three further granular elements. First, the infrastructure can be the modular organizational design elements. In turn, the design elements facilitate technological architecture. Subsequently, design elements and architecture relate to the functions and innovations relevant to BI&A. *BI&A Cultural Capability* 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. Since the three capabilities that constitute *BI&A Innovation Infrastructure Capability* are the result of applying skills and knowledge of individual employees applied to the operand resource of BI&A, they are basic operant resources (Madhavaram et al., 2008).

Technological, governance and cultural elements associated with *BI&A Innovation Infrastructure Capability* provide the abilities to a firm that helps in managing data, knowledge, and intelligence through embedded routines and processes of the organization. Organizations deal with a large amount of structured and unstructured data (Delen et al., 2013). Technology plays an important role in the structural dimension needed to capture, store, and analyze this data in a firm. Various communication systems and information systems can be linked in an organization to integrate the previously fragmented flow of data and information. These linkages can eradicate hurdles to communication between different business units and enable collaboration among them.

Further, BI&A 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&A technology can help organizations deal with competitive and institutional pressures that firms face within an industry (Ramakrishnan et al., 2012). Further, proper use of such technology can assist new possibilities to achieve innovation in either improved process, product delivery, or service.

While *BI&A Technology Capability* provides the foundation, *BI&A Governance Capability* establishes an organizational framework and readiness to accommodate and leverage this foundation. Structure and governance examine the distribution of tasks, coordination, the flow of information, and decision-making rights within an organization (Ang et al., 2008). Further, firms with a rigid structure and governance 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, to leverage BI&A technology, it is important to have *BI&A Governance Capability* in place that encourages 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. Such firms will be well equipped to use BI&A effectively for anticipating market opportunities and responding to market demands. This will further help organizations to adapt to volatile market changes and identify new business opportunities, making use of BI&A very effective.

Finally, *BI&A Culture* espouses interactions between individuals and groups as a basis for 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. Such a BI&A culture will influence *BI&A Effectiveness* by empowering employees to become responsive to market demands and deal with unpredictable industry/market changes.

We propose that *BI&A Innovation Infrastructure Capability* is a formative second-order capability due to three reasons. First, the technological, governance, and cultural elements 'form' *BI&A Innovation Infrastructure Capability*, wherein each element makes a unique contribution to the second-order construct.

Second, an increase in any of the technological, governance, or cultural elements does not increase another. Third, the three elements are distinct and complementary. Therefore, BI&A Technology, BI&A Governance, and BI&A Culture represent the underlying formative elements of *BI&A Innovation Infrastructure Capability*. To establish the value proposition of *BI&A Innovation Infrastructure Capability*, we suggest that a firm can foster innovation using the technological, governance, and cultural elements of BI&A capabilities. The technological element of BI&A Innovation Infrastructure determines how data and information travel throughout the organization and how the intelligence regarding product and process is captured and shared. Thus, BI&A tools can be used for retrieving and using intelligence about products and processes within the organization. This improves the effective usage of BI&A within the organizations. The governance element of BI&A Innovation Infrastructure will allow data and information to be exchanged seamlessly between different business units, thus improving the effectiveness of BI&A. Further, having a culture that facilitates interaction between individuals and groups to exchange information and intelligence generated by BI&A to come up with new innovative ideas will make the BI&A more effective to identify new business opportunities, adapt to the volatile market, and become responsive to market demands. Therefore:

Hypothesis H1: BI&A Innovation Infrastructure Capability has a positive influence on BI&A Effectiveness.

3.2 BI&A Customer Process Capability, Effectiveness and Organizational Performance

BI&A Customer Process Capability refers to the capability that enables BI&A to improve customer-centric activities such as helping employees solve customer issues, using BI&A to improve customer retention, and also take advantage of the knowledge acquired from the customers to compete in the market. For a firm to do well in a competitive business environment, it is important for them to use BI&A to understand and communicate with customers (Watson, 2010). This involves understanding customer needs and serving them, improving customer satisfaction and thereby customer loyalty. Customers play an important role in creating value for any organization (Agarwal et al., 2009). Harrah's entertainment is a good example of a firm that uses BI&A to create a loyal customer base and become the leader in the gaming industry. Harrah's entertainment accomplished this by using BI&A to gather data from various touchpoints and integrate them and based on that create promotional offerings to their loyal customers (Watson, 2009). In effect, Harrah's entertainment captured their consumer-oriented information and further used this information to develop a plan to improve their customer loyalty. Thus, the ability to absorb customer-oriented information/intelligence and convert them into an actionable plan are two facets of *BI&A Customer Process Capability*.

Therefore, we conceptualize *BI&A Customer Process Capability* as consisting of two dimensions, thereby as a composite operand resource (Madhavaram et al., 2008). The first dimension reflects the process to absorb customer-oriented information/intelligence in the organization using BI&A (*BI&A Customer Application Capability*) and the second dimension uses this intelligence/information and is oriented towards meeting the customers need and improve customer loyalty (*BI&A Customer Orientation Capability*) (see figure 2). *BI&A Customer Application Capability* involves using BI&A to analyze intelligence gained from customer handling experiences. Further, this capability also helps organizations learn from customer handling mistakes. Firms can leverage this BI&A capability to understand customer psyche. Firms can gain insight into customer needs and their purchasing behavior and thereby identify new business opportunities. Organizations can utilize this capability to improve their *BI&A Effectiveness* in anticipating market opportunities and becoming more responsive to market demands. The *BI&A Customer Orientation Capability*, on the other hand, helps organizations to use the intelligence gained from handling customers into improving customer loyalty and customer satisfaction. Customer orientation facilitates the collection and distribution of customer intelligence throughout the organization so that effective action can be taken to meet customer needs (Allred et al., 2011). Firms can use *BI&A Customer Orientation Capability* to gather customer intelligence and identify and provide innovative services based on customer needs. Firms can effectively use BI&A to identify loyal customers and provide them with promotional offers. Further, by leveraging on BI&A, Customer Orientation Capability organizations can take advantage of the knowledge acquired from customers and use BI&A effectively to help solve problems associated with new customers. Since skills and knowledge of individual employees applied to the operand resource of BI&A lead to *BI&A Customer Application Capability* and *BI&A Customer Orientation Capability*, we conceptualize them as basic operand resources (Madhavaram et al., 2008).

We propose that *BI&A Customer Process Capability* is a formative second-order capability. *BI&A Customer Application Capability* and *BI&A Customer Orientation Capability* constitute or 'form' *BI&A Customer*

Process Capability, and both make a unique contribution to the second-order capability; an increase in one does not necessarily increase the other; and, the two first-order capabilities are distinct and complementary. Therefore, *BI&A Customer Application Capability* and *BI&A Customer Orientation Capability* are the first-order formative capabilities of *BI&A Customer Process Capability*. Thus, tapping into these capabilities of BI&A may make BI&A more effective in helping the organization respond to the market demands and be innovative to meet the business needs and customer demands. Therefore:

Hypothesis H2: BI&A Customer Process Capability has a positive influence on BI&A Effectiveness.

3.3 BI&A B2B Process Capability, Effectiveness and Organizational Performance

BI&A B2B Process Capability is the ability of BI&A to penetrate the firms' business processes. This capability consists of the functionalities of BI&A that can sustain B2B centric activities. Business processes in a firm help orient its activities towards value creation. Prior research indicates that IT creates value for an organization by its direct impact on the business process (Elbashir et al., 2008; Ray et al., 2005). Logically extending this, we argue that the effectiveness of BI&A lies in its ability to create value by influencing the business process in organizations.

A process generally has many activities that are performed by various individuals across an organization. A simple process may target only a small functional unit within the organization. On the other hand, an end-to-end process can span different departments and different business partners. BI&A should be able to influence the process at all levels. Further, to create value the business process in the firm needs to include activities that can convert raw materials to finished goods/products or services (operations). To carry out operations, the firm should have a good relationship with other firms that could be its manufacturer, suppliers, retailers, or partners. Thus, for a firm to create value, it should have a process in place that can seamlessly integrate data and information generated by the different partners and help the decision-makers in making decisions. We argue that to use BI&A effectively, BI&A needs to leverage three different sets of capabilities that can influence the B2B process and enhance its effectiveness, thus, leading to the higher performance of the firm. All three capabilities are a result of the application of skills and knowledge of individual employees to the operand resource of BI&A and are hence conceptualized as basic operand resources (Madhavaram et al., 2008).

Based on the three sets of capabilities, we conceptualize three dimensions of *BI&A B2B Process Capability* (see figure 2). The first one is the *BI&A B2B Orientation Capability*. We define *BI&A B2B Orientation Capability* as "the way BI&A is oriented to meet the needs related to the supply chain." Firms can use BI&A to meet the supply chain needs. For example, firms can utilize BI&A to improve data visibility in the supply chain to reduce inventory.

Similarly, BI&A can help in resolving supply chain integration issues by identifying specific problem areas. Further, BI&A can help meet the goals of supply chain partners through various analyses such as production variability analysis to ascertain where remedial actions need to be taken or transport analysis for cost reduction and increased efficiency for transport providers. Furthermore, results of such analyses can also be used to anticipate market opportunities and to identify new business opportunities. This will further help firms to respond quickly to fluctuating market demands, thereby improving *BI&A Effectiveness*.

The second dimension of the *BI&A B2B Process Capability* is the *BI&A B2B Engagement Capability*. We define this capability as the "use of BI&A to engage new B2B partners and improve coordination with existing B2B partners." Firms can use BI&A to streamline B2B engagement and enhance approachability with their business partners. Enterprise data is continuously changing, particularly when firms sign up new partnership deals. In such situations, firms can use BI&A to provide a single consistent version of business information (Ramakrishnan et al., 2012). Having a single consistent view of business information facilitates different stakeholders to collaborate and develop new applications, thus saving time for the users (Watson et al., 2004).

Further, it enables efficient communication between the different business partners as they have access to the same information (Massa et al., 2005). Successful B2B engagements rely on knowledge sharing, frequent interactions, and joint development of solutions between the B2B partners. Thus, *BI&A B2B Process Capability* can improve *BI&A Effectiveness* by assisting in sharing knowledge, improving communication, and facilitating collaboration between B2B partners.

The third dimension of *BI&A B2B Process Capability* is *BI&A B2B Compatibility Capability*. We define this capability as the "The ability of BI&A to improve process coordination and operational capability." Thus,

organizations can utilize BI&A to optimize their process, thereby increasing efficiency and making the process compatible with different channels and stakeholders. For example, firms can use BI&A to analyze data for balancing supply chain resources with the requirements, thereby improving supply chain consolidation and optimization. Further, organizations can utilize BI&A to make informed decisions regarding ordering the required items and the optimum quantity. At the operational level, firms utilize BI&A for stock location planning, inventory planning, transport management, purchasing/vendor analysis, and distribution and logistics. Therefore, by leveraging *BI&A B2B Process Capability* firms can make operations more efficient and improve coordination between different stakeholders at the operational level, thus improving *BI&A Effectiveness*.

We propose that *BI&A B2B Process Capability* is a formative second-order capability that is a composite operant resource. This is because of its constituent first-order capabilities, which are basic operant resources, make a unique contribution to *BI&A B2B Process Capability*. The first-order capabilities do not necessarily covary and are distinct and complementary. Consequently, *BI&A B2B Process Capability* consists of BI&A applications related to supply chain integration through orienting BI&A in the proper direction, engage new partners and improve coordination with existing partners, and using BI&A for process coordination and operational improvements. Furthermore, *BI&A B2B Process Capability* aids activities with B2B partners due to insights through the visibility of goods and information, business-level integration, and process-level coordination across channels. Together, BI&A B2B Process Capabilities provide firms with the capacity to derive analytical insights in its business processes, making BI&A effective in identifying new business opportunities and helping the organization adapt to volatile industry/market changes. Therefore:

Hypothesis H3: BI&A B2B Process Capability has a positive influence on BI&A Effectiveness.

3.4 BI&A Integration Capability, Effectiveness and Organizational Performance

Although it is important for firms to leverage their BI&A process capabilities by incorporating B2B and customer-centric capabilities, it is equally important for the organizations to acquire new intelligence, integrate them with existing intelligence, and make use of the intelligence within their organization (Işık et al., 2013; Ramakrishnan et al., 2012). Prior studies have identified many such aspects of integration capabilities including capturing, assembling, exploiting intelligence, creating, transferring, using intelligence (Gold et al., 2001). These different aspects of integration capabilities can be grouped into two major categories of acquiring intelligence and converting it into a useful form.

Acquisition-oriented BI&A capabilities are geared towards procuring and sharing intelligence within the organization. Different terms such as acquire, capture, create, collaborate, generate, and seek has been used to describe this capability. The generic theme in all these terms is the acquisition of intelligence, which requires the application of skills and knowledge and is thus a basic operant resource. The acquisition of new intelligence involves having a process in place within the organization for understanding current business and generating new intelligence from existing data and information (Inkpen et al., 1998). Another way to acquire intelligence is through collaboration. Collaboration takes place between the individuals within the organization and between the organization and its business partners. Through such collaborations, intelligence regarding best practices and knowledge about new products, services, and innovation can be shared and disseminated.

However, acquiring intelligence is not sufficient. It must be used appropriately for gaining a competitive advantage. BI&A conversion capabilities are those oriented towards making existing intelligence useful. Such capabilities can help to convert intelligence into a plan of action for new product design or service offerings. Again, note that this capability is the result of applying of skills and knowledge of employees to the operand resource of BI&A in a business context and is thus a basic operant resource (Madhavaram et al., 2008). Integrating this intelligence into a standard organizational framework will help reduce redundancy and thereby improving efficiency (Davenport et al., 2007). Such a framework also enables organizations to replace outdated intelligence, combine the intelligence of different individuals, and maximize efficiency. Thus, organizations should be able to integrate intelligence from different systems and individuals.

We propose that *BI&A Integration Capability* is a formative second-order capability (and composite operant resource) due to three reasons. First, *BI&A Acquisition Capability* and *BI&A Conversion Capability* make unique contributions to *BI&A Integration Capability*. Second, the two first-order capabilities do not co-vary. Third, they are distinct and complementary. Therefore, *BI&A Acquisition Capability* and *BI&A Conversion Capability* represent underlying formative elements of *BI&A Integration Capability*. *BI&A Integration Capability* comprising of acquisition-oriented capabilities and conversion-oriented capabilities makes BI&A

more effective. For example, customer-centric activities require the 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&A to adequately respond to market and environmental changes. For example, aggregation of healthcare data helps providers to avoid uncertainty or volatile conditions and take appropriate decisions at the right time (Tremblay et al., 2007; Tremblay et al., 2012). Hence, BI&A can provide insights regarding the nature of the 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 substantive and insightful, thereby making subsequent decisions faster and more effective. Thus, the integration capability of BI&A that can provide decision-makers with timely and usable information will make BI&A more effective in identifying new business opportunities, responding quickly to new market demands, and increasing the sales growth. Formally:

Hypothesis H4: BI&A Integration Capability has a positive influence on BI&A Effectiveness.

3.5 BI&A Effectiveness to Organizational Performance

BI&A Effectiveness refers to the use of BI&A in making organizations effective in meeting changes in market demands and environmental volatility. There are no clear or well-defined notions regarding what it means to make an organization effective or how it can be measured (Gold et al., 2001). However, like any other organizational resource, effective use of BI&A should contribute to improving *Organizational Performance*. Therefore, we examined the literature on BI&A to ascertain the key contributions of BI&A. Such contributions may include the ability to anticipate market changes and identify new business opportunities (Torres et al., 2018).

Similarly, BI&A may also provide organizations with the ability to become responsive to market demands and be able to adapt to volatile industry/market fluctuations. For example, Harrah's entertainment used BI&A to take advantage of the change in the gaming laws in the early 1990s and become a leader in their industry sector (Watson, 2009). Further, such effective use of BI&A for identifying new business opportunities or being able to adapt to volatile industry/market changes may also improve the bottom line figures of the organization. For example, using BI&A to become responsive to market demands may result in increased sales. Identifying new business opportunities and capitalizing on it may improve the financial performance such as return on equity for the company. Thus, in general, using BI&A effectively within firms may have a positive impact on *Organizational Performance*. Therefore, we hypothesize:

Hypothesis H5: BI&A Effectiveness has a positive influence on Organizational Performance.

4 Methodology

We use a primary data collection method in this study. For this purpose, we followed a multi-step protocol for survey data collection in India that was developed in earlier studies (Kathuria et al., 2018a; Kathuria & Konsynski, 2012; Kathuria et al., 2010). We used the partial least square technique (PLS), a second-generation structural equation technique, to validate the measurement model and analyze our data. For robustness, we also estimate our models using ordinary least squares regression.

4.1 Operationalization of Constructs

First, to operationalize the constructs, we reviewed existing literature and developed an initial data collection instrument using items from prior studies adapted to our context. These initial instrument items were cross-validated through a pre-test with seven scholars and industry respondents (senior managers in IT, marketing and operations functions involved with BI&A implementation and use). These respondents were interviewed about their interpretation of the items and comments on content validity, appearance, terminology, clarity of instructions, organization and response format, were solicited. Accordingly, adjustments were made to the questionnaires. The items were further revised based on a pilot test with a small sample from the targeted population. The final survey instrument is provided in table A2 of the appendix. All items were measured on a seven-point Likert scale.

4.2 Development of Sample Frame

Second, we developed our sample frame by collating multiple industries, city and state directories from the largest state (by gross domestic product) of India, resulting in an initial list of approximately 1500 firms. This

list was pruned by removing organizations for which public records had not been filed with India's federal Ministry of Corporate Affairs, were small in size (less than 50 employees), or had less than 3 Directors. Organizations that do not meet these conditions are unlikely to have mature IT organizations with BI&A implementations. This process resulted in a sample frame of 790 firms.

4.3 Data Collection Procedure

Third, the questionnaire was administered voluntarily, anonymously, and both online and in-person to one respondent from each firm in the sample frame. Respondents were the highest-ranking IT executive in their firm and had designations of Chief Information Officers, Chief Technology Officers, IT Directors, and IT Managers. An executive summary of the findings and a small souvenir were offered to incentivize participation. Usable data were collected from 154 respondents using BI&A in their organizations across a range of industries, resulting in a response rate of 19.5%. We compared the means of firm age and *BI&A Effectiveness* between early and late responders, online and in-person responders, and responders and non-responders. This analysis did not reveal any statistically significant difference, thereby demonstrating the absence of any bias in the data.

Twenty-one percent of respondents were responsible for the overall management of BI&A in their organizations, and around 8% of respondents were involved in evaluating and purchasing new BI&A tools. Further, more than 31% of the respondents evaluated themselves as advanced BI&A users and around 30% as intermediate BI&A users. More than 38% of the respondents were using BI&A in the manufacturing sector whereas around 7% of the respondents belonged to the service industry. Around 7% of the respondents classified themselves to have a technical orientation towards BI&A whereas more than 50% of the respondents classified themselves to be more business-oriented with regards to using BI&A.

4.4 Choice of Analysis Technique

We chose PLS as our primary analysis technique as it allows the estimation of a series of interrelated dependence relationships simultaneously. Further, PLS is better at handling multi-level formative constructs as compared to covariance-based SEM (Lowry et al., 2014) and our model contains multi-level formative constructs. Another advantage of PLS is its ability to handle a smaller sample size. SmartPLS 3.0 was used to carry out the analysis. Note that it is inappropriate to automatically use PLS as a solution for small samples. The commonly used heuristic to derive the sample size for PLS is "to multiply 10 times the scale with the largest number of formative (such as causal) indicators or to multiply 10 times the largest number of structural paths directed at a particular construct in the structural model" (Lowry et al., 2014, p. 132). Our model has 11 formative constructs and no more than five independent constructs influencing a single dependent construct, thereby implying a minimum sample size of 110. Therefore, the sample size of 154 is adequate for the use of PLS in this study.

4.5 Assessment of Measurement Model

The measurement model describes the relationship between the measured variables and their latent constructs. This is addressed by assessing the validity and reliability of the measures.

Table 2. Descriptive Statistics and Correlations amongst First Order Constructs

ID	Construct	# of items	Mean	SD	α	Rel.	AVE	1	2	3	4	5	6	7	8	9	10	11	12		
1	BI&A Technology	3	4.67	1.45	0.91	0.95	0.85	1.00													
2	BI&A Culture	5	4.76	1.63	0.95	0.96	0.84	0.56	1.00												
3	BI&A Governance	4	4.64	1.74	0.95	0.96	0.87	0.52	0.61	1.00											
4	BI&A Customer Orientation	3	4.61	1.79	0.96	0.98	0.93	0.55	0.57	0.63	1.00										
5	BI&A Customer Application	3	4.34	1.83	0.96	0.97	0.92	0.53	0.68	0.68	0.65	1.00									
6	BI&A B2B Orientation	4	4.47	1.89	0.97	0.98	0.91	0.51	0.66	0.54	0.54	0.62	1.00								
7	BI&A B2B Engagement	3	4.44	1.85	0.96	0.97	0.93	0.53	0.62	0.70	0.73	0.72	0.57	1.00							
8	BI&A B2B Compatibility	3	4.52	1.91	0.96	0.98	0.93	0.58	0.65	0.65	0.70	0.73	0.54	0.73	1.00						
9	BI&A Acquisition	2	4.22	1.63	0.9	0.95	0.91	0.63	0.54	0.53	0.62	0.58	0.64	0.53	0.51	1.00					
10	BI&A Conversion	3	4.27	1.79	0.95	0.97	0.91	0.54	0.69	0.63	0.62	0.71	0.76	0.64	0.63	0.68	1.00				
11	BI&A Effectiveness	4	4.98	1.74	0.96	0.97	0.88	0.49	0.61	0.64	0.67	0.68	0.52	0.74	0.75	0.45	0.59	1.00			
12	Org. Performance	3	4.51	1.96	0.96	0.97	0.93	0.55	0.61	0.63	0.65	0.65	0.58	0.68	0.72	0.55	0.66	0.67	1.00		

Rel.: Reliability
Kendall rank correlations are reported due to the ordinal nature of the variables

4.5.1 Assessment of Reflective Constructs

Convergent validity for the reflective constructs was assessed by examining the average variance extracted (AVE). The AVE indicates the amount of variance explained by measurement items for a construct relative to the amount of variance captured due to measurement error. For a latent construct to exhibit adequate convergent validity, all factor loadings should exceed 0.7, and it should have an AVE score greater than 0.5. All the items of our constructs loaded on their respective constructs with a score higher than 0.7 (see table 2 for variable correlations) and the AVE scores for all our latent reflective constructs were greater than 0.5. Thus, all constructs exhibit adequate convergent validity.

Discriminant validity is assessed by observing the relationship between the correlation among the latent constructs and the square root of the AVEs for these constructs. If the square root of the AVEs is greater than the correlation among the latent constructs, then the indicators are said to exhibit adequate discriminant validity. After dropping one item from the acquisition construct, the correlation among the constructs was less than the square root of the AVEs (shown in table 2). This indicates satisfactory discriminant validity for all our reflective constructs. Although the correlations among the first-order constructs seem a little high, they are still less than the prescribed cut-off of 0.9 (Fornell et al., 1982; Fornell et al., 1981). To assess the robustness of our results, we re-ran the model after orthogonalizing the variables, following the Gram-Schmidt procedure suggested by prior research (Kathuria et al., 2018a; Sine et al., 2006). The results remain largely similar and are omitted for brevity. Correlations between second-order constructs are shown in table 3.

Table 3. Correlations amongst Second Order / Latent Constructs

ID Construct	1	2	3	4	5	6
1 BI&A Innovation Infrastructure Capability	1.00					
2 Customer Centric Process Capability	0.74	1.00				
3 B2B Centric Process Capability	0.75	0.79	1.00			
4 BI&A Integration Capability	0.66	0.68	0.75	1.00		
5 BI&A Effectiveness	0.66	0.76	0.68	0.55	1.00	
6 Organizational Performance	0.69	0.70	0.72	0.63	0.67	1.00

We evaluated the reliability of our constructs by examining the composite reliability score and the Cronbach's alpha. For the constructs to exhibit adequate reliability both these scores should be greater than 0.7 (Nunnally, 1978). All the constructs exhibited adequate reliability (Table 2).

4.5.2 Assessment of Formative Constructs

In addition to the above tests, we assessed the construct validity of the second-order formative constructs (see figure 2). The reliability of *BI&A Innovation Infrastructure Capability* was 0.97, while the reliabilities of *BI&A Technology Capability*, *BI&A Governance Capability*, and *BI&A Culture Capability* were 0.95, 0.96, and 0.96 respectively. There were statistically significant path coefficients between the first-order dimensions *BI&A Technology* ($\beta = 0.250$, $p < 0.01$), *BI&A Governance* ($\beta = 0.357$, $p < 0.01$), *BI&A Culture* ($\beta = 0.454$, $p < 0.01$), and *BI&A Innovation Infrastructure Capability*. The reliability of *BI&A Customer Process Capability* was 0.97, and the reliabilities of *BI&A Customer Orientation Capability* and *BI&A Customer Application Capability* were 0.98, and 0.97 respectively. There were statistically significant path coefficients between *BI&A Customer Orientation* ($\beta = 0.517$, $p < 0.01$), *BI&A Customer Application* ($\beta = 0.528$, $p < 0.01$), and *BI&A Customer Process Capability*. The reliability of *BI&A B2B Process Capability* was 0.98, and the path coefficients and reliabilities of first-order constructs were significant: *BI&A B2B Orientation*, *BI&A B2B Engagement*, and *BI&A B2B Compatibility* were 0.98, 0.97, and 0.98 respectively. Path coefficients between *BI&A B2B Orientation* ($\beta = 0.389$, $p < 0.01$), *BI&A Engagement* ($\beta = 0.322$, $p < 0.01$), *BI&A Compatibility* ($\beta = 0.328$, $p < 0.01$) and *BI&A B2B Process Capability* were also significant. Finally, the reliability of *BI&A Integration Capability* was 0.97, while the reliabilities of *BI&A Acquisition Capability* and *BI&A Conversion Capability* were 0.95, and 0.97 respectively. There were statistically significant paths between the first-order dimensions *BI&A Acquisition* ($\beta = 0.389$, $p < 0.01$), *BI&A Conversion* ($\beta = 0.633$, $p < 0.01$), and *BI&A Integration Capability*.

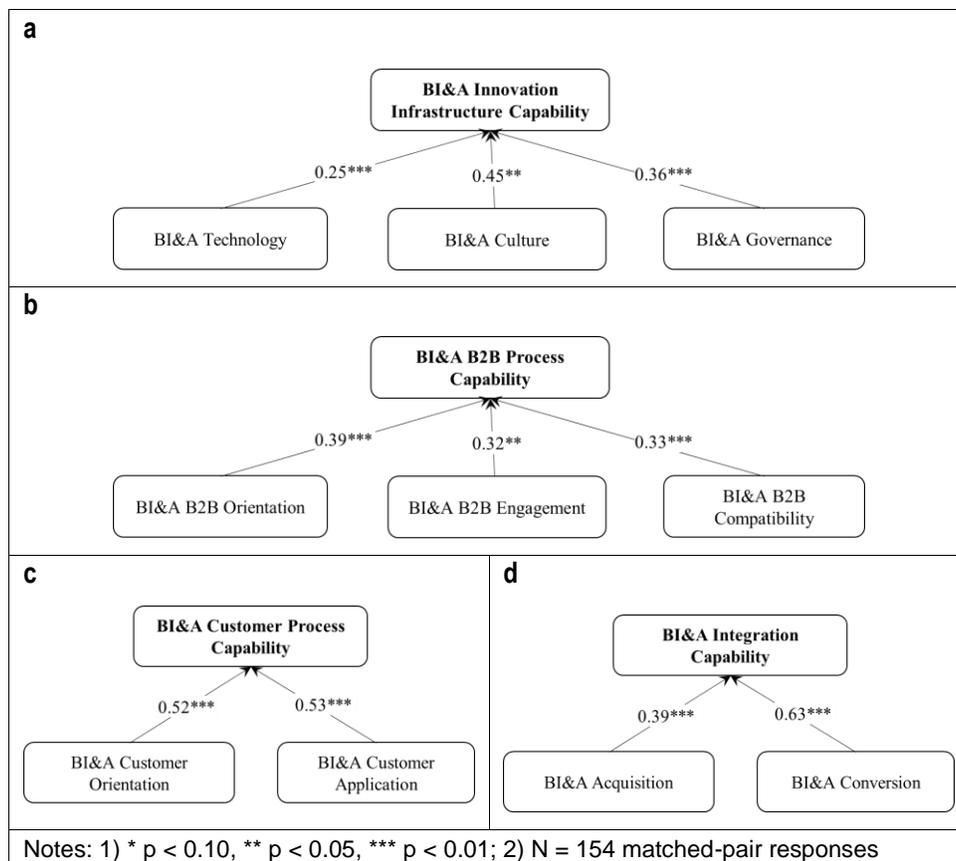


Figure 2. Second-Order Formative Constructs and Loadings

All four second-order constructs were formed by calculating weights of the first-order constructs to the second-order construct, and all weights were significant at $p < 0.01$ (Kathuria et al., 2018a; Pavlou et al., 2006). Further, correlations among first-order constructs were significant, but not overly high, thereby evidencing the appropriateness of a formative model. Moreover, an alteration in any of the first-order

dimensions does not necessarily cause a change in the other dimensions; a reflective model, therefore, seems unlikely. Thus, the proposed second-order formative constructs are supported.

Taken together, these tests suggest psychometric adequacy of the measurement model.

4.6 Assessment of Structural Model

The structural model evaluates the relationship between theoretical constructs. Bootstrapping with a sample size of 500 was performed to assess the statistical significance of the structural model. Hypotheses were tested using a one-tailed t-test due to their unidirectional nature. Prior studies have indicated that implementing BI&A within an organization is an expensive procedure. Thus, revenue generated by the organization will play a role in the implementation of BI&A. Further, effectively using BI&A will depend on the experience and the BI&A orientation (technical or business side) of the BI&A user. Therefore, we control for revenue, BI&A experience, Organization type, and BI&A orientation for both *BI&A Effectiveness* and *Organizational Performance*.

4.6.1 Structural Model Test Results

Structural model tests results (see table 4) indicate that BI&A Infrastructure Capability, *BI&A Customer Process Capability*, and *BI&A B2B Process Capability* have significant positive relationships with *BI&A Effectiveness* (BI&A_IIC: $\beta = 0.30$, t-statistic = 2.17, $p < 0.01$; C_PC: $\beta = 0.74$, t-statistic = 3.67, $p < 0.01$; B2B_PC: $\beta = 0.30$, t-statistic = 1.64, $p < 0.05$), supporting H1, H2, & H3. Interestingly, although our results indicate that *BI&A Integration Capability* has a significant relationship with *BI&A Effectiveness*, the sign of the path coefficient is negative. Thus, the relationship is in a direction opposite to what we hypothesized (BI&A_IIC: $\beta = -0.42$, t-statistic = 3.66, $p < 0.01$). The reasoning for the occurrence of this phenomenon is given in the discussion section. Further, results indicate that *BI&A Effectiveness* has a significant positive relationship with *Organizational Performance* (BI&A_effectiveness: $\beta = 0.86$, t-statistic = 30.02, $p < 0.01$), supporting hypothesis H5. Overall, our model (figure 3) explained approximately 89% of the variance in *BI&A Effectiveness* and 79% variance in *Organizational Performance*.

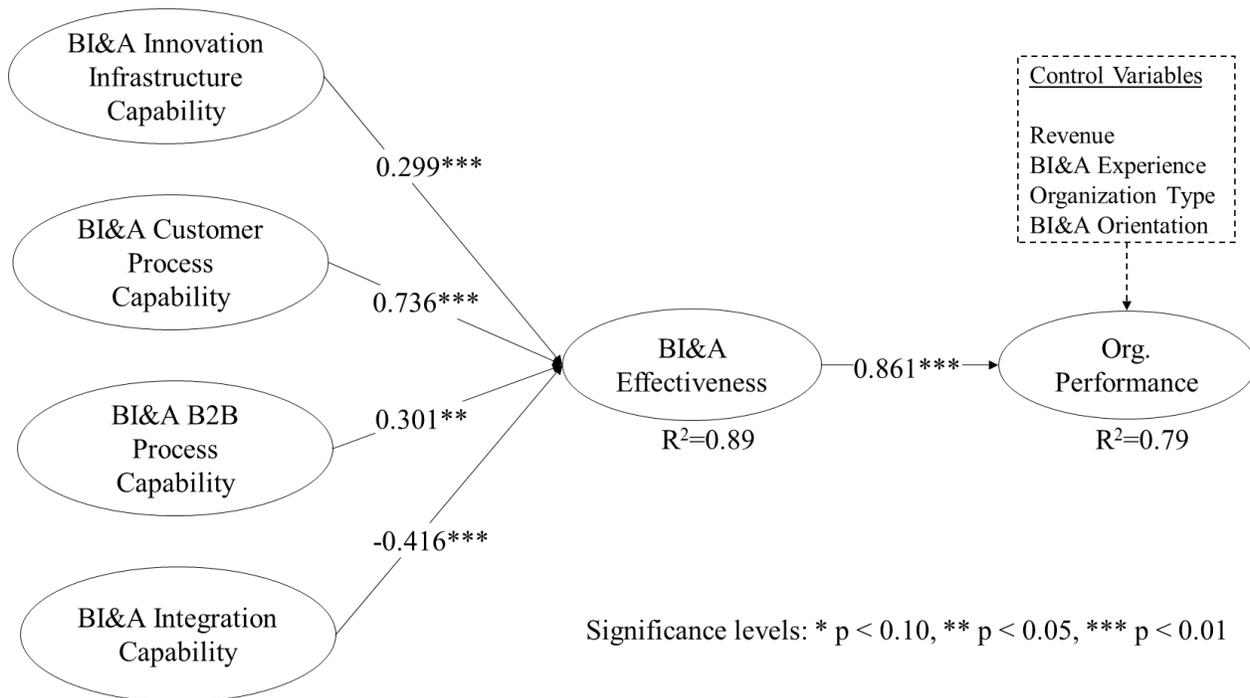


Figure 3. PLS Estimation Results

4.6.2 Robustness Tests

Table 4. Results of Hypotheses Testing

Hypothesis	β Coeff	T Stat.	P-Value	Result
H1 There exists a positive relationship between BI&A Innovation Infrastructure Capability and BI&A Effectiveness.	0.299	2.17	0.01***	Supported
H2 There exists a positive relationship between BI&A Customer Process Capability and BI&A Effectiveness.	0.736	3.67	0.00***	Supported
H3 There exists a positive relationship between BI&A B2B Process Capability and BI&A Effectiveness.	0.301	1.64	0.05**	Supported
H4 There exists a positive relationship between BI&A Integration Capability and BI&A Effectiveness.	-0.416	3.66	0.00***	Supported (Sign reversal)
H5 There exists a positive relationship between BI&A Effectiveness and organizational performance.	0.861	3.02	0.00***	Supported

Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

For robustness, we estimated Ordinary Least Squares to test the hypotheses, results for which are shown in table 5. The first column shows the effect of each of the four BI components on *BI&A Effectiveness*. The second column shows the effect of *BI&A Effectiveness* on *Organizational Performance*, and the last column shows the effect of the BI components and *BI&A Effectiveness* on *Organizational Performance*. These are largely similar to the findings using structural equation models.

Table 5. OLS Estimation Results

	(1)	(3)
	BI&A Effectiveness	Org. performance
BI&A Effectiveness		0.88*** (0.04)
BI Innovation Infrastructure Capability	0.23** (0.10)	
BI Customer Process Capability	0.71*** (0.13)	
BI B2B Process Capability	0.31** (0.15)	
BI Integration Capability	-0.34*** (0.07)	
BI Orientation	0.00 (0.03)	0.06 (0.03)
Organization type	-0.03 (0.03)	0.05 (0.04)
BI Experience	-0.04 (0.03)	0.003 (0.04)
Revenue	0.06** (0.03)	-0.03 (0.04)
F-statistic	151.05***	131.19***
Adjusted R-square	0.88	0.82
Observations (N)	154	154

(1) Standard errors in parentheses.
 (2) Significant at *10%, **5%, and ***1% level.
 (3) Intercept is included, but in the interest of space, we do not show the estimates.

Also, since our measure of organizational performance may be susceptible to bias, we performed supplementary analysis. First, though many of our respondent firms are privately held, we were able to collate an objective measure of organizational performance – Return on Assets, for a significant proportion

of the sample. This measure was significantly positively correlated (<0.80) with the self-reported measure of firm performance. We ran OLS estimations with this measure of organizational performance and received qualitatively similar results. Second, in our survey questionnaire, we had asked respondents to indicate their firm's revenue. As a robustness test, we used this coarse measure to re-estimate our econometric specification and again received similar results. Results for these tests are not reported to conserve space.

4.6.3 Assessment of Common Method Bias

We performed three analyses to assess the threat of common method bias. We conducted Harman's one-factor test (Podsakoff et al., 1986) by entering all variables in exploratory factor analysis. Per expectations, no single major factor emerged, with the largest factor accounting for only 27% of the variance. Second, we used the partial correlation method (Podsakoff et al., 1986), in which the highest factor from the factor analysis was added to the PLS model as a control variable. This did not produce a significant change in variance explained. Third, we performed the marker variable test (Lindell et al., 2001) by adding a theoretically unrelated construct (organizational size) to the model. The correlations among variables did not change significantly after accounting for common method variance. These suggest that common method bias is not a significant concern.

5 Discussion

5.1 Findings

This study has some important findings. First, our results indicate that *BI&A Effectiveness* does impact *Organizational Performance*. Thus, using BI&A effectively can have a positive impact on the bottom line for a firm. Therefore, effectively using BI&A for identifying new business opportunities, becoming responsive to market demands, and adapting to the market changes will improve the financial performance of the firm. Second, in order to use BI&A effectively, it is important to leverage different capabilities that BI&A can provide. The different BI&A capabilities include *BI&A Innovation Infrastructure Capability*, *BI&A Customer Process Capability*, *BI&A B2B Process Capability*, and *BI&A Integration Capability*.

BI&A Innovation Infrastructure Capability has a positive influence on *BI&A Effectiveness*. This suggests that in order to use BI&A effectively firms need to leverage the governance capabilities, the technological capabilities, and the cultural capabilities of BI&A. Organizations should have appropriate BI&A tools for collecting, integrating, and sharing data and information within the firm. Further, firms must have the proper governance in place to facilitate the use of these BI&A tools. BI&A governance must facilitate sharing and exchange of intelligence and information across internal boundaries within the organization. Organizations should have process and policies in place that encourages the use of BI&A within the organization. Firms must further create a culture that promotes the use of BI&A with the organization. Leveraging, these different dimensions of BI&A Innovation Infrastructure Capabilities will help firms improve their *BI&A Effectiveness*.

BI&A Customer Process Capability has a positive impact on *BI&A Effectiveness*, indicating firms will be able to utilize BI&A better to meet market demands and identify new business opportunities if they can leverage the customer-centric capabilities of BI&A. To do so, firms should have two BI&A processes in place: one that can help learn from customer handling mistakes and gain knowledge from the customer, and, a second process to incorporate and integrate data and information gathered from the interaction with customers and utilize them to solve customer issues, improve customer retention, and meet long-term needs of customers.

As hypothesized, *BI&A B2B Process Capability* has a positive impact on *BI&A Effectiveness*. Firms can effectively use BI&A to identify new business opportunities and anticipate market changes by leveraging the B2B process capability of BI&A. Employing BI&A to engage with B2B partners and different stakeholders may provide the firms with a single consistent view of relevant and timely information. Such information may help the firms' partners such as suppliers or manufacturers to deliver the raw materials or the products in time for the firm to meet market demands. Further, using BI&A to integrate the supply chain process and coordinate different processes within the firm will help in demand management and inventory control thus improving the *Organizational Performance* and *BI&A Effectiveness*. Thus, organizations can leverage *BI&A B2B Process Capability* by implementing BI&A for B2B engagement, B2B orientation, and B2B compatibility and improve the effectiveness of BI&A.

Our results indicate that *BI&A Integration Capability* hurts *BI&A Effectiveness*. This surprising and counter-intuitive finding is not a generalized justifiable relationship. We suggest that this may be a finding relative to the firms in our sample. As stated earlier, the sample of firms in this study belongs to India. The contextual

conditions in India concerning information technology use across firms may be the reasons for our results (Kathuria et al. 2018b). First, although most of the firms in India are avid users of information technology, when it comes to leveraging BI&A they may be exploring the early implementation stages of BI&A, such as in the states of BI&A orientation and technological capabilities. In other words, firms in our sample may not have implemented BI&A integration capabilities to derive any benefits out of it, nor would they have made plans regarding BI&A integration.

Second, a significant portion of respondent firms belongs to the manufacturing and services sector (45%), with more than 60% of firms being a novice or intermediate users of BI&A. While this supports the fact that BI&A usage is at its nascent stage, the user profile reaffirms that BI&A integration may be a far-fetched experience for the users.

Third, the *BI&A Integration Capability* refers to efficiency and effective acquisition and conversion of business intelligence for the organization. In other words, the BI&A efforts need to be aligned to the business strategies and goals to be effective—that has been widely suggested to be a missing process or problem for firms in IT capabilities literature (Coltman et al., 2015; Segars et al., 1998). We would allude to this problem in the context of our sample of firms to posit that due to lack of strategic alignment of their BI&A efforts, and ad-hoc comprehension of BI&A capabilities in the organizations, we see a negative effect of BI&A integration on BI&A organizational effectiveness.

To sum up, we submit that the negative impact of BI&A integration capabilities on BI&A organizational effectiveness is due to sampling of firms in an emerging country, the issue of measurement and response within the sample, and lack of understanding for aligning the BI&A efforts towards the effectiveness of the BI&A at the firm level. Also, we also note that these findings may not be generalizable to other contexts such as firms in developed countries that are at the pinnacle of leveraging BI&A or, for firms that are at advanced stages of BI&A implementations, such as Uber, Google or Amazon. Nevertheless, conceptually, we suggest that organizations can implement BI effectively by ensuring that all the data sources within the firm are properly integrated. A firms' BI effort is only as good as its data, therefore having the capability of acquiring and integrating different types of data sources and thereby data is very important for leveraging *BI&A Effectiveness*. For example, Continental Airlines achieved its success in BI by integrating different data sources from crew data, flight data, marketing, operations, revenue, and more.

Further, just acquiring data and intelligence is not enough. The insight provided by the integrated data and intelligence should be converted into an actionable plan. In the previous example, Continental Airlines used the intelligence captured by integrating the different data sources to develop new applications within days rather than months thereby letting Continental be agile (Watson, 2010). Thus, leveraging BI&A integration capabilities will help firms' use BI&A effectively. Interestingly, we did not find any significance in the relationship between *BI&A Integration Capability* and *Organizational Performance*. Thus, further research is required to understand the lack of significant relationship between *BI&A Integration Capability* and organizational performance; and more so in developed countries, or across different industry sectors and different firm types.

5.2 Theoretical and Managerial Contributions

This study has both theoretical and managerial contributions. First, our study identifies specific BI&A capabilities that are key to *BI&A Effectiveness*. Thus, our study provides a nuanced explanation of specific underlying features of BI&A that may explain or causal pathways to explain how BI&A affects organizational performance. This study suggests that organizations can achieve success by effectively employing BI&A. This study further takes a microscopic view on the different capabilities that BI&A offer, leveraging which, firms can use BI&A effectively.

From a theoretical perspective, this study adds to the existing literature in BI&A capabilities. We provide a conceptualization of BI&A capabilities that integrates the organizational and technological perspectives, thereby enriching the discourse on BI&A. In this manuscript, we have focused on the analysis and discussion of the core capabilities of BI&A that needs to be leveraged to successfully utilize BI&A in the organization. We believe this is important because many firms tend to implement BI&A, simply as a tool, without any consideration of its different capabilities that can warrant any measure of success. Through theoretical analysis and empirical testing, this study provides evidence to support that BI&A endows organizations with different capabilities. Firms can leverage on this endowment to use BI&A effectively and thereby improve organizational performance. In line with prior studies, the results indicate that the effective use of BI&A is essential for improving organizational performance. However, unlike prior studies, this

research indicates that BI&A capabilities cannot be simply measured in terms of the tools used or the analysis that can be performed using BI&A. Instead, there are different BI&A capabilities, which are multi-faceted and reside at the operational and strategic levels. For example, one of the capabilities is the innovation-infrastructure capability that has technological, governance, and cultural dimensions to it.

Similarly, firms can leverage the customer and the B2B process capabilities for effectively using BI&A. Firms can do so by either focusing on customer-orientation and the customer-application dimension for customer-centric or the B2B compatibility, B2B engagement, and/or the orientation level dimensions for the B2B Process Capability. Along the same lines, organizations can focus on the BI&A acquisition and the BI&A conversion dimensions to leverage *BI&A Integration Capability* and use BI&A effectively.

From a managerial perspective, this study provides a framework for both IS and business executives to understand and evaluate BI&A capabilities and how to pursue their future development. This study provides a direction to managers for implementing BI&A within their organization. Managers continuously face many challenges in their day to day operations and strategic planning. Effectively using BI&A helps in providing managers with established and accurate numbers regarding demand and supply. As shown from our results, using BI&A effectively to meet market innovation or volatile demands of the market will help in improving the overall performance of the organization. Further, in order to ensure the effective use of BI&A, it is important to mobilize and deploy BI&A to support innovation in the organization. Managers must devote time and money to establish *BI&A Innovation Infrastructure Capability* that can leverage BI&A functionalities.

Similarly, managers have to ensure that the BI&A within their organizations support the firms' business processes. *Target* lost about one million dollars due to poor control of their inventory. Using *BI&A B2B Process Capability* *Target* could have better controlled the integration between their warehouses and storage space. Thus, the results of this study show that managers need to leverage their *BI&A B2B Process Capability* for effective use of BI&A. A lot of customer data is generated through social media and the internet. The likes and dislikes of the customers, their satisfaction rating regarding the product and the service offered by an organization, their perception regarding the quality of the product or service are few of the information that organizations capture to improve customer satisfaction. Managers can leverage *BI&A Customer Process Capability* to analyze this information and effectively use BI&A to improve their organizational performance. As organizations pursue the deployment of BI&A for analyzing the increasing amounts of data, it is important for them to focus on the goal of implementing BI&A and BI&A capabilities that are required for achieving these specific goals. Exemplars of organizations that have been successful in this endeavor can be found - Amazon successfully leverages their BI&A B2B Process Capability to determine where to store more than three billion products so that they can be quickly shipped to the customers without delay. Similarly, Starbucks successfully leverages its BI&A customer process capability to offer recommendations and rewards to customers based on their previous shopping histories and to introduce new menu items to customers based on their tastes.

5.3 Limitations

Our results should be interpreted in light of certain limitations. First, although the sample size of 154 is sufficient to carry out PLS analysis, larger sample size may have permitted a more robust and comprehensive analysis. Second, less than ten percent of the respondents had a technical orientation towards BI&A, which could have influenced the ability of the respondents to accurately assess *BI&A Innovation Infrastructure Capability* as they have the components of technology and governance capability. Third, as stated earlier concerning some counterintuitive findings, the results of this study may not be generalizable across all contexts or all firms. Indeed, this limitation of the study should encourage future research in either replicating or extending this study to a different set of firms, industry sectors, and national contexts. Finally, the study may also have limitations in terms of the scope of the variables considered. In this study, we examine the impact of BI&A capabilities on *BI&A Effectiveness* and organizational performance. Given the time and scope of this project, other factors such as competitive pressure, institutional pressure, and other such external factors that may have an impact on *BI&A Effectiveness* and organizational performance have been left out. Thus, further research that incorporates all the factors in understanding the effectiveness of BI&A is required.

5.4 Future Research

In the age of big data, an increasing number of firms will embrace BI&A. These trends will engender opportunities for future research that can examine can study how emerging capabilities, such as those related to artificial intelligence and deep learning, interact with BI&A capabilities. The hierarchy of

capabilities presented in this manuscript provides a foundation upon which higher-order capabilities can be conceptualized and empirically tested.

We also encourage capability research on how BI&A capabilities identified in this study integrate with other IT capabilities for process and business innovation. How these relationships vary across different environmental contingencies is also a prime topic for future studies (e.g., Khuntia et al., 2019). Finally, we acknowledge that our set of BI&A capabilities is not exhaustive; future work can examine other BI&A operant resource capabilities.

5.5 Conclusion

In conclusion, we note that with the advent of business intelligence, organizations are somewhat moved by a 'fad' effect around this tool. In practice, while the buzz around BI&A is very high, it resembles a "six blind men went to see the elephant" story. In other words, BI&A perspectives and viewpoints vary across firms, with differing concepts, definitions, and applications. While eliminating the differences would be a herculean task, integrating BI&A perspectives into a holistic model can certainly be a fruitful approach. In this study, we intend to provide such a holistic view around BI&A integration in an organization, albeit with the bias towards capability perspective. Taking the capabilities perspective helps us to highlight the fact the BI&A is 'not just a fad' or buzz' in the practice and academic discourse, but it can help garner higher organizational performance. Overall, the study takes an integrative approach to BI&A. The central tenet of the study focusses on four dimensions of BI&A capability and relates it to organizational performance. A survey methodology is used for data collection. The findings of the study provide a capability-integrative framework for BI&A implementation and motivate managers to see BI&A from an organizational performance improvement perspective.

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Appendix A

Table A1. Illustrative Prior Studies Related to BI&A, Capabilities, and Performance

Study	Research question	Methodology	Key fFinding/s
Peters et al., 2016	Examines the linkage between BI, management control systems, performance, and competitive advantage.	An empirical study, using survey data for 324 firms.	BI infrastructure integration influences competitive advantage. BI functionality, performance measurement capability, and self-service are mediators in the relationship between BI infrastructure integration and functionality.
Yeoh and Popovic, 2015	Examines CSF for Implementing BI systems.	Case study analysis.	Organizational factors such as committed management support & sponsorship and clear vision & well-established business case play an important role in BIS implementation success.
Gonzales et al. 2015	Assess the impact of BI on the performance of enterprises in a developing region.	Mixed method study with 23 interviews and 110 survey responses.	Information quality and service quality influence user satisfaction, and user satisfaction influence the individual impact of BI usage.
Popovic et al. 2014	Examines how information-sharing values influence the use of IS within the context of BI.	An empirical study, using survey data for 146 medium and large firms	Within the BI context, information sharing values do not directly influence IT-enabled information use. However, it has a positive impact on Information Quality and also moderates the relationship between information quality and information use.
Corte-Real et al., 2014	Examines how BI&A can create competitive value and improve firm performance.	Conceptual model	Suggests that BI&A capabilities offer dynamic capabilities based on effective knowledge management, which enables firms to achieve competitive value, which in turn can improve firm performance.
Isik et al., 2013	Examines the role of BI capabilities on BI success and the influence of the decision environment on the relationship between BI capabilities and BI success.	An empirical study using survey data of 97 respondents	Data quality, integration with other systems, user access, and flexibility influence BI success. The relationship between risk mgmt. Support and BI success was not significant. The variables' decision types and information characteristics moderated the relationship between risk management support and BI success and flexibility and BI success.
Mishra et al., 2013	Examines the relationship between IT capability, inventory efficiency, and shareholder wealth.	An empirical study using firm-level secondary data	IT capability influences inventory efficiency which in turn increases stock market returns and reduces stock market risk. Further, IT capability also directly influences stock market returns positively and stock market risk negatively.

Tamm et al., 2013	Examines how Business Analytics (BA) contributes to business value.	Conceptual model	Identifies three pathways consisting of the provision of advisory services, creation, and enhancement of BA tools and the BI platform, and the use of BA tools by end-users through which BA contributes to business value.
Ramakrishnan et al. 2012	Examines the factors that influence BI data collection strategies.	An empirical study using survey data of 63 respondents	Institutional pressure drives organizations to employ BI for achieving consistency of data and information. Comprehensive BI data collection strategy is best suited for implementing BI for achieving consistency and organizational transformation.
Popovic et al. 2012	Examines BI success by investigating the role of BI system maturity and culture on decision-making.	An empirical study using survey data of 181 medium and large firms	BIS maturity influences information content quality and information access quality. Further, information content quality has an impact on the use of information systems in business processes. Although analytical decision-making culture influences the use of information in business processes, it hurts the relationship between information content quality and the use of information in business processes.
Chau & Xu, 2012	Proposes a framework for gathering BI from blogs.	A qualitative study, proposing a framework	Design a framework and system for automatically collecting blogs. This framework is useful in revealing patterns that answer important questions in the domain of BI in blogs
Chen and Siau, 2012	Examines the effect of BI use and IT infrastructure flexibility on organizational agility.	An empirical study using survey data of 214 respondents	BI usage and IT infrastructure flexibility influence organizational agility. IT infrastructure flexibility has a positive influence on BI usage.
Mithas et al. 2011	IT capabilities influence on firm performance?	An empirical study using archival data of 160 firms	Information management capability influences firm capabilities such as performance management capability, customer management capability, and process management capability. These firm capabilities influence firm performance.
Gold et al., 2011	Examines knowledge management from or organizational capabilities perspective.	An empirical study using 300 survey response	Knowledge infrastructure capability and process capabilities are second-order constructs with technology, structure, and culture forming the dimensions of knowledge integration capability and acquisition, conversion, application, and protection forming the dimensions of knowledge process capability. Both these capabilities have a positive influence on organizational effectiveness.

Trkman et al., 2010	Examines the influence of business analytics on supply chain performance.	Empirical analysis using 310 survey responses	Business analytics for the plan, source, make, and delivery has a positive impact on supply chain performance. Further, information systems support and business process orientation moderates the relationship between business analytics and supply chain performance.
Watson, 2009	Describes comprehensive, generic BI environment; and discusses four important BI trends.	A qualitative study, identifying BI resources that are available for faculty and students.	Identifies 3 BI targets: development of single or few BI applications, the creation of infrastructure that can support BI needs, an organizational transformation where BI can change how a company competes in the marketplace. Identifies 4 BI trends viz: scalability, pervasive BI, operational BI, and BI based organization
Elbashir et al. 2008	Examines the relationship between business process performance and organizational performance.	An empirical study using survey data from 419 respondents	Business process performance has a positive influence on organizational performance. The industry type moderates the relationship between business process performance and organizational performance with non-service industries having a stronger moderating effect between the relationships in comparison to the service industries.
Jourdan et al., 2008	The genesis of BI.	Reviews and synthesis of the literature on BI from 1997 to 2006	Early carried out in BI from 1997 to 2006 fits into the categories of artificial intelligence, benefits, decisions, implementations, and strategies.
Herschel and Jones, 2005	Examines the difference and the relationship between BI and knowledge management.	Reviews and synthesis of literature from 1986 to 2004.	Suggests that BI should be viewed as a subset of knowledge management since BI focuses on explicit knowledge, but knowledge management encompasses both tacit and explicit knowledge.
Negash, 2004	Proposes a BI framework and potential research topics.	Qualitative conceptual model	Develops a framework that highlights the importance of unstructured data. Further, it discusses the need to develop BI tools for its acquisition, integration, cleanup, search, analysis, & delivery.
Zhu, 2004	Examines the business value of e-commerce capability and information technology infrastructure in the context of electronic business at the firm level.	An empirical study using primary and secondary data.	E-commerce capability and IT Infrastructure exhibit positive relationships with firm performance measures. The integration of e-commerce capability and IT infrastructure (interaction effect of IT infrastructure and EC capability) reinforces the main effect.
(1) The table is not comprehensive and lists only a few illustrative studies to show the uniqueness and newness of the present study about relevant previous work. 2) Much of the text in this table is taken verbatim from the corresponding studies.			

Table A2. Survey Instrument

Variable	Items
<i>Scale: 1= strongly disagree... 7=strongly agree</i>	
Organizational Performance	The degree to which organizational performance has improved Over the past three years, our financial performance has exceeded our competitors Over the past three years, our sales growth has been outstanding. Over the past three years, we have been more profitable than our competitors.
BI&A Effectiveness	The degree to which BI&A has contributed to making the organization effective in different dimensions – to meet market/innovation/coordination/volatile demands My organization has improved its ability to identify new business opportunities. My organization has improved its ability to anticipate market opportunities. My organization has improved its ability to adapt to volatile industry/market changes. My organization has become responsive to market demands. My organization has improved its ability to innovate new products/services* My organization has improved its ability to reduce redundancy in knowledge-centric effects*
BI&A Technology	The degree to which BI&A technology is implemented in an organization My organization uses BI&A technology to retrieve and use intelligence about products and processes. My organization uses BI&A technology to collaborate with individuals inside and outside the organization. My organization uses BI&A technology to search for new knowledge and map a specific type of knowledge.* My organization uses BI&A tech. to allow employees in multiple locations to learn as a group from a single (multiple) sources at a single (multiple) point of time
BI&A Culture	The way the use of BI&A for decision-making has become the norm within an organization Employees understand the importance of BI for the success of the organization.* Employees are encouraged for intelligence exploration and experimentation Senior management support the role of BI&A in our firms' success My organization expects a high level of participation in intelligence capture, share, and transfer My organizations have an underlying value of on-job training and learning around BI&A In my organization, the vision and objective around BI&A are clearly stated and understood
BI&A Governance	The degree to which BI&A structure is defined within an organization, including rules, policies, procedures, processes, the hierarchy of reporting patterns and relationships within the firm My organization's structure of departments inhibits exchange and sharing of intelligence My organization promotes collective intelligence rather than individualistic acumen My organization Incentivizes performance based on BI.* My organization has processes to facilitates exchange and sharing of intelligence My organization facilitates the transfer of intelligence across structural boundaries
BI&A Customer Orientation	The way BI&A is oriented to meet the firms' customer needs and serve them) Our BI&A system helps employees in solving customer issues. The use of BI&A in our organization has improved customer retention. The use of BI&A in our organization has helped us meet the long-term needs of the customers. The goals of the customers are met through our BI system*
BI&A Customer Application	The process to absorb customer related intelligence in the organization using BI&A) My organization has processes for applying BI&A learned from customer handling mistakes My organization has processes for using BI&A in development of new customer-oriented channels. My organization has processes to take advantage of knowledge acquired from customers
BI&A B2B Orientation	The way BI&A is oriented to address supply chain related needs Our BI&A focuses on meeting supply chain needs. The goals of our supply chain partners are met through our BI&A system. Our BI&A system helps in resolving supply chain integration issues. Our BI&A facilitates the transfer of information across the downward supply chain. Our BI&A helps in upward management of supply chain.*
BI&A B2B Engagement	Usage of BI&A to engage new B2B partners and improve coordination with existing B2B partners The use of BI&A has streamlined B2B engagement. The use of BI&A has increased engagement with our business partners.* The use of BI&A has enhanced approachability with our business partners. The use of BI&A has provided synchronized coordination with our business partners.

BI&A B2B Compatibility	The degree to which BI&A has contributed towards process coordination and operational capability improvement through increased compatibility BI&A has provided us the capability to be compatible with e-commerce capability. BI&A has provided us the capability to be compatible with different channels BI&A has provided us the capability to be compatible with different stakeholders
BI&A Acquisition	Processes to acquire business intelligence My organization has processes for acquiring intelligence about our business. My organization has processes for distributing intelligence throughout the organization. * My organization has processes for acquiring intelligence about new product/services/innovation.
BI&A Conversion	Processes to convert business intelligence My organization has processes for converting intelligence into new product design/service offering My organization has a process for converting intelligence into a plan of action My organization has processes for transferring organizational intelligence to individual employees My organization has processes for absorbing intelligence from individual employees into an organizational framework. *
Revenue	Please select the response that best describes the total annual revenue of your organization (Less than \$100 million, \$100 million - \$499 million, \$500 million - \$1 billion, higher than \$1 billion)
BI Experience	Please indicate your experience with BI (New BI User, Intermediate BI User, Advanced BI User)
Organization Type	Please indicate your organization type (Manufacturing, Service, Healthcare, Government, Others)
BI Orientation	Please indicate your BI orientation (Technical, Business)

Table A3. Illustrative Examples of Process Failures with the Potential Role of BI&A Capabilities

Company	Description / What happened	Impact	Role of BI&A capabilities
Target ¹	Target tries to enter into the new market with 124 shops and three distribution centers, without testing or predictable operations of its distribution network first. The problem is ascribed to a poorly designed ordering system.	Overflowing warehouses with stock, however empty store shelves, lost control of inventory. The firm lost around \$1 billion	Leveraging the BI&A B2B process capability would have allowed Target to effectively use BI&A to test and ensure proper integration between warehouse and store shelf, before the opening of the system.
Apple's iPhone X ²	The facial recognition software requires two modules. One module was created at a faster rate leaving the unequal amount of the other part to couple off with.	Increased cost and a limited supply of OLED displays. Reduced the number of iPhone X during their November launch.	BI&A Innovation Infrastructure Capability could have been leveraged to use BI&A effectively to ensure that they had an equal number of both the modules.
KFC ³	Changed their delivery partner. The partner had trouble delivering fresh chicken to 900 restaurants across the UK.	Many branches of KFC in the UK had to be closed.	Effective use of BI&A by leveraging BI&A B2B Process capability and BI&A Customer process capability would have ensured that chicken was delivered to all the restaurants promptly.
Boeing Dreamliner ⁴	Launched production of the twin-engine 787 in 2007 and vowed to set record production times	Many glitches such as running out of fasteners caused delays that escalated into a revised timeline amounting to years.	Using BI&A effectively by leveraging BI&A Integration capability would have ensured that Boeing Dreamliner had all the materials to finish the production during the estimated time.

¹ <https://channels.theinnovationenterprise.com/articles/5-great-supply-chain-failures>

² <https://www.afflink.com/blog/the-biggest-supply-chain-blunders-of-2017>

³ <https://www.thebci.org/news/supply-chain-failure-closes-more-than-half-of-kfc-fast-food-outlets.html>

⁴ <https://venturebeat.com/2017/01/01/the-top-5-supply-chain-fuckups-of-2016/>

Apple ⁵	An unexpected manufacturing problem at scale	Wireless earphones that were promised to be delivered to retailers by September were not delivered even by December.	BI&A B2B process capability could have ensured the effective use of BI&A for lot sizing, lot scheduling, and optimizing the sequence of orders in the manufacturing line, which would have helped in resolving the manufacturing problem.
Compaq	Compaq was not able to capitalize on the new microprocessors unveiled by Intel. When vendors announced changes in engineering specifications, they incurred more reworking costs.	It took more time than its rivals to launch the next generation of PCs. Compaq did not reap many benefits when the price of the components fell.	BI&A customer process capability would have improved the effective use of BI&A to provide the required agility for the supply chain to take advantage of the market changes.
Ericsson	A Philips facility in Albuquerque that supplied the required radio frequency chips to Ericsson and Nokia went up in flames.	Ericsson had to scale back production for months after the fire. It had to delay the launch of a significant new product. Nokia stole market share from Ericsson.	BI&A Innovation Infrastructure capability would have improved the effective use of BI&A to help Ericsson quickly carry out design changes and contact backup suppliers.
HP	HP's integrated circuit division kept low inventory as one of its key success factors.	This resulted in long lead times for the supply of ICs to HP's ink-jet printer division. The ink-jet printer division had to create a large inventory of printers to offset the long lead time. More expensive	Leveraging BI&A Integration capability for the effective use of BI&A would have helped HP be more cost-effective.
Cisco ⁶	The demand for their product slowed down in 2001 and Cisco had excess inventory.	Stock drops 50% Cisco takes a \$2.2 billion inventory write-down	Analytical capability in the planning process with supply and demand planning would have avoided this bull-whip effect.

⁵ <https://www.raconteur.net/business/10-supply-chain-disasters>

⁶ http://www.scdigest.com/assets/refs/SCDigest_Top-11-SupplyChainDisasters.pdf

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