# Business Intelligence Systems:
# A Necessity for Agile Supply Chains

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## ABSTRACT

*Enterprises today have to be more responsive and agile to customer needs. In addition to being able to deliver in shorter lead times, they also need to manage much wider assortment of products. Thus the challenge for the enterprise is threefold – increased number of SKU's (Stock Keeping Units); reduced lead times and flexibility to accommodate last minute order amendments. In such a scenario, the entire value system has to be seamlessly integrated with every upstream and downstream channel partner sharing business intelligence for an integrated decision making process, thereby establishing a globally optimized system. Business intelligence (BI) overarches the decision support systems and processes for effective decision making while building agile supply chains. This paper bridges the gap in extant literature on the importance of BI in building agile and responsive supply chains through best practices and case examples of global and Indian firms. The paper enumerates the guiding principles of an agile supply chain and the critical success factors to establish such a system. The paper also analyzes the factors that are essential for firms to adopt* **technology which is a key enabler in the entire process.**

*Keywords :* *Agile supply chain, business intelligence system, data mining, data warehousing, decision analytics, real time information, technology adoption, decision support system.*

## Introduction

Lack of patience, restlessness, value price offerings and extended customer service facility are some of the attributes which characterise a typical customer today. The need of the hour is to make goods and services available, acceptable and affordable to the customer. The *"Three A's"* take a heavy toll on the manufacturer, distributor and the retailer as they look to establishing an efficient and agile supply chain. From the neighbouring *"Kirana Store"* in the locality to the supermarkets[1] and hyper markets[2] (e.g. Big Bazaar, Hyper City Mall, and Star Bazaar) at the town centre, every retail store has to face this challenge to retain its customer base first and work on increasing market share. Catering to the needs of the

customers with varying demographic and socio economic backgrounds in a diverse country like India becomes all the more challenging. Understanding buying behaviour in terms of wallet share by category and SKU, time of purchase during the day, spend per visit, brand preferences by category, to name a few becomes critical in order to avoid loss of sales, enhancing customer lifetime value and focusing on high margin items. These decision analytics can be made available to the retailer and the upstream channel members only if there is a robust technology layer which collects, analyzes and provides the necessary dashboards at the right time intervals. All these lead to building an agile supply chain connecting the supplier's supplier and customer's customer. Modern day enterprises take help of robust BI systems (BIS) to take informed and globally optimized decisions that help firms not only to increase revenue, but also at the same time control costs and overheads. This paper studies the role and importance of BIS in establishing a responsive and agile supply chain through best practices of leading firms across the globe and India spreading various industry domains.

The paper is divided into eight sections starting with the introduction and followed by the review of literature. Subsequent sections define the features of an agile supply chain, criticality of technology adoption and role of BI in building agile supply chains. The concluding sections of the paper deal with challenges and impediments in building an integrated BI, conclusions and references.

**Literature Review**

Business Intelligence (BI) as a term was first used by Gartner Group in 1989. Extant literature defines BI as a combination of concepts, methods and processes to improve business decision making (Muller et al., 2010). Cabral et al., (2012) specifically discuss the role of BIS in enhancing overall supply chain performance in terms of selection of key performance indicators by applying analytic network process (ANP) in an auto maker's supply chain. While it can be observed in extant literature that BI has been studied considerably in general, specific research pertaining to supply chain performance has been scant. One of the latest works on this theme (Sangari & Razmi, 2015) discusses the relationship between agility in supply chain and BIS, measured by agile capabilities and agile performance. Sangari, Razmi, & Zolfaghari, (2015) have proposed a reference framework for measuring supply chain agility using grounded theory. A dip stick view of extant literature throws light on several research papers that approach the correlation between BI and supply

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[1]   Supermarket is a self-service store offering a wide variety of food and household merchandise, organized into departments.

[2]   Hypermarket is a superstore combining a supermarket and a department store carrying a wide range of products under one roof, including full groceries lines and general merchandise

chain performance in a more generic way. Sahay & Ranjan, (2008) study the role of real time BI in ensuring customer loyalty in service oriented firms. The importance for integration of the value chain partners to have a single holistic view of the system as a whole has been brought about by Power (2005). Similarly the importance of BI in demand forecasting has been highlighted by Krupnik (2013). In a comprehensive review of literature on BI and its application between the period 1997 and 2006 covering 167 articles, it was observed that about 94 articles pertained to implementation of BI (e.g. CRM, ERP, SCM) and aspects of collaboration, integration, customization etc, (Jourdan, Kelly Rainer, & Marshall, 2008), thus indicating the importance of the topic.

An analysis of the importance of BI was studied in detail in extant literature tracking various reports from technology analyst firms. It may be deduced that increasingly firms have started implementing state of the art BIS to not only get a handle of the historical and current performance trends, but to predict the future performance using predictive analytics of BIS. The adoption of technology is fast and growing, more so in the developed world.  Gartner Inc. has forecasted a 5.2% increase in BI spend globally year on year, with the figure estimated to touch 16.9 billion USD in 2016[4]. Further, it is predicted by a leading
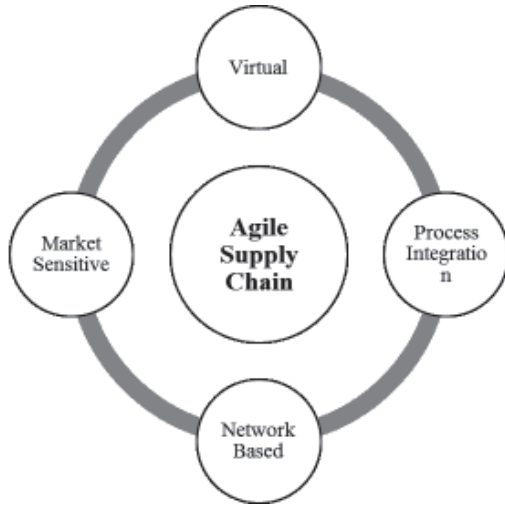
analyst firm, Research and Markets that BI spend would grow at a compounded annual growth rate (CAGR) of 8.25% over the five year period 2014-19 and reach about 27 billion USD in 2019. Thus it can be concluded that role of BI in establishing and nurturing agile supply chains is one of the most relevant research areas the field of technology and operations management.

This paper bridges the gap in extant literature on the need for BI systems to develop an integrated, collaborative and agile supply chain. The paper is conceptual and is based on best practices and success stories of firms both in the developed and the emerging world. The author also shares his consulting experience in development and implementation of BI systems to build agile supply chains.

**Agile Supply Chain - Features**

The characteristics of an agile supply chain are its ability to be responsive to changes in demand patterns much faster. They are nimble and based on a pull system rather than push. Best in class supply chains make use of predictive analytics and predict demand real time for raw material, components and end products or services based on past and ongoing trends. The philosophy that drives the design of such supply chains is goods made to order or configure to order or assemble to order based on the trends. Fig.1.0 represents the guiding principles of an agile supply chain adopted from the

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4     http://www.yellowfinbi.com/YFCommunityNews-Business-Intelligence-software-spend-to-boom-in-new-era-of-accountability-216786

**Fig.1** Agile Supply Chain Guiding Principles[5]

A detailed analysis of the guiding principles indicate that to establish an agile supply chain there are certain enablers and attributes which every member in the supply chain needs to adhere to. They are:

*1. Establishing a Virtual System:* Every entity in the value system i.e. both upstream and downstream needs to be integrated with seamless exchange of information. Real time access to information pertaining to inventory i.e. finished and work in progress (WIP), production schedules and job schedules, tracking logistics carriers, etc is critical. The view of the overall supply chain real time enables informed decision making which is much faster and reduces time to serve. Transparency in the chain reduces bull-whip effect and overall inventory in the chain, thus reducing the cost of goods sold.

This is possible with technology layer integrating the various entities. We discuss in the subsequent sections the varying degrees of maturity of virtualization and networking within supply chains and its effects.

*2. Trust:* As agile supply chains need to be transparent and operate on global objectives rather than operating in silos, there needs to be a great level of trust between different entities. Manufacturer's suppliers need to reveal all information vital for the manufacturer to know i.e. identity of supplier's supplier, delivery schedules, delays or postponements if any, quality issues and its impact on delivery schedules etc. In turn the manufacturer also needs to be transparent in sharing the order volumes and pipeline across different order buckets, order amendment status, production schedules etc. This is possible when all the entities in the supply chain are willing to collaborate and share information which may be viewed as confidential to their business. Thus trust between the partners enables free flow of information and data which helps informed decision making.

*3. Investment in Supply Chain:* Supply chains have limitations unless there is certain degree of automation at every entity level. Building a resilient and agile supply chain demands technology enablement of the various entities. Whether disparate enterprise applications or similar,

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5    Source: Martin Christopher, Cranfield School of Management,
     http://www.sclgme.org/shopcart/Documents/creating_the_agile_supply_chain.pdf

an integration of the platforms for real time exchange of data, transactions and analytics is key. This is possible only when firms are willing to invest in technology to realize the long term benefits. Building an agile supply chain is a strategic decision and hence to have a sustainable business ecosystem, firms need to commit themselves for a long term period.

Though agility and responsiveness is key to reducing supply chain risk, there are impediments which need to be overcome. One of the critical success factors in setting up an agile supply chain lies in adoption of technology and transitioning from age old manual systems to an integrated technology platform. Hence firm preparedness and willingness to adopt state of the art technology is essential for building an agile supply chain. Based on the author's personal experience, it can be stated that maturity of supply chains is a function of the industry in which the firm operates, age and maturity of the enterprise, scale of business and the vision of the firm. Adoption of technology by a firm is impacted by all these factors. In the following section we analyse the criticality of technology adoption across a few industry sectors.

**Criticality of Technology Adoption**

There is a linkage between technology adoption and supply chain performance. The paper attempts to bring out this aspect across a spectrum of scenarios and the impact it has on overall firm performance.

*1. Shorter Product Lifecycles:* Firms offering products and services which have a very short product life cycle i.e. music, books, garments and accessories, mobile phones, laptops and computers have a greater dependency on a pull based supply chain. The sales of the products peak within three to four months of launch and start declining by the fourth quarter. Thus production and sales planning with historical data becomes irrelevant. It is important to have a better assessment of point of sales (POS) data including *"early sales data")*[6].

Researches have indicated significant improvement in forecast accuracy based on early sales data. A case example of an apparel firm dealing with fashion garments, indicates an improvement of forecast accuracy to 92% based on first two weeks of sales data vis-a-vis 45% in a gut feel based forecast (Fisher et al., 2000). In such a scenario, it is essential to have access to POS data on early sales, patterns of sales by competing brands, past sales performance by demographics (e.g. age, gender, income group) of similar products, sales performance by region and store format (e.g. specialized vs. Convenience vs. Supermarkets). The data is then run through various cycles of analysis to provide the key metrics and patterns on

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[6] Sales patterns in the initial one or two weeks of launch of the product across different retail formats

demand by SKU, margins, revenue, store format etc which then goes into the planning cycle. For example, data analytics enables a fashion garment manufacturer to order a specific number of a particular colour, size and design of T-Shirt from its contract manufacturer based in Pakistan or India for sales in a Target store in outskirts of Baltimore, USA. The same example may be extended to the mobile phone display manufacturer in Taiwan for a particular model which has been just launched along with few more for sales in London. Hence nature of the industry for the firm has a strong influence on propensity for technology adoption.

*2. Maturity of Firm:* Technology adoption by a firm is also a function of numbers of years in business, especially for categories in the maturity stage of product lifecycle. These would be product categories i.e. cement, hot rolled coil steel, television sets, and refrigerators, to name a few. However, exceptions do exist and there are innumerable examples of firms that are technology savvy and within the first 2-3 years of inception, invest on automation and are early adopters of technology. This has got to do more with the nature of leadership. But the generally acceptable norm while setting up enterprises is to first stabilize the operations, build a customer base and ecosystem and then venture out to other areas which need funds. In a conservative set up like this, adoption of technology is slow. Hence it becomes a bottleneck to build agile supply chains around such firms.

For example, steel firms globally and especially in India have been very slow in adopting enterprise applications though they have a multi tier supplier and customer base with huge complexity in production and inventory management. Even post adoption, managing change and acceptance of technology by workforce is another daunting task. But once the successful integration happens, the firm is able to plan inventory across the supply chain, including the steel service centres which are closer to the customer and supply cut to length sizes to the automotive, consumer durable, infrastructure and engineering customers. For the steel mill, the historical demand data by customer across various specifications in different quarters provides a sound database for statistical analysis to ascertain demand pattern. Mining of historical data, assessing seasonality in demand, identifying low volume and high margin variants are some of the analysis done by the marketing and planning departments. For example, considering the surge in demand for white goods during festival times i.e. Diwali, Dussehra or Christmas, steel firms plan the production schedule in such a way that specific grades of colour coated steel required by white good manufacturers are produced in those periods and the steel service centres also stock the desired length and sizes of blanks to be supplied to the end customer.

*3. Impact of Business Environment:* The influence of competitors, channel partners, customers

and the quality of technology solutions available for the industry in general and firm in particular makes a huge impact on speed of technology adoption. In an industry where there are a plethora of software solutions, the rate of adoption is higher. Similarly, when the adoption is high in the ecosystem i.e. most suppliers (tier 1, tier 2) are automated and there are EDI (Electronic Data Interchange) systems in place, there is peer pressure for the incumbent to bring in automation.

Thus, adoption of technology and embracing change from a manual process to a transparent and real time integrated technology platform is a huge transformation for a firm. This is a greater challenge in emerging economies like India, China, Brazil, Vietnam, Indonesia, Malaysia and Russia that have experienced a dramatic growth phase over the past one and a half decades. While the firms have grown significantly, the talent pool is yet to catch up with the desired skill set to match the growth, and therefore it becomes a case of complex transformation. This challenge is to stay for the next few years at least, as these economies battle the economic crisis and the human change related issues acting as impediments to technology adoption.

After having discussed and analyzed the features of an agile supply chain and the influencers of technology adoption, the paper explores in greater detail in the next section the role of BI in transforming firms and making them more customers focused, agile and responsive to market dynamics. Further, the paper goes on to bring out the latest trends and what have been some of the challenges which firms are going to face in the times to come, with the proposed counter measures.

## Role of BI in Building Agile Supply Chains

Before a detailed analysis of the benefits and implications of BI in building agile supply chains is discussed, it is imperative to map the progress of this field of study i.e. Decision Support Sciences (DSS) as has been termed over the last 5 – 6 decades. Analytics in its first avatar appeared in the late 1960's and early 1970's as Decision Support Systems (DSS). Terms like Data Warehousing (DW) and BI started to be used by both industry and academia in late 1980's and early 1990's. Today BI is used as an umbrella term covering different aspects, namely, technologies (e.g. data cleansing tools), processes and applications (e.g. Online Application Processing). An architectural schema of BI system is given in Fig.2. It represents the various data sources from various technology platforms leading to a data warehousing system and subsequently to generation of reports for effective decision making. Analytics is also being used interchangeably for BI, predominantly from a commercial engagement stand point wherein firms are outsourcing the function to specialized service providers e.g. Infosys, Wipro, TCS, Genpact, to name a few.

At different points in time researchers have defined BI in their own way. Adelman et al. (2002) describe BI as a term that encompasses a broad range of analytical software and solutions for gathering, consolidating, analyzing and providing access to information in a way that helps enterprise's users make better business decisions. Malhotra (2000) defines BI as the platform which facilitates networking and bringing real-time information to centralized repositories and support analytics that can be exploited at every horizontal and vertical level within and outside the firm. There are many similar explanations on BI in extant literature. However, a comparison of the definitions reflect that the main objective for enterprises to invest on BI applications has been to derive meaningful inferences from huge data repositories generated from various business transactions, which in turn assist in better decision making, maximizing customer and firm performance.
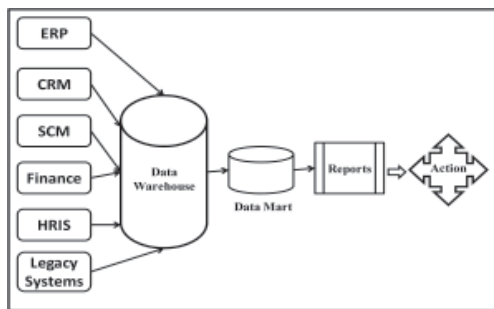


**Fig.2** Architectural Schema of a BI System[7]

Supply chains can be designed to be agile on robust BIS within the value system of the enterprise. Though firms have been operating with very basic data mining and intelligence systems, they are significantly constrained in building a world class supply chain. Success stories of some successful enterprises and how they have approached in designing their supply chains is explained below.

**Case Examples in Western Countries**

*1. Caesars Entertainment Corporation:* An American public gaming firm with interests in casinos, hotels, golf courses and resorts became a market leader by devising its growth strategy using BI to understand customer profitability, lifetime value of loyal customer base, target segments and need gaps. The firm realized that to create sustainable competitive advantage, it had to develop a DSS based on robust a BIS especially in a high growth industry like entertainment.

*2. World Group:* Japan based World Group, a leading fashion garment player is able to manage the entire cycle from new product design to delivery at the store within three weeks and a cycle time of just two weeks from order to delivery at the store. This has been possible with adoption of robust sales forecasting practices of early sales trends, seasonality and integrating production, design and distribution centres with real time information exchange. World Group with its various group companies have integrated on a single technology platform with real time information exchange, leading to setting up a responsive firm to changing fashion trends and patterns.

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[7]Adapted from Solutions, L. (2016). Business Intelligence, (February). Downloaded on 1st July, 2016

*3. Proctor & Gamble (P&G):* P&G is arguable the leader as far as adoption of technology and BI is concerned among consumer product group (CPG) firms globally. BI is claimed to be one of the four pillars in their digital strategy and the firm proudly claims to have competitive advantage in the field. The BI program at P&G centres around the fifty plus "Business Spheres"[8] where each Business Sphere provides executives access to 500 million data points each month ranging from POS data from retailers, syndicated market reports, internal ERP, inventory and shipment data. In addition to the systems generated data, information collected from letters, emails, phone calls and blogs also reside in system providing insights, drill downs, charts and on the fly analysis (termed as Decision Cockpits) for better decision making. The BI tool has also helped P&G significantly in their innovation drive, in identifying new opportunities and breakthrough product or service ideas. On the whole, P&G has been able to build a responsive and agile supply chain integrating all its value chain partners with the help of the state of the art BI tool.

*4. Wal-Mart, TESCO, Target & Other Retailers:* Retail industry along with few others have derived maximum benefit from BIS in not only managing CRM led decisions, but also enhancing efficiency and effectiveness of suppliers, warehouses and logistics service providers. TESCO, Wal-Mart, CostCo, Amazon, Kroger and Carrefour have been the pioneers as far as leveraging technology in building DSS is concerned[9]. With a modest beginning of identifying sales patterns by SKU at a store level, today there is real time linkage between the retail outlets with the DC (Distribution Centre), TPL (Third Party Logistics Carrier), corporate data centre and the gamut of suppliers. BI in retail sphere has been at the most advanced level with assistance in decision making in terms of shelf arrangement, stocking in shelves, stocking near billing counters, type of store lighting by category of stocking, to name a few. All these analysis are being done at a SKU level so that right items are stocked at the right places in the right quantities. Retailers through loyalty cards are also tracking customer specific buying behaviour, spend by category, and spend by season / month / days and time of days.

With emergence of one market - the global market, enterprises have realized the need to serve customers faster in terms of "what they want", "where they want", at the "right time" in "right quantity", "right quality" and at an "affordable price". This has been a benchmark for firms desiring to build a responsive supply chain with minimum disruptions. The above examples of the developed world demonstrate the role played by BI in enabling this transformation.

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8   In-house BI tool at P&G

9   http://www.investopedia.com/articles/markets/122415/worlds-top-10-retailers-wmt-cost.asp

While adoption of BI as a business enabler has been more prevalent in the western markets, of late emerging countries like India, Brazil, China, South Africa, and Malaysia have shown a drastic improvement in implementing BI applications and solutions. Some of the Indian firms that have implemented best in class BI DSS have been explained below.

*Case Examples in India*

*1. Tata Steel:* Tata Steel is one of the early adopters of predictive and prescriptive decision analytics, especially for the outbound supply chain. The firm has well established marketing and planning departments who have the responsibility to determine the sales plan and the production plan based on historical trends and future demand projections by customers. Robust statistical analysis is done on historical data by customer and by time period analyzing the spikes. Market intelligence on competitors, both in India and globally is also integrated with the forecasts collected by field sales force from the customer pool to arrive at the demand plan and the production plan. The technology platform integrates the production centers, yard, sales force and the leading channel partners sharing real time data on orders, stock positions, production runs etc to make informed decisions.

*2. Toyota Kirloskar Motors Ltd (TKML):* TKML has been one of the first firms to have an integrated dealer management system (DMS) connecting the firm's dealers across India. The core of the DMS is the Warranty Management System which provides vital decision analytics on frequency of failures by component and vehicle type that is used as an input in vendor rating and evaluation. This particular aspect of evaluating and rating vendors is being used today by most of the leading automotive OEM's (Original Equipment Manufacturers).

In addition to the above two specific examples, there are innumerable applications in banks, insurance, retail and telecommunication industry. The case of Bharti[10] is very well documented in public domain as how they have gone about with the on demand business solution offered by IBM India encompassing CRM, data warehousing, billing and other online collaborations. This has helped Bharti in understanding the diverse customer base better and design specific services depending on the target segments to maximize lifetime customer value.

The above success stories of firms that have understood their customers and serve them better, have in place a robust BI solution. These firms have have used it as a source of competitive advantage. It is an integral part of their value system that integrates the supply chains of suppliers and customers. This has been possible by practising certain processes and norms of governance over a period of time. Agile supply chains are built over years of trust

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[10]  https://www-03.ibm.com/press/us/en/pressrelease/6910.wss

and process driven behaviour by partners and the following section reflects some of the impediments and challenges in building an integral BI system.

## 1. Challenges & Impediments in Building an Integral BI System

Organizations face various challenges while implementing a BI system. The source is manifold – technology, people, processes and governance, to name a few. The impact is far reaching as it could very well make the entire system redundant and dis-functional. Based on prior experience and published research some of these impediments are highlighted below.

*1. Discipline in entering data at POS, Warehouse, DC:* Many retailers, especially in emerging economies are sceptical about the quality of data that they possess and hence are unsure of taking decisions based on system reports. This mainly happens due to lack of discipline in process adherence by personnel manning the billing counters and goods return counters. Some glaring practices are those of using price look up function and matching product by price rather than product code and thus resulting in mis-match in actual store stock vis-a-vis system reporting stock. For example, a billing counter clerk in a hurry could enter two items for Coke 1 Litre bottle which is priced at INR 50/- as against 1 item of 1 Litre. Coke bottle (priced at INR 50/-) and 500 gm of Tide Detergent (priced at INR 50/-), which is the actual transaction. As a result the in-store inventory for Coke

1 Litre is erroneous by +1, while Tide 500 gm by -1 as against the system. Similar errors also crop up when data entry is not proper for product exchanges and returns or even maintaining inventory records at warehouses and distribution centres. The best practices to address such concerns and improve data quality are:

a. Physical matching of stock with system data: Matching in store physical stock with system data and amending errors on a periodic basis

b. Training: Periodic training of store staff at billing counters, returns desk, back room inventory from time to time and explaining the importance of data quality and its impact on sales. The same may be experienced at the warehouses as well.

c. Skill levels: One of the key success factors in any technology intervention in business processes is the skill levels of people performing the function. Thus, hiring of skilled resources performing the various functions i.e. inventory tracking and record keeping, billing, goods return and warehouse systems provides the necessary edge to firms in implementing technology solutions, be it ERP or a BI platform.

*2. Technology solution and business requirement fitment:* On many occasions availability of the right solution fitting the business need is an impediment. The mismatch in the need versus availability may be due to single or a combination of factors.