

STRENGTHENING SUPPLY CHAINS THROUGH THE UTILIZATION OF BIG DATA

Dylan A. Howell
University of Central Arkansas
1708 War Eagle Dr.
North Little Rock, AR 72116
(501) 681-0021
dahowell1313@yahoo.com

Mark E. McMurtrey*
Professor of MIS
MBA Director
College of Business 102-H
University of Central Arkansas
201 Donaghey Ave.
Conway, AR 72035-0001
(501) 450-5308
markmc@uca.edu

*Corresponding Author

ABSTRACT

The creation of efficient and effective supply chains is paramount in the success of companies around the world. These supply chains must be flexible in how they operate, as the landscape of business is constantly changing. Maximizing efficiency and effectiveness is heavily reliant on the data that companies receive from the links of their supply chains. Companies that have the analytical capabilities to make use of massive amounts of data are creating competitive advantages. These “big data” capabilities are difficult to come by and often even more difficult to adapt. Big data capabilities without the flexibility to attain new skills with new systems can pose quite the issue to companies. As the information age continues and rapidly expands, companies need their employees to have the ability to take large data sets, that are pulled from their supply chains, and produce useful information that can provide an advantage to the company.

INTRODUCTION

Big Data is a relatively new concept that many companies tend to find scary or intimidating. Big data is commonly characterized by its high volume, velocity, and variety. Being able to collect, store, and utilize large amounts of data can make a substantial difference in how firms go about doing business. Growth and innovation, within most firms, is based on how they use the data that they have collected to make new decisions, create new systems, or generally change the way that they are operating. The importance of continued innovation cannot be understated, and supply

chains are constantly innovating to make the movement of products, materials, and information as seamless and efficient as possible.

Within a supply chain, many steps are taken that ultimately result in a product or service being distributed to customers. These steps, or links in the supply chain, produce massive amounts of data that could ultimately be used to increase efficiency and effectiveness through active management of the supply chain. Utilizing such data is intimidating to firms that do not have the human capital necessary to analyze large amounts of data and firms that lack the resources (software, systems, data warehouses, etc.) to create useful information from extremely large data sets. For these reasons, much available (and useful) data goes to waste.

Big data does require specific systems and trained individuals to readily make the most of it, but if the analysis of such data allows for reduction of cost in the manufacturing process or the efficient allocation of resources within a firm, it would likely be foolish to waste such an asset. Stronger, more efficient supply chains have the potential to be created when firms utilize the big data that is produced by their production processes. These efficient supply chains are typically created through the restructuring of firm operations and an increased focus on core competencies, which can create sustainable competitive advantages. If big data can create competitive advantages through stronger supply chains, firms should utilize big data willingly.

LANDSCAPE OF BIG DATA IN SUPPLY CHAINS

Big data without the analytical capabilities to produce useful information from it is useless, for all intents and purposes. In order to make something of big data, analytics applications need to be in place to create intelligence. Many firms put applications in place in the areas of marketing, logistics, operations, and sourcing. This being said, firms typically attempt to find the area of their business in which they believe the most help is needed, and they implement applications in these areas. In doing this, they have to be careful not to choose areas of their supply chain that will not prove profitable once costly applications are implemented.

A problem that is constantly run into is technology cost versus the needs that can be met through the implementation of the applications. It has been found that it can be more cost effective for firms to focus on specific areas in which big data utilization is paramount, because, “big data implementation efforts that tackle too many areas can become easily diffused” (Sanders, 2016). In order for implementation of big data capabilities to make sense for the firm, they must be able to assist the firm in the long-term. Given that it is very difficult to predict the technological innovations and requirements of the future, many firms are hesitant to take the leap into big data analytics. This very fact can prove to be the detriment of companies if they wait too late to make a move.

Supply chains were originally created to use structured data from databases, but big data has made many of the systems being used obsolete. Big data capabilities that have since been developed to give firms access to much more data still face the need to be reined in. One of today’s difficulties is that, “companies cannot always use the data that they have today given the current supply chain architecture,” and, “new methods,” need to be put in place to utilize the power of big data (Orenstein, Ladik, and Rainford, 2016). It seems that though firms are doing their best to use the

data that they have, the methods that they are using to provide them with useful information are insufficient. The amount of data and information that is available to a firm at any given time is increasing exponentially, and without the adequate tools to make use of such data, firms are falling behind and losing their relevance.

WHAT'S TO GAIN FROM USING BIG DATA?

The number of data sources that are being supplied within large supply chains is growing at an increasing rate. The amount of information within a company is vast, but the amount of information that is within the supply chain but external to the company is even greater. It is becoming more prevalent for companies to use these data sets to make predictions about future outcomes. The use of these predictive analytics upon big data sets can, “radically improve the results of everyday decisions on risk, underwriting, marketing and distribution” (Gallagher, 2014). Being able to discern what suppliers, distributors, and even departments within your own firm will do in the future allow a firm to make effective decisions that can eventually prove profitable. With such large amounts of data, forecasting through predictive analytics can be extremely accurate. Obviously, the past is not always indicative of the future, but trends can be established that will make the future clearer to many firms.

Big data allows for a change in focus within firms. We have established that big data gives firms a better view of the past, but it should also push a firm more toward real-time data and analytics. As large amounts of data continuously come into a firm, they must, “develop continuous processes for gathering, analyzing and interpreting data” (Davenport, Barth, & Bean, 2012). As this is done, firms will gain the ability to make decisions faster than competitors, which will give them the possibility of first mover advantages. This will also make it easier for firms to quickly make changes to their business processes which leads to greater efficiency and lower costs, hence greater profitability. Being able to harness the speed of big data gives firms a great competitive advantage, but they can also get swallowed by the speed and the continuous need for system innovation. This being said, making real-time business decisions is a huge advantage that is hard to beat.

If nothing else, big data can be drawn from customers. Marketers rely on consumer behavior to drive the way that they make decisions. Big data capabilities make it easier for firms to understand the customer completely, deliver enhanced value, and immediately access customer information. Marketers want nothing more than to be able to, “quickly and accurately discern what customers want and to then offer it in an efficient manner,” and that goal can be accomplished when real-time big data is utilized (Grossberg, 2016). The more data that companies receive about their customers, the better they can meet their needs on the grounds of things such as product innovation and price point. As these customer needs are met, profitability can almost be guaranteed.

These advantages that make big data an attractive endeavor require the right human capital and analytical capabilities to be effective and prove profitable. Big data cannot make a company successful on its own, but it can create and expand upon competitive advantages that allow companies to be leaders in their industry. It seems increasingly likely that big data and predictive analytics within the scope of supply chains is going to be a common occurrence of the future. It is becoming increasingly rare that companies do not utilize the data supplied to them by suppliers

and distributors, and as this data increases at an exponential rate, it is imperative to keep it from going to waste.

BIG DATA FROM EACH LINK OF THE SUPPLY CHAIN

For the purposes of recognizing how big data from all parts of the supply chain can be used, we will look at a supply chain with the parts or “links” of raw materials, supplier, manufacturer, distributor, retailer, and consumers. For the intents of this illustration, the firm that will be using the big data is the manufacturer. This specific manufacturer will be a producer of t-shirts. We will not touch on all of the possible uses for big data, but this will show how big data comes from all parts of the supply chain, in many situations.

Raw Materials

The raw material that is paramount to the production of a t-shirt is commonly cotton. Therefore, the manufacturing firm would be wise to keep up with data regarding the price of the commodity. As the price of cotton increases or decreases, so will the price of the t-shirt sold by the manufacturer. Spot prices of cotton vary at a moment’s notice. This means that the pricing data has high velocity and volume. Having big data analytical capabilities will allow the manufacturing firm to recognize specific trends in cotton pricing data and make up-to-the-minute decisions regarding the price of the finished t-shirt. Having this data and being able to analyze trends within it would be the primary big data capabilities that would be useful to the manufacturing firm.

Supplier

A supplier of the t-shirt manufacturer would be a company that produces cotton thread. Data that would be useful to the manufacturer would be data regarding the quality of the supplied product and the margins being gained by the sale of the product to the manufacturer. Being able to track supplier quality can allow the manufacturer to make decisions regarding whether what they are being supplied is sufficient to produce the quality of product that they want to provide. It is also vital that the manufacturing firm understand the per unit margins being attained by the supplier. This helps them to recognize whether the price they are paying for the thread is at, below, or above the industry average. These types of data are voluminous and full of variety. The quality data would especially require big data analytics that could make use of the seemingly obscure data. Knowing your supplier frees companies from ambiguity about the types of inputs they are using for their products.

Manufacturer

Likely the best opportunity for collecting big data would be in the actual production of the t-shirts. Many manufacturing companies have, “been collecting big data for years,” but the key is to pull, “information out of the data using [appropriate] data analysis tools” (Brandl, 2013). This available information can include things such as labor hours, equipment productivity, total output, etc. The manufacturer can use these pieces of information to make decisions regarding where the manufacturing system requires significant changes, where costs can be cut within the facility, and what equipment is likely to need replaced or repaired soon. These things help the manufacturer to

run more efficiently, and it all stems from the substantial amounts of data that are constantly being collected within the company.

Distributor

The company that distributes the t-shirts produces data that would be useful to the manufacturer, as well. As the manufacturer, you would want to know how quickly the finished product is being distributed to retailers and how many defects are occurring as a result of distribution, among other things. When this information is received by the manufacturer, big data capabilities will allow them to make decisions regarding whether it is worth their while to use that specific distributor. This could not be done objectively without a large amount of empirical data (big data sets) to back up the decision. This too could save the t-shirt producing company in the resources that they dole out to produce and sell their product.

Retailer

Retailers can also provide important big data that will benefit the manufacturer. Information such as the product turnover within the retailer's inventory system, the average time a unit of their product sits on the shelf, and the sales history of similar products sold through that retailer can be useful. These types of information help the manufacturer to decide how many units of their product they want to sell through a particular retailer. It does them no good to let their product sit on the shelves or in the warehouse with a retailer when it could be moving and selling with another retailer. This type of big data can serve the t-shirt producer by maximizing sales volume with the retailers they choose.

Consumers

This is arguably the most important piece of the puzzle for any company. The information that they can receive from consumers is extremely vast and most directly drives how the company goes about distributing and selling a product. It is important to note that big data, "may be used to exploit consumers," but, "it is also changing business practices in a way that helps those same consumers" (Das, 2016). The big data collected from consumers help companies like our t-shirt manufacturer to be centered in customer needs. It also allows the t-shirt producer to know the market and make pricing and distribution decisions based on what markets they are entering and what is perceived as positive by the consumer. When it comes down to it, the uses of big data all lead to the consumer buying the product, and if they do not make the purchases, companies go out of business. Therefore, the primary uses of big data, for most companies are in consumer behavior and marketing.

PROBLEMS WITH BIG DATA USE

Given that big data and its usage is a relatively new concept to most firms, finding the individuals who can bring the most out of its usage is a difficult (and fairly costly) task. It takes a fair amount of human capital to sustain big data applications and the analytical capabilities of big data. These individuals commonly have a decent amount of education and formal training in the usage of big data, therefore, they are highly sought-after in the job market. Since this is so, many companies

have individuals who are, “largely self-taught,” in the usage of big data applications that are molded to their specific needs and not to the need for changing capabilities (Rooney, 2012). This makes companies more hesitant to change the ways in which they utilize big data, because the individuals that they have controlling such applications are not well-versed in big data capabilities enough to sustain a seamless change in system.

With the extreme growth in the amount of data that is available to most firms, there is increased pressure on being able to use this data to produce useful information for a firm. With decision-making using big data being more real-time than ever, “new processes and tools are needed to help organizations take control of the massive volumes of information” (Database Trends and Applications, 2011). These tools are costly and are continuously changing, therefore, companies are hesitant to upgrade their systems given high capital requirements and the aforementioned cost of new human capital to maintain the systems. Whether it is the amount of data a company can store, the amount of stored data they can pull useful information from, or the benefits that can be gained from the information their analysis provides, there are trade-offs that must be made to decide on system needs. Deciding on sticking with old systems, revamping them, or replacing them is an ever-present problem for IT managers who use big data within their company. This problem is not likely to go away, but the capabilities that companies have with large amounts of data will likely set them apart in their ability to foresee the future and make real-time changes to their organizational tactics.

These problems will have to continue to be addressed, because the amount of data being produced is not slowing down. If firms plan to remain competitive in the long-term, they will be forced to have big data capabilities that allow them to make real-time decisions about the direction of their firm. Let us not be so narrow-minded as to think that big data will solve all problems, but if these companies are not cognizant of the things going on around them and within their own supply chains, how are they to make informed decisions? Decisions have been commonly made on the basis of emotion/feelings and not through the use of empirical data analysis. Firms that are using big data capabilities to maximize their core competencies are likely to be the ones to have good growth prospects, but if the above-stated problems are not addressed, firms will have very little chance to create a competitive advantage through the use of big data analytics.

BIG DATA IN THE FUTURE

Big data through the scope of the supply chain has a vast potential for future growth. Supply chain analytics (SCA) that are derived from big data can be applied in all stages of the supply chain process as stated in the table below:

Table 1

Stage	Significant Application of SCA
Planning	Prediction of market requirement of products and services, forecasting, dynamic pricing
Sourcing	Supplier selection and evaluation, price negotiation
Making	Production planning and control, inventory planning
Delivery	Logistics management, location planning, warehouse planning, network planning

(Biswas & Sen, 2016)

In looking at Table 1, we see that SCA and the use of big data is extremely important in planning, selecting, and forecasting, which are all predictive in nature. The use of big data is vital in the prediction of future events. The greater the volume and velocity of big data, the more accurate representation firms will get of what to expect in the future, based on past events. Data will not become smaller in the future, it will continue to stockpile and come in at a faster rate, so firms will have better chances than ever to make the most informed decisions possible based simply on data that is collected and analyzed in bulk at great speeds.

In order to solve one of the problems of using big data, education regarding the usage of big data and how to apply it to different parts of the supply chain (and business as a whole) is vital. Teaching tools will have to be developed that help in teaching big data concepts. The issue arises in that big data is not static, therefore, data sets that do not grow and change will lack sufficiency in big data education. Education providers will have to build, “partnerships with businesses,” and/or, “invest in purchasing software that includes data sets,” that are sufficient in teaching big data courses (Henry & Venkatraman, 2015). Producing educational material regarding big data analytics will be a difficult, ongoing process that will cost universities greatly, but could change the potential for the business world and the capabilities of the future workforce.

Big data brings about the capability to have more information at the tips of your fingers that could produce useful information for your future. Big data being available to the world, “invites experimentation, as well as collaboration,” and the same holds true in the business world (Huwe, 2012). Firms have a greater ability to make changes to their processes and try things out that other companies are not able to see at that time. They are also able to work with other companies in making the supply chain an easy flow of information from one company to the other. In essence, the future holds greater integration of businesses and their supply chains through the effective use of big data.

CONCLUSION

There is very little doubt that the capabilities of the data that is currently available to businesses are not being maximized. Without big data analytics, companies are going to continue to have a tough time keeping up with the vast amounts of data that is hitting them from all directions, at any given moment. Big data is constantly being produced within every link of the supply chain, and

firms could capitalize on all the information that is being created with the ability to cut costs and maximize the core competencies of their business to create competitive advantages. The sad truth is that the lack of use of big data is going to be the detriment of several companies, and the lack of human capital and resources to implement systems that will maintain big data will likely be the excuse. In order to grow and succeed in the ever-changing markets, big data will have to be used to aid in decision-making. Companies that fail to use the information that their supply chains provide them will lack the understanding of the factors that underlie their businesses and they will make decisions without valid reasoning. Big data and its effective use will drive the growth and efficiency of supply chains in the looming future.

REFERENCES

- Barth, P., Bean, R., & Davenport, T. (2012). How Big Data is Different. *MIT Sloan Management Review*. 54(1). 43-46.
- Biswas, S., & Sen, J. (2016). A Proposed Architecture for Big Data Driven Supply Chain Analytics. *IUP Journal Of Supply Chain Management*, 13(3), 7-33.
- Brandl, D. (2013). Drowning in Data, Starved for Information. *Control Engineering*. N/A
- Das, S.R. (2016). Big Data's Big Muscle. *Finance & Development*. 53(3). 26-28.
- Database Trends and Applications*. (2011). Big Data-Big Challenges, Big Opportunities. 25(1). 12-14.
- Gallagher, T. (2014). Transforming Big Data into Analytical Insight. *Journal Of The Australian & New Zealand Institute Of Insurance & Finance*, 37(2), 21-24
- Grossberg, K.A. (2016). The New Marketing Solutions that will Drive Strategy Implementation. *Strategy & Leadership*. 44(3). 20-26.
- Henry, R., & Venkatraman, S. (2015). BIG DATA ANALYTICS THE NEXT BIG LEARNING OPPORTUNITY. *Academy Of Information & Management Sciences Journal*, 18(2), 17-29
- Huwe, T. K. (2012). Big Data, Big Future. *Computers In Libraries*, 32(5), 20-22
- Orenstein, P., Ladik, D., Rainford, S. (2016). What are the Key Drivers of Future Supply Chains? *Journal of Accounting, Business & Management*. 23(1). 31-40.
- Rooney, B. (2012). Big Data's Big Problem: Little Talent. *Wall Street Journal*. April. N/A.
- Sanders, N. R. (2016). How to Use Big Data to Drive Your Supply Chain. *California Management Review*, 58(3), 26-48.