Agile Manufacturing: A Border Perspective

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ABSTRACT

Manufacturing along the United States-Mexico border was built on the low-cost and low-technology model of early maquiladora plants, which offered cheap alternatives to the U.S. labor rates and an alternative to labor-intensive assembly and attractive tax benefits. Forty years later, other areas of the world are offering a lower cost alternative to the same targeted manufacturing organization. The alternative choices are often a lower-cost option, making the United States-Mexico border region an option that gets left out of the equation. A review of the literature and an investigation of attractive features of the border region suggest a different approach that highlights the advantages of a proximity-based model interspersed with the components of agile manufacturing.

Keywords: Agile Manufacturing; Border Commerce; Manufacturing; U.S.-Mexico Trade; Maquiladoras; Mexico

INTRODUCTION

As Asia, Eastern Europe, and South America are becoming active participants in global manufacturing, it is imperative for the border region of the United States and Mexico to accept the improvements that agile manufacturing offers to remain viable in future sourcing decisions. Many jobs have left the border region once dominated by twin plants and maquiladoras. The maquiladoras were structured around a model of low-technology and low wages. Other world regions offer a better option for low cost and may offer both high and low technology solutions for product selection. Southern United States and Northern Mexico must embrace a broad view of agile manufacturing. Ever since the Iacocca Institute at Lehigh University developed the term and defined agile manufacturing, the term has been the focus of change and innovation (Vinodh, Devadasan, Maheshkumar, Aravindakshan, Arumugam, & Balakrishnan, 2010).

Agile manufacturing may be defined as the integration of processes and technologies that reduce the lead time in the life cycle of a product from the ideation phase to the retirement phase (Lloyd, Beck, & Gonzalez, 2010). The following review of the literature leads to a conclusion that for the U.S.-Mexico border region to take a leadership role in manufacturing, agility needs to be the operative word. The practices outlined in the paper should be taken seriously by area stakeholders and maquiladora operators.

PROXIMITY-BASED MANUFACTURING

Sargent and Matthews (2007) suggest that Mexico should take full advantage of the geographical location adjacent to the United States and use the location as a strategy to further develop the manufacturing base. Sargent and Matthews posit that China holds the skills that Mexico would need to develop in pursuit of a high-technology model and Mexico may not be able to offset the decisions to send manufacturing to China versus Mexico. Originally a novel approach to job creation, the low-wage model has been set up in over 100 countries and workers in many regions cannot meet basic needs with standards and conditions prevalent in the majority of facilities (Horowitz, 2009). There are other more logical models that Mexico should follow to make manufacturing in the region a viable option to decision-makers. To compete solely on low-tech and price may drive poverty and become strategies that Mexico may regret in the long-term.

AGILE SYSTEMS

Agile manufacturing has been defined by many with different criteria and enablers, such as rapid prototyping, lean sigma systems, emerging technologies, communication, product life cycle and integrated logistics, and others. The drivers of customer-driven customization and the environment also need to be considered in an agile strategy (Lloyd, et al., 2010). Unless an organization is using all of the factors stated above and is influenced by the drivers of customized products and the environment, the organization is not fully utilizing the entire spectrum of agile manufacturing (Lloyd, et al, 2010).

Agile manufacturing operates in a continuously evolving environment, but particular focus is given to the final assembly stage in the manufacturing strategy (Calvo, Domingo, & Sebastian, 2008). Agility is a response to the demands of the customer and the flexibility brought on by constant change (Calvo, et al., 2008). Agile manufacturing, when fully utilized, can be a powerful force in helping an organization to acquire new business because of the efficiency, quality, and pricing that results. Reviewing each factor can reveal some strategies to make companies more competitive in the global manufacturing environment. A plan to implement agile manufacturing in serving the United States market may be a long-term plan that Mexico may want to endorse widespread implementation. Some key enablers follow.

RAPID PROTOTYPING

Without risking the quality factor of manufacturing, organizations are being asked to react quickly to customer demands and one tool that can be useful in meeting the goal is rapid prototyping (Vinodh, et al., 2010). Computer-aided design (CAD) and rapid prototyping allow traditional organizations to achieve agility by quickly designing and modeling new concepts, which can lead to sustainability and competitive advantages in a global environment (Vinodh, et al., 2010). The use of CAD and rapid prototyping allows organizations to be responsive to the ever-increasing demands of a public wanting customized products (Vinodh, et al., 2010). The integration of CAD and rapid prototyping technology allows organizations to be competitive and viable in a world of uncertainty and uncertain change (Vinodh, et al., 2010). User-friendly tools and systems need to be available for full customer participation.

Some organizations have allowed direct customer interface with end-user customization to standard products with customer-dictated CAD files to modify the standard product (Ninan & Siddique, 2007). Systems for customer interface need to be user-friendly and internet-based to optimize customer participation (Ninan & Siddique, 2007). A rapid feedback and iteration generating interactive feature of the system is needed to ensure rapid development of products.

Mass customization is a strategy that companies offer to match customer needs and products offered (Chang & Chen, 2009). Customization can be intimidating and organizations that offer customized services need to make sure that adequate support systems are in place to assist the customer (Chang & Chen, 2009). Customers may know what is desired but lack the training or experience to use common engineering tools. Relative low-cost resin prototypes can be generated for a fraction of what a steel tool costs.

LEAN SIGMA SYSTEMS

Lean sigma systems are a combination of lean manufacturing and six sigma methodology. Lean manufacturing concentrates on improving the entire flow of the process, and six sigma focuses on optimizing the process (Mandahawi, Fouad, & Obeidat, 2012). Lean manufacturing observes the process from the customer point of view and eliminates waste in an effort to achieve perfection (Mandahawi, et al., 2012). Six sigma uses the DMAIC (Define, Measure, Analyze, Improve, and Control) model and analyzes defects and process flow (Mandahawi, et al., 2012). Organizations embrace lean sigma systems to be more competitive in the global market (Mandahawi, et al., 2012). The implementation of lean manufacturing and six sigma may lead to improvements in cost, quality, and production time (Mandahawi, et al., 2012). Extra planned downtime can lead to an optimization of production while minimizing waste (Mandahawi, et al., 2012).

In order to produce customized products at mass production prices and with short lead times requires appropriate supportive production operations systems (Hasan, Sarkis, & Shankar, 2012). The infrastructure must be designed to achieve integration of many design changes, operations and capacity optimization, and a large factor in the success of an agile system is managing production flow (Hasan, et al., 2012). Agility is a vision of manufacturing that is a natural development built of the concepts of lean manufacturing (Dahmardeh & Banihashemi, 2010).

A hostile and competitive market has pushed organizations to accept variety and innovation through careful development and management strategies and technology to be successful (Hasan, et al., 2012). One such solution is the layout design, which can reduce operating expenses by up to 50% while improving efficiency (Hasan, et al., 2012). The best use of time handling parts and the best use of space provides safety and flexibility in the manufacturing process. A robust system needs to be able to handle a variable product mix and the continuous introduction of new products resulting from customized customer demand (Hasan, et al., 2012). Lean manufacturing is a process that trains the organization to identify and reduce waste. In practicing lean sigma systems, organizations need to embrace the other agile tools to realize innovation, improvement, and survival (Lloyd, et al., 2010).

EMERGING TECHNOLOGIES

Global manufacturing has led many organizations to pursue new techniques and machines using emerging technologies as a means of achieving a competitive advantage. Sources of emerging technologies include a need for lower cost, reduced lead time, increased quality performance, or increased production agility (Dietrich & Cudney, 2011). Chanthapan, Rape, Gephart, Kulkarni, and Singh (2011) explored the emerging manufacturing technologies that allow for disruptive applications. An example of emerging technologies is in the area of spark plasma sintering, which was achieved using flexibility in engineering components for a faster, energy efficient, 100% density one-step process using nano-particles to achieve alternative disruptive manufacturing methods (Chanthapan, Rape, Gephart, Kulkarni, & Singh, 2011). With manufacturing technology at the maturing stage, many processes are believed to be ready for change (Dietrich & Cudney, 2011).

Some believe that digitsation may be the next emerging manufacturing technology that will drive the future of the industry (The Third Industrial, 2012). Software and three-dimensional printing is only in the early phase, but some products are being designed and printed on a 3D printer by building up successive layers of material (The Third Industrial, 2012). Factories full of people may become obsolete as printers produce one-of-a-kind products according to the needs of a mass customization-driven consumer (The Third Industrial, 2012). An awareness of what is emerging can enable and encourage a company to innovate and use the new products or process.

Nano materials are getting much attention, but materials are just one aspect of agile manufacturing. Agile operations need to be aware of potential breakthroughs in materials, new products, and process, and be ready to embrace the change to reap the benefits of being involved in change from the early stages. Innovation, agility, and change all become important features for border operations to be aware of and watching for.

COMMUNICATION

Agile information systems have emerged, which are using agile methods and are described as having many upgrades and a small number of periodic feature upgrades (Weiyin, Thong, Chasalow, & Dhillon, 2011). Customer requirements and customization have created a demand for faster development and upgrade times for software (Weiyin, et al., 2011). Agile methods allow software developers to break the chain of long development time and replaced the old methods with a continuous flow of development and changes (Weiyin, et al., 2011). Rather than a desire to have all the potential issues worked out before delivery the agile approach does not attempt to provide a full range of features when delivered to users (Weiyin, et al., 2011). The approach is to deliver a system with requested features implemented at the end of the development cycle (Weiyin, et al., 2011). Events take place concurrently and evolve as the project takes shape.

Information technology and communication is essential to any organization, but when you introduce speed, communication becomes critical. Many organizations have opted to organize around teams to better communication and to use communication as an advantage. Information technology is everywhere in an agile environment and the connectivity is what drives the agility in the organization. An integrated system with security controls can drive a powerful force in the communication effort that makes an organization agile. Knowledge management and a highway of information not only creates new knowledge, but the shared information creates the dynamics needed to become an idea-generating organization (Chilton and Bloodgood, 2008).

PRODUCT LIFE CYCLE AND INTEGRATED LOGISTICS SUPPORT

Product life cycle takes in all facets of the manufacturing process from concept to retirement. In order to meet the needs of a customer who is constantly changing design and demand, the agile answer may be solved with a virtual organization. In a virtual organization, a company can quickly access needed pieces of a complicated puzzle to run what is needed without tying up long-term resources. An agile solution for the life cycle and integrated logistics support is the selection of virtual suppliers based on capacity and the integrated costs of the chain (Pan & Nagi, 2010). A company that operates in the context of agile manufacturing needs the capability of operating in a competitive environment wherever and whenever conditions change (Pan & Nagi, 2010).

In an uncertain environment, organizations need to react quickly and logistics and transportation become critical factors in decision-making (Pan & Nagi, 2010). A robust optimization between production planning and other members of the supply chain need to work together to secure the shortest path to solving the challenge (Pan & Nagi, 2010). Manufacturing should include high quality, low cost, and rapid delivery with continuous change and flexibility to the satisfaction of end-users (Calvo, et al., 2008).

CUSTOMER-DRIVEN CUSTOMIZATION AND ENVIRONMENTAL CONCERNS

Agility and customization are synonymous with an organization’s ability to survive in uncertain times (Dahmardeh & Banihashemi, 2010). Organizations need to accept change and exploit customer demands as an opportunity to gain market share (Dahmardeh & Banihashemi, 2010). Organizations must abandon mass production and focus on customized products produced with high quality and delivered when and where customers need the goods (Dahmardeh & Banihashemi, 2010). Agility and responding to customer demands for customized products are characteristics of companies having the ability to respond effectively and purposefully (Vinodth, Sguandararaj, Devadasan, Kuttalingam, & Rajanayagam, 2010). Mass customization is a vision of producing effectively and with agility to meet each individual customer’s needs (Vinodth, et al., 2010).

A fundamental difference between traditional manufacturing and agile manufacturing is the idea of sustainability. Manufacturing needs to evolve in a sustainable way perhaps even more simple in design so that materials can be recovered for use at the end of useful life (Calvo, et al., 2008). The ideas of entropy and sustainability need to become design partners (Calvo, et al., 2008). Customers want to conduct business with responsible organizations that are willing to satisfy the consumers’ social and environmental needs.

CONCLUSION

Many components of agile manufacturing are already established, but in a fragmented state (Dahmardeh & Banihashemi, 2010). A formal method to incorporate all components is yet to be developed but is what is most needed for the new manufacturing model to gain widespread acceptance. Agile manufacturing can create a vision for the future, create a culture of change, and build on the concepts of technology. It is time for the border region to take bold steps and embrace the concepts discussed in this paper. One or two aspects of agility will not return the vitality of manufacturing to the region. The concepts need widespread acceptance and ideas need to be put into practice to once again take a leadership role in manufacturing on the world stage.

AUTHOR INFORMATION

Allan M. Beck, DM, is known as a manufacturing specialist and has spent much of his research investigating characteristics of international business environments. His doctoral research was to uncover what successful traits of maquiladoras in Reynosa, Tamaulipas, Mexico consisted of, and presenting a new model for success. He has served as the principal investigator for many projects involving industry and he is viewed as an innovative individual providing solutions to complex challenges. Professor Beck has taught online and at various campus locations for the University of Phoenix, and most recently The University of Texas – Pan American. He has taught at the undergraduate and graduate levels with a specialization in strategy, leadership, and management. His doctorate degree is in Organizational Leadership from the University of Phoenix. E-mail: alalbeck@aol.com

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