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A study concerning Small Manufacturing Business within B2B E-Commerce Value Chain

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ABSTRACT

This paper addresses challenges faced by one small manufacturing business in a competitive environment that is expanding with lower costs, higher quality, improved reliability and quicker responsiveness. The business processes require changing the relationship between companies and suppliers to establish a competitive advantage. The company identifies the business process and the supplier aligns with the process to create a value chain. The paper starts with identifying the complexities of manufacturing business and the demands created from the technological advances and the competitiveness of the industry. Examples of the challenges facing a small manufacturing business are then identified through a case study on Globe Engineering Co., Inc. The case study shows the impact of the changes in the industry on small manufacturing business and recognizes the necessity to build a flexible system to provide services in a timely fashion.

Keywords

Lean Manufacturing, Electronic Data Interchange (EDI), In-house systems, Manufacturing Resource Planning (MRP), Employee Stock Option, E-commerce, Long Term Agreement (LTA)

INTRODUCTION

The challenges of today's complex business environment have expanded as the pace of change increases in which old paradigms collapse. Organizations today are under pressure to remain flexible while adapting rapidly to economic demands of society as technology becomes ubiquitous and e-commerce expands. Technology has created a global market with the development of business utilizing the Internet. Information systems (IS) are not only changing business, the relationships between businesses are immensely altered as well.

Small manufacturing business is rapidly changing in an effort to utilize IS systems in building a manufacturing plant to succeed. Small manufacturing business environments have fewer financial resources to be able to purchase large technology systems (Burns 2001; Carter and Evan, 2000; Chen, Themistocleous, & Chiu, 2004). However, developing and investing in technology is necessary because of the dynamic changes in successful business models. The small manufacturing business must be able to use the technology to build efficiencies into the processes as well as implement systems to communicate in the e-commerce arena. Small businesses have difficulty purchasing extensive technology systems to assist in creating an e-business environment. The combination of rapid change in society and the concise processes necessary to create a successful environment add to the complexity experienced in small manufacturing plants. The challenge for the business is to identify how to align, both internally and externally in a very extensive IS centric era. The expansion has generated a change in the application of the technology from a tool to be used for efficiency to a centric process of doing business.

Globe Engineering Co., Inc. is a small manufacturing business in the Midwest that works with different metals forming them into shape for aircraft manufacturing. Globe is recognized as a link on the value chain of aircraft manufacturing. This case study will identify the changes occurred in realigning the business practices to meet the demands of the value chain in B2B commerce and how Globe Engineering is meeting these demands.

SMALL MANUFACTURING BUSINESS

The complexities of managing a small business include a variety of levels of necessary communication internally and externally aligning the business with technological advancements necessary to remain competitive. Small manufacturing businesses utilize technology in the manufacturing processes to benefit the company creating a streamlined process of

building a product. Integrating the technology to create a steady flow for the processes internally is identified as Enterprise Application Integration (EAI). The term is used to identify the process of forming a seamless system (Voss & Schubert 2004; Lutz 2000; Linthicum 2001). The EAI is not clearly defined and ranges from the inclusion of interfaces between businesses to the application within one company (Schubert 2004). The external integration requires a bridge between the business processes to allow a communication for building a value chain, often referred to as E-Commerce Business 2 Business (B2B) or as Schubert (2004) states B2B Application Integration (B2BAI). The interactions within the business as well as the interactions across the business in an external alignment create a synergistic process difficult to dissect and study in isolation (Ehrlich 2004). The parts interacting create a level of system design to produce the benefit of interactions along the value chain (Sakaguchi, T. Nicovich, S. G. & Dibrell, C. C., 2004). Truong and Azadivar (2003) discuss the challenges of managing and creating an optimal solution across an internal as well as external business process. The business process often faces conflicting objectives as well as a dynamic system continuously evolving.

CASE STUDY

Globe Engineering Co., Inc.

This paper discusses the challenges faced in one small manufacturing business in developing and creating the technical alignment internally and externally to compete in today's complex, dynamic environment. The research completed is a single case study research utilizing exploratory methodology. The exploratory case study is completed before the implementation of a hypothesis and the development of the research questions (Yin, 1994). The use of the exploratory case study allows the field research to be completed with a desire to build and create discussion questions for further utilization and development of frameworks for application in small manufacturing businesses. The following case study was completed by interviewing employees within the company.

History

Albert Nelson graduated from Oklahoma State University with an aeronautical engineering degree and began his career in the aircraft business in the early 1940s. While in school Albert, trained to become a pilot and started flying under a government grant developing a love for flying. After obtaining his degree, Albert began working for Beechcraft Aircraft (currently Raytheon Aircraft Company) and part-time for Boeing Company. Albert developed and documented the process flow for building parts for the aircraft industry. His primary focus was on building efficiency into the flow of the manufacturing process as well as efficiency in the actual manufacturing process. In reviewing his manuals, the data found and the procedures described are very similar to what is known today as Lean Manufacturing. Albert had a skill in identifying where processes could be improved and efficiencies developed and technology applied as necessary.

In Albert's spare time he designed a tube-bender in his garage. The tube-bending was created from a process Albert recognized as a need in the manufacturing of aircraft. The tube-bending operation soon outgrew the garage and Albert began leasing a small building to continue his work. On August 30, 1946, Albert used his engineering skills to design a high chair and car seat from which the company called Parent-Ease Products was created. Parent-Ease Products was later changed to Globe Engineering Co., Inc. to reflect the conceptual applications of the products produced. Albert used his tube-bending to build the product allowing the high chair to double as a car seat. Albert also designed and built other products such as a step stool for small children. All manufactured items used his tube-bending equipment in producing the products. Albert soon expanded his tube-bending to include work for the aircraft industry. Albert had a gift in recognizing a need and fulfilling the need by solving the problem through the development of processes and tools he created. His mind-set included the belief that a problem could be solved and "it could be done." In an engineering capacity, Albert provided solutions to completing a process.

Albert began working full-time in his own business, but did not simply take orders and manufacture the product. When Albert met with his customers he asked to meet with the engineers and discuss ideas for making the product cost-effective. Albert was a problem solver using efficiency processing, and built his business on the idea of helping with the difficult issues, allowing the easy stuff to come. Albert would often visit customers and return with projects to complete in order to fulfill the customer's needs. If Albert was unable to complete the task as desired, he would present alternatives and ideas for other solutions. Albert would return from meetings and bring back magazines articles for the employees to read, with new ideas to improve the processes of manufacturing. He tried to make sure all work was completed in-house with little outsourcing, but investing in technology to improve processes as necessary.

Albert continued to grow and moved to the current location in 1957 with a '60x80' building with 20 employees. Albert appreciated and understood how important the individual person was in the manufacturing process. Through this people-

mind business he took good care of his employees as long as they worked hard and gave him a fair days' work, if not he had no problem asking them to leave. In 1966 Albert began a profit sharing plan, giving each employee 15% of their wages as an investment after 12 months of full-time employment. Growth was not a vision of Albert's. He wanted to keep the business small so he could manage the quality and take care of his employees. He felt 100 employees was the maximum. Albert did not operate on borrowed money. His belief was to use the profits from the company to continue to build efficiencies and processes into the company. He was not afraid to purchase or develop new technology systems with the profits gained each year. In 1986 with around 90 employees the company's sales reached close to \$9 Million.

Albert's belief in his company was based on a strong ethical platform. Globe Engineering, Co., Inc. believed good business included an emphasis on ethics from the top. This included providing services with promised deliverables that can be met, accurate and realistic pricing, losing work before jeopardizing integrity. The honesty with the customer meant there were times when he would have to walk away from an order. Globe refused to practice promising short deliveries with low prices which are not achievable if they are to stay in business. It meant that the company had to be diversified. In 1986 the company was 50% commercial aircraft and 50% government. When one dropped the company could maintain with the other industry, which happened in 1986. The government discontinued their work, but the company was able to recover and found a contract with Boeing, which replaced the 50% government contracts. In fact, the Boeing contract exceeded the government contract. In 1991 the company reached a record \$13 million in sales and the employee base was 120. This was the first painful lesson when leaving the core value of diversification and becoming too deep with one customer, caught up in the sales. In 1991-1992 Boeing discontinued their work and Globe was faced with their first real lay off, dropping back to 85 employees and by 1994 sales had dropped to \$9 million.

In 1991, Albert decided it was time to retire. And so at the age of 71 Albert was faced with what to do with this company he had built. He reviewed several options including looking at the possibility of giving it to Oklahoma State University where he had graduated from and served on the Board of Regents for many years. Unable to find a way to do this, he did not want to sell to someone who may destroy what he had built. He finally decided to set up an Employee Stock Option (ESOP), carefully structuring the program for success.

The ESOP plan included a buy out of Albert over a span of 8 years using money from the growth of the business. Again, the business was to be purchased without borrowing money, but rather pay it off with profits. The buy-out was completed in 4 years as the company continues to grow and expand.

The company today continues to remain under one roof, seeking to build processes of efficiency, with a diversified customer base, using profits to reinvest in new technologies basing it all on the strong ethical platform of honest business practices. The processes include a firm belief that a problem can be solved.

Products

Globe Engineering Co., Inc. is a small manufacturing business providing a service of forming different types of metals utilizing three major applications including hydro-forming, spinning, and tube bending. The forming along with the assembly of multiple parts creates the core competency of the business. The vision is to try to produce all products with a minimum amount of outsourcing; if it cannot be produced then it is not accepted as contract for order. The assembly process is an area that is expanding and is generating opportunities as the company creates additional levels of developing products in an effort to increase the average price of the product shipped.

Vision

The company has 160 employees formed in to an Employee Stock Option program (ESOP), meaning the employees own the company. The ESOP creates an opportunity for the employees to benefit directly from efficiency and improvement in processes remaining flexible in business practices. The dividends are paid to the employees as owners of the company. The company maintains a quality policy:

Globe Engineering management and employees are committed to fabricating and marketing the highest quality sheet metal components in the aerospace industry through the efficient use of resources, employee empowerment and continuous quality improvement in order to increase customer satisfaction, market share and profitability.

Business and Manufacturing Processes

Globe Engineering Co., Inc. operates with a lean manufacturing process. The days of an engineer traveling to a business to gather an order are quickly disappearing; the trip is now often completed through the Web. When an order is reviewed for

bid at Globe, the tooling planner decides what tools are needed to process the order-based on drawings electronically transferred. The electronic drawings require the use of a product that creates a layer of interface so the specifications from the drawings can be determined. ENCAPTA and ANOVIA are both software applications used by different companies to look at the CATIA files pulled off the Web to determine the specifications. Once the drawings are accepted to view, the tooling planner utilizes specification books that come from the customer as well as specifications from the internal processes of Globe to identify the necessary steps to produce the finished product. The current process is manually driven as the specifications are in a physical book. The future plans are to create a database of specifications to allow a faster review of processes necessary linking this to the tooling systems. The wide array of systems from the different customers; however, creates a challenge for building a structured database. Several of the customers use their own system or different purchases systems. These steps are required before a contract is even negotiated for bid.

When the bid is received and accepted, Globe must begin to establish an order system with the customer. The aircraft industry provides the strongest customer base for Globe Engineering, with over 95% of the purchases. Globe Engineering Co., Inc. has over 350 customers, with the top 12 customers identified as providing 80% of the sales. These customers are identified as the "primary customers." The current business for Globe is to provide metal forming, aligning with other businesses creating a link in the supply chain management of manufacturing aircraft. Globe continues to strive for diversification and provides parts for piston engines, corporate jets, commercial and military aircraft as well as support for space programs. The service requires the internal process alignment to develop a system to create the necessary parts in a timely fashion, meeting the necessary quality standards.

The alignment with customers is evolving as technology changes occur and business processes are improved. Globe Engineering must remain flexible to meet the customers' demands as well as upgrades to manufacturing processes. Historically Globe Engineering began by taking orders through the mail and over the phone as well as personal visits. The complete order process was very time-consuming utilizing mail, with overseas accounts taking as long as 7-10 days in between each transaction for an order or updated specifications for the tooling process. Some of the orders from customers are still placed in this manner; however, the majority is driven by a contractual agreement. The first impact occurred with the introduction of the fax machine, this is also a process still used by some of the customers. The fax machine increased the span of communication, decreasing the time necessary for transmitting data; however, it did not allow for prints. The manual transfer of prints was still necessary. The next change was the Electronic Data Interchange (EDI). The introduction of EDI required technology to be purchased in order to read the EDI files and interpret the data. EDI was an interface for electronically exchanging data. This process is not used as much and is being replaced by Web-based order processing, as businesses upgrade their systems (Muller-Lankenau & Klein, 2004). Globe must now design and utilize a Web interface for each customer, with Globe responsible for retrieving the orders, based on the customers' inventory counts available on the customers' Web pages. The process of being able to evaluate the cost benefit was irrelevant to Globe. It was a necessity to develop for communication with the customer, even though it was complex and challenging to use (Iacovou, Benbast, & Dexter, 1995). (See Figure 1)

Aircraft Design Flow From Primary Company to Globe Manufacturing

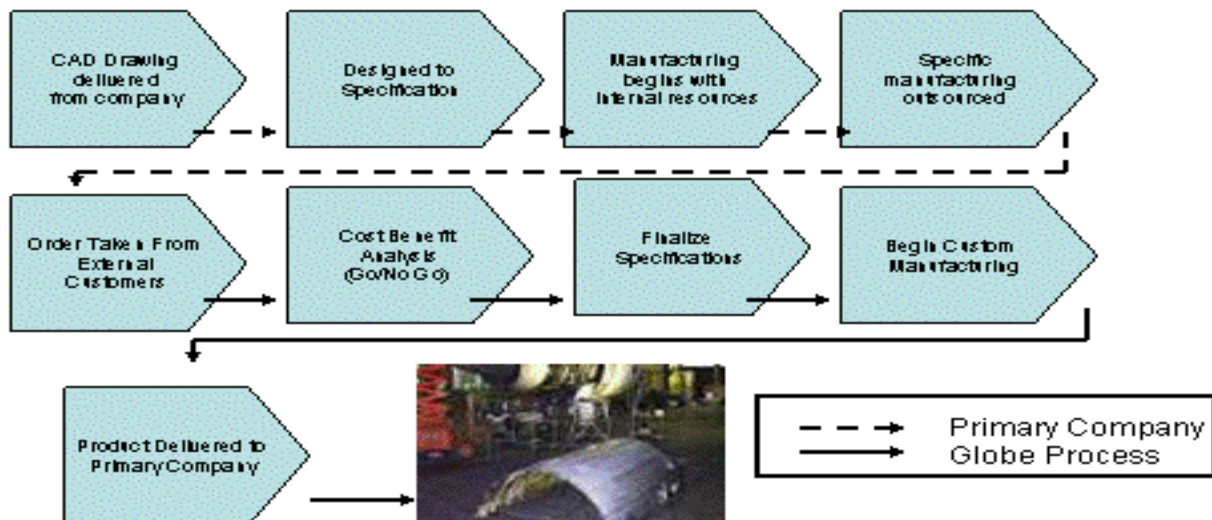


Figure 1. Value Chain

E-Business Application

Globe Engineering receives requests for orders in many different formats as mentioned above, taking these orders and translating the files into a format to place into the internal technology system. The primary communication for accepting orders is still via mailed purchase orders. Only 20 of the 350 customers have an established electronic data transfer system through a web based system. The “primary customers” however, do have electronic data transfer business process and this does account for over 80% of the total sales. Thus, Globe must be able to translate and process the files in a timely fashion. The challenge for Globe is the fact that the electronic systems used by the 20 customers are not all the same. Some companies have purchased packaged inventory software systems for maintaining and controlling the inventory ordered from Globe Engineering. The companies sometimes customize these software packages or simply build their own custom package developed internally. The customer then requires Globe to interact with their technology, and often requires Globe to pay a fee to use the technology to maintain inventory as needed for the development of the product.

The new order system and inventory control systems have created a new process within Globe Engineering. Historically Globe Engineering provided a product as it was ordered from a purchase order via the customer. Today Globe Engineering is changing the methodology of conducting business with their primary customers as a new customer relationship is forming. Technology within the customer’s process has created a value chain process or supply chain management system where the product is to be delivered in a just-in-time fashion as a link on the system. The customers with the technology now require Globe to establish a Long Term Agreement (LTA) building a new relationship between Globe and the customer. The LTA is basically a blank purchase order requesting Globe to supply the product through the development of a relationship and often has a reducing price. The reducing price means over time the customer will pay less as Globe strives to build the product with efficiency. The relationship with the customer also establishes the necessity for Globe to provide the product requested in a Min/Max inventory level. Globe becomes responsible to provide the product to the customer when the customers’ inventory has reached the minimal allowable inventory level-based. The maximum amount of inventory Globe can deliver; however is also established within this contract. The LTA now requires Globe to monitor the inventory via the technology the customer has identified as being the accepted inventory control system. The inventory control systems are located on the Web page of the customer and require Globe to monitor the system to provide the service.

The customers of Globe are in the process of seeking to minimize the number of suppliers used to produce a product in order to reduce the costs and create a value chain. Suppliers are identified as growth-meaning the business will do additional work

with the supplier; sustaining-meaning the business will continue to do the current work promised with the supplier; or deleting-meaning the business plans on discontinuing service with the supplier. The goal for Globe is to remain as a growth supplier to generate new work opportunities. The requirement from the customer is to maintain a 97% level of performance for quality and on-time delivery. This is up from 90% requirement less than five years ago. Competition continues to grow more efficient and more competitive as the processes are developed technologically.

The new relationship with customers in a LTA with a min/max creates a challenge in the production of product. When a product is produced a minimum number needs to be generated in order to be able to make a profit. The min/max may not allow; however a complete order to be delivered. Globe has had to now build inventory because the maximum allowed for shipment is often less than the minimal amount of product that is needed to be manufactured to achieve a return on the invested time necessary to generate a profit. Globe Engineering has established an inventory system that places the extra product into inventory to be sent first and if the inventory is not there then and only then will a new order be placed for manufacturing.

Globe Engineering utilizes a system designed and built in-house using Windows based software written with a client/server platform. The system uses Linux and Novell to create a secure system as additional technology has been added to the manufacturing process. The system is set up for the Novell to act as the program that calls the application. Linux is used as the processing of the application. The software system was established in the late 1980s utilizing Data Point later following a spin off company called Sunbelt. The original network architect hooked multiple computers together to communicate across PC platforms. The system interface was created in-house to communicate and build a shop-based production system. The system includes manufacturing resource planning (MRP) based on per-person, per-hour, shop-based process. The use of technology has increased in manufacturing and the platform used has allowed Globe to create flexibility to communicate with different platforms externally while building an internal system of efficiency. (See Figure 2).

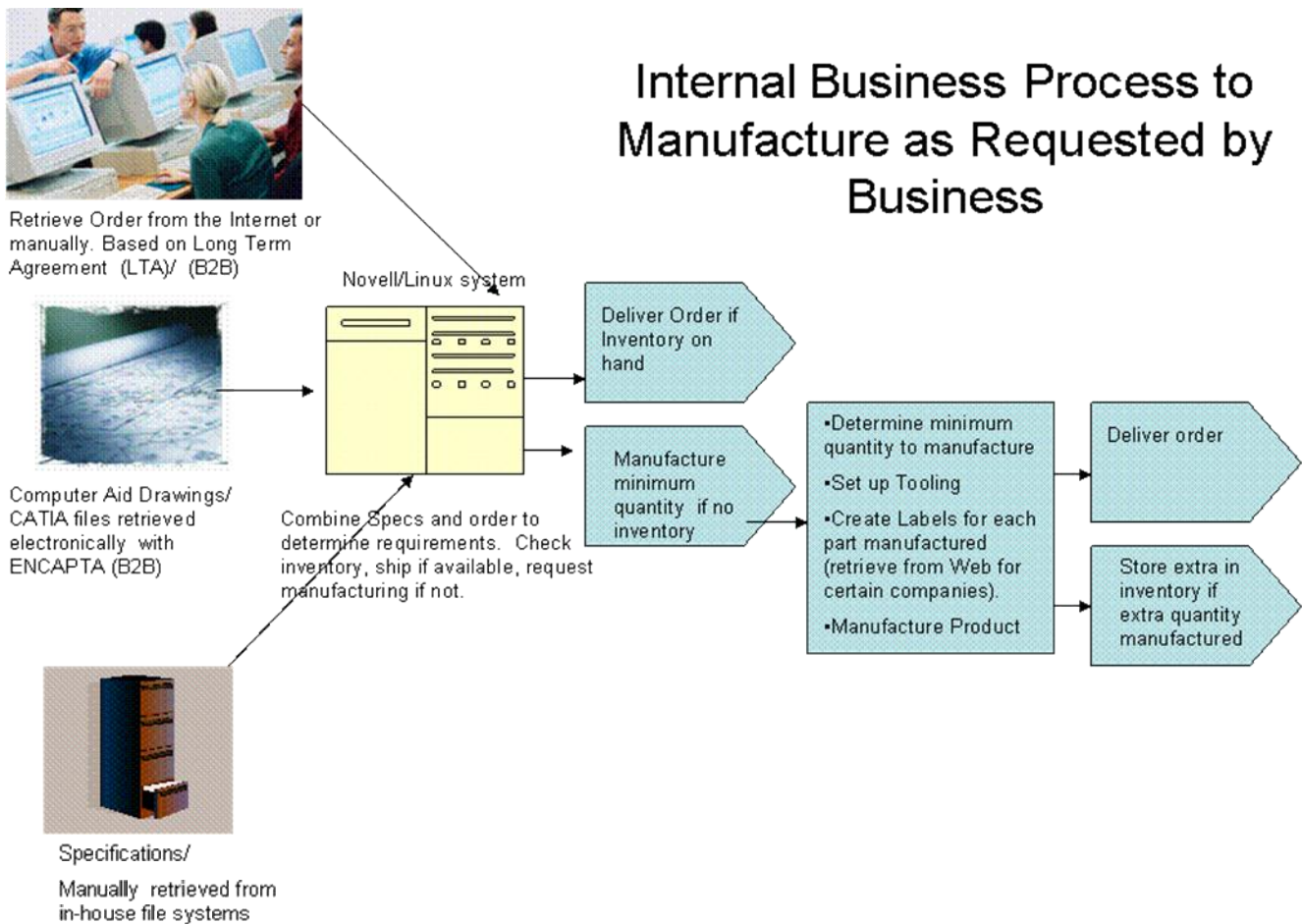


Figure 2. Internal Business Process

Bar Coding

The product creates a data trail as it proceeds through the manufacturing plant. Each part is individually labeled with a scannable bar code. The part number is entered into the system and then tracked as it proceeds through the entire manufacturing process, with each process and delivered to the customer, ultimately assembled onto the final aircraft. The technology allows the product to be reviewed at any time during the process to identify the location and the potential length of time before completion. As the product flows through the system it is identified as Work in Progress (WIP). The WIP allows adjustments to be made as necessary to the planning process. Different orders require different levels of priority. Globe does work for the government and must move military orders to the top when required. The WIP process allows the production process to be adjusted as necessary under the different demands of the aircraft business. The tracking process allows data to be collected for reporting costs and time required for production of product. The lack of industry standard across the diversified customer base is a challenge for purchasing software solutions, thus the flexibility of the in-house system allows the development of technology to proceed. The application of building the bar code has now shifted and requires Globe to find the requirements for the Bar coding for each company on the customers' Web site. Globe must then build an interface and create the compatible labels to be used for the bar coding.

Project Management

The changes in the aircraft industry as well as the changes in manufacturing have required Globe Engineering to change their business practices. The use of technology was originally utilized in record keeping and has quickly expanded to management support and executive decision support (Markus, Majchrzak, & Gasser, 2002). The expansion has generated a change in the application of the technology from a tool to be used for efficiency to a centric process of doing business. While the small size may cause concern in the availability of resources, the small size provides strength in the ability to flex as needed. Globe Engineering has the ability to adjust as the primary customers are asking Globe to do more of the assembly process. This is a potential growth area for Globe as they begin assembling the product providing the one basic unit desired by the primary customer. The idea is to provide the product in the lean environment of just in time inventory established by the customers' requirements. Globe has improved manufacturing processes taking the average days for each process from 22 down to 6-8 days and the items declared as work in progress from 1900 down to 850. The amount of work in progress has recently increased because of 132 new jobs. New jobs require a longer time in the manufacturing process; however provide a future for Globe.

Globe Engineering recognizes this means they must adjust their business practices to be able to provide the inventory desired at the proper time in a low cost environment. Globe has accepted this challenge and created a manufacturing process that requires maintaining inventory necessary to meet the orders of their customers while allowing the manufacturing of a product at a profitable level. The shift has been from the customer placing the order to Globe having to monitor the inventory via the Web and maintain when and how much product to ship based on the LTA.

Globe has learned from the new business practice and now has shifted and absorbed a one time cost of establishing inventory. Previously 60-70% of the product manufactured at Globe was shipped directly to the customer. Now, 60% of the manufactured product goes to stock to be shipped in multiple drops based on the min/max requirements. The shift has created new expenses to Globe and profits have decreased as the new business process requires additional inventory and labor expenses. In addition to the inventory, new labor expenses are incurred as it requires a manual process to align the inventory and the reorder lead times. Many of these costs are one time expenses, but increased efficiency is required to increase profits. Process improvements are demanded from the departments manufacturing the products, with every department required to identify ideas quarterly. Ultimately, Globe would like to be able to electronically incorporate their customer's data into their system; however, the multiple platforms do not allow the electronic process to occur, thus a manual external alignment process is still necessary.

LESSONS LEARNED

Globe Engineering Co., Inc. has learned many lessons as the company has seen the manufacturing industry change. Technology has impacted the relationship between Globe and the customer. The use of the Web within the business process has forced Globe to adapt new software into the business process. The software is necessary to read the drawings for bidding on new projects as well as building existing projects. The selection of the software is made by the customer, thus Globe must purchase software and adapt the software to the business practices demanded by the customer. The specifications are currently a manual process that will soon be online as well. The current practice will have to be adjusted. The bar coding of

each manufactured product is a necessity, Globe must be able to have a system that allows the bar coding to adjust as needed for each client. The last process is to maintain inventory for the different customers' in a Min/Max system. Globe has had to invest financially in the different systems to stay aligned with their customer. The customers' do not have a standard, thus each customer requires a different process. It requires a flexible agile system to continue to align with each customer to maintain the systems necessary. Future research is needed to further understand the necessary changes required to survive in this rapidly changing environment.

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