A Lean Supply Chain Manufacturing Model

Challenges with on-premise ERP systems and communication links limit the ability for firms to connect across the manufacturing supply chain to suppliers, customers, and their remote inventories. This paper discusses the challenges of communication flow and how integrating lean technologies can improve supply chain communications.

Building a lean supply chain structure is possible through the use of forecast models, bar code scanners and pull signals, also known as Kanbans. The success of using a lean manufacturing model increases by adopting improved communication methods through the internet and other web-based technologies. Once only accessible to larger members of the manufacturing supply chain, these same tools are now available to toll processors, distributors, material owners, brokers and end-users. The relationship between supply chain members strengthens as the exchange of information becomes faster and more reliable. The result is that all partners can benefit from saving time and money by limiting dual entry of information, reducing reliance on paper documents, maintaining servers and managing software updates.

Firms using Internet applications must continually look to increase operational efficiencies to reduce overhead expenditures. A solution for an inefficient model is replacing on-site systems with an outsourced, web-based system. These web-based systems are generally referred to as Software-as-a-Service (SaaS), ASP, or cloud computing applications. SaaS applications can be employed to reduce the need of having a large IT department on hand to update and maintain software and services. Using SaaS allows the entire supply chain to access accurate, real-time information while cutting waste and streamlining workflow production. More importantly, using these enterprise resource planning (ERP) applications make it easier to do business by standardizing and automating processes and procedures.

Today's Challenges

Manufacturing supply chains are complex and difficult to navigate in the best of circumstances (Figure 1). Multiple communication avenues exist through forecast schedules, Kanbans, phone calls, faxes, emails, and websites. To complicate matters, every customer, supplier and manufacturer have different sets of business rules and management structure. Internal and external situations within these firms ultimately decide successes and failures with both IT and system upgrades. An even bigger challenge of business integration is the resistance to change both internally and throughout the supply chain. Humans are creatures of habit, so the desire to switch back to the status quo is high, regardless of whether or not it is beneficial[1, 2]. When cases are made to upgrade, replace or introduce new ways of doing business, persuading decision makers and supply chain partners is often the first hurdle to jump.

A second barrier to resistance is basic uncertainty throughout the supply chain. There are several reasons for this uncertainty. A supply chain partner may refuse to make improvements based on increased costs, disruptions in the chain or data integrity issues[3]. Being able to manage and reduce these concerns to external partners is important when making the case for such large upgrades. Along with addressing partner concerns, the same ones may also be found internally. Corporate culture sometimes creates a roadblock for integration of new technologies, especially if the mindset is "if it isn't broke then why fix it." Just because the system is not broken does not mean it is the most effective way of doing business.

Increased cost in managing supply chains is something that firms try hard to avoid. Short-term thinking like this can lead to long-term problems. Antiquated manual systems and ineffective communication can lead to hidden systemic costs which will cost more in the long run. Smaller companies are more prone to this scenario than larger companies due to the inability to allocate finances for these projects regardless of the size.

Outside factors include economic uncertainty and disruption of the supply chain. Certain economic situations increase the likelihood of resistance, especially for large projects like system upgrades or implementation of new technologies like e-kanbans or bar code scanners. Today's economic picture paints a dismal picture. The last two years have forced most manufacturers into survival mode. Budgets are tight, making the possibility for change difficult. Besides an economic barrier, the hassle of disrupting the supply chain and dealing

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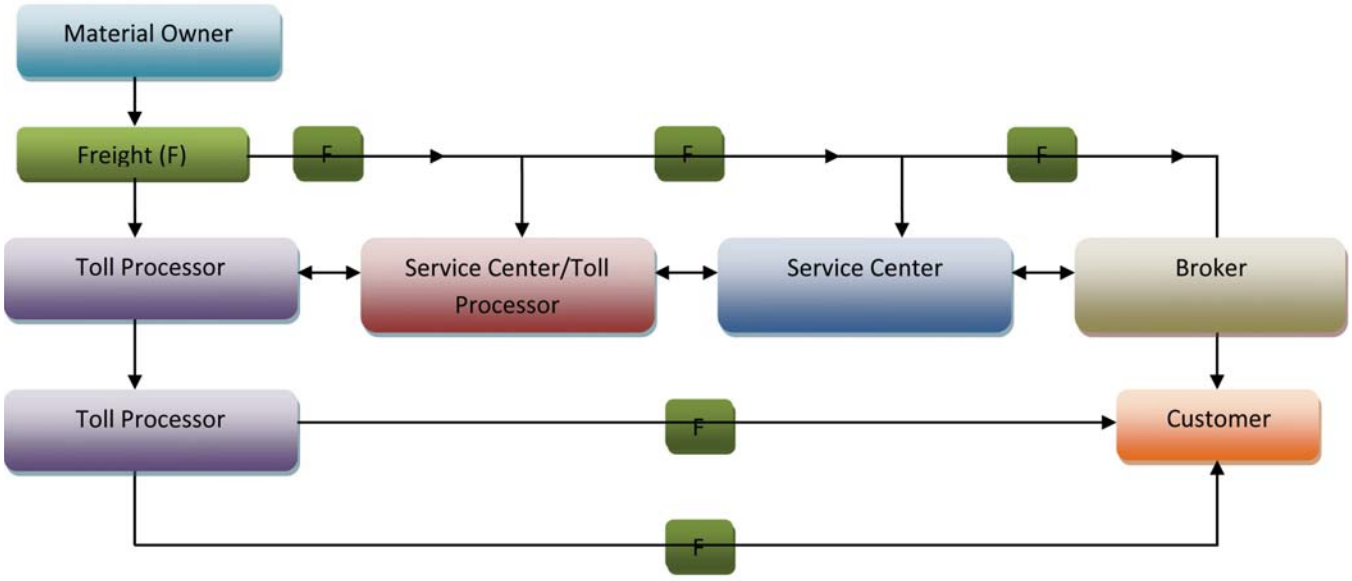
Figure 1



Example of manufacturing supply chain.

with unhappy partners is a valid reason for dissuading against numerous upgrades. These include not receiving correct data, training for new ways of transferring information and downtime for upgrades and system maintenance. Disruptions, even for a short period of time, equate to lost revenues and unsatisfied customers.

Lastly, with these upgrades comes the question of data integrity. Integrity of data exchanged across the supply chain needs to be validated. Diverting from faxing and mailing paper documents across the supply chain leads to decreased manual entry, and fewer people touching the data.

Realities of On-Premise Systems and Lean Technologies

Legacy or traditional ERP systems require upgrades, patches and modifications in order to handle frequent changes in the metals industry. For companies with a diverse business model, building an ERP system to fit the needs may be the best solution. With this comes a high price tag. A second option is using two or even three different systems, or a best-of-breed approach. Choosing the latter often results in duplicate entry of information, as well as long training periods on all of the systems. Either way, both options are costly, cumbersome and require a long list of customizations, training and upgrades (Figure 2). Along with these issues, upgrading on-premise systems have components that may not be beneficial to the business unit. Periodic upgrades require more budget planning, time and training with the upgrades and may not actually mirror what is happening in the changing paces of manufacturing.

An example of the changing environment of the metals industry is the switch to consignment, brokered or remote inventories. Instead of processors storing customer's material on-site, remote inventories are stored at the customer site. This way, material is reconciled only when taken for production. Once this material leaves the owner's physical location, there is no way to track the material through the production process with on-premise systems.

On-premise or traditional ERP systems limit visibility, traceability and syncing material information with orders. With these systems, suppliers are required to manually update and constantly check the status of material, leading to inaccurate data. Inaccurate information corresponds directly with high inventory and long lead times for customers. Adding remote inventories to the mix leads to a messy and cumbersome paper trail. Both require folders, copies and manual entry of information. This information must be faxed and copied for accounting, shipping, lab and customers. When material is processed at different locations, it is next to impossible to track the status of all the processes. The only way to know where the material is requires emails, phone calls and faxes. When quality issues surface, managers have to wait for the paperwork to move through the channel in order to make decisions. The final process is for accounting to manually reconcile the invoices and shipping and receiving documents for the material. From this example, it is easy to see where improvements are needed.

Whether dealing with remote inventories or outside processors, deciding to upgrade legacy systems is a large cost that firms must account for when deciding on the direction of their ERP and management systems. Along with these system upgrades, servers must be set up and networks established. Having multiple locations makes solving this problem more difficult. Depending on the size of the project, updating legacy systems and software may be too complex for small staff. In order to concentrate on core business competencies, outsourcing these projects to vendors may be the best solution for IT and process integration.

Smart Use of Technology to Manage Supply Chain and Processes

When the decision is made to implement lean techniques, a major question is "How do we go about doing it?" Regardless of the expected outcome, using new tools internally or externally for sending and receiving data is automated, thus creating a more efficient

process. Sourcing IT integration and pull systems outside of the organization is becoming a popular solution for organizations today. There are vendors that deal specifically with supply chain management, handle several customers at once and are experts in the industry. Using a SaaS-based system is a successful way to manage a lean supply chain. SaaS is an Internet-based software solution that does not require the user to buy hardware or software, but pay for the services as needed. With firms being charged only what they use, money is left to invest back into the company. Vendors with web-based platforms improve processes and save time, money and manpower. SaaS is dependent on acceptance and greater use of internet technology and the commitment of sharing supply chain information with trading partners to accomplish lean manufacturing objectives. Aside from easily meeting customer demands, firms now have a sustainable competitive advantage.

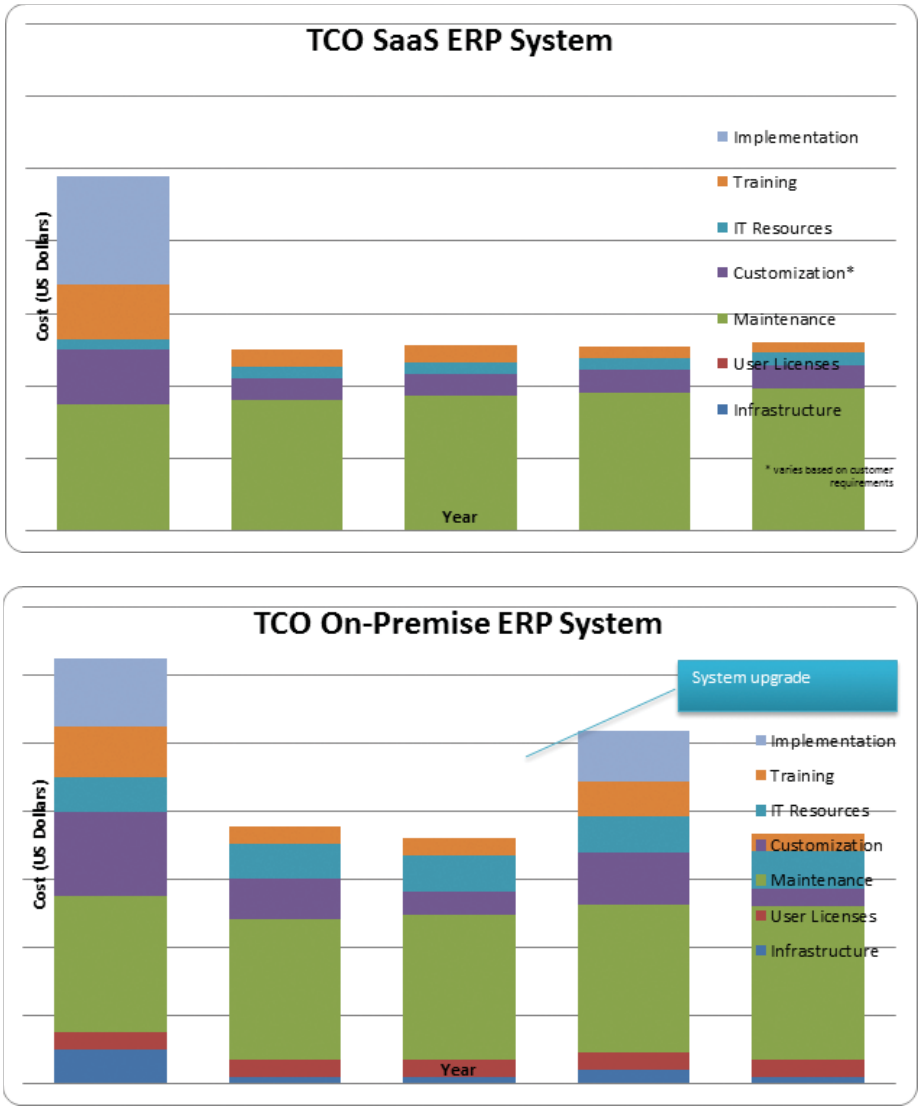
Integration of new technologies for firms exists both internally and externally. The development of one or the other only works to a certain extent, but the development of both together has been shown to give the largest returns on production and investment. The first question to ask openly is, can the internal IT staff handle the continuous upgrades and integration of systems needed to keep up with industry changes? Managing both processes can be difficult, so partnering with supply chain firms to help with external integration while staff is working on internal integration can greatly reduce risk, increase returns and reduce uncertainty levels across the supply chain[4] (Figure 3). Research on leading technologies and determining what best fits the organizational scope of each firm is the best way to formulate a game plan. A well-rehearsed plan leads to effective integration of new technologies. There are several applications and combinations to consider with supply chain technologies. Ward & Zhou[5] assert:

> IT integration facilitates the use of pull systems, or Kanbans. Without information systems, pull systems can only work well in one link of a supply chain. Internal IT systems such as advanced planning and scheduling can help with bottleneck/constraint removal and facilitate cycle-time reduction. With internal and external IT integration, pull systems can transmit the order information through the entire supply chain in a timely fashion, thus reducing customer lead time. External IT systems such as direct connections between suppliers and buyers help reduce production lot size, enhance pull-system effectiveness, and facilitate agile manufacturing approaches.

Firms then create a proactive solution for customers instead of a reactive one. Errors that are caught internally can then be corrected, or quality issues resolved, resulting in higher customer satisfaction and shorter cycle times for customers. Along with having a SaaS-based system, another proactive solution is having a pull system. With pull systems, material is replaced as it's consumed, so there is little worry of stocking out, or having to deal with excess inventory.

Another technique that can be used across the supply chain is electronic data interchange (EDI). An increasingly common option to ensure data accuracy is the use of "error queues." These queues are built to capture any information that is incorrect, and is held until repaired by reprocessing or through manual correction. Using an SaaS-based system allows errors to be corrected in a virtual environment through

Figure 2



A total cost of ownership comparison of on-premise vs. SaaS

the use of sync queues. Ensuring data integrity was previously only available to large companies. This makes using EDI a viable, efficient option for small to medium sized businesses. Another benefit of EDI is the use of business rule validation. The data is checked as it flows through the system against business rules, to ensure the data going to the customer is correct and validated. By automating processes with bar code scanners and EDI, processes become less expensive, are more accurate, and less susceptible to human error. These applications replace the need for the paper trail of files, folders and dual entry of information.

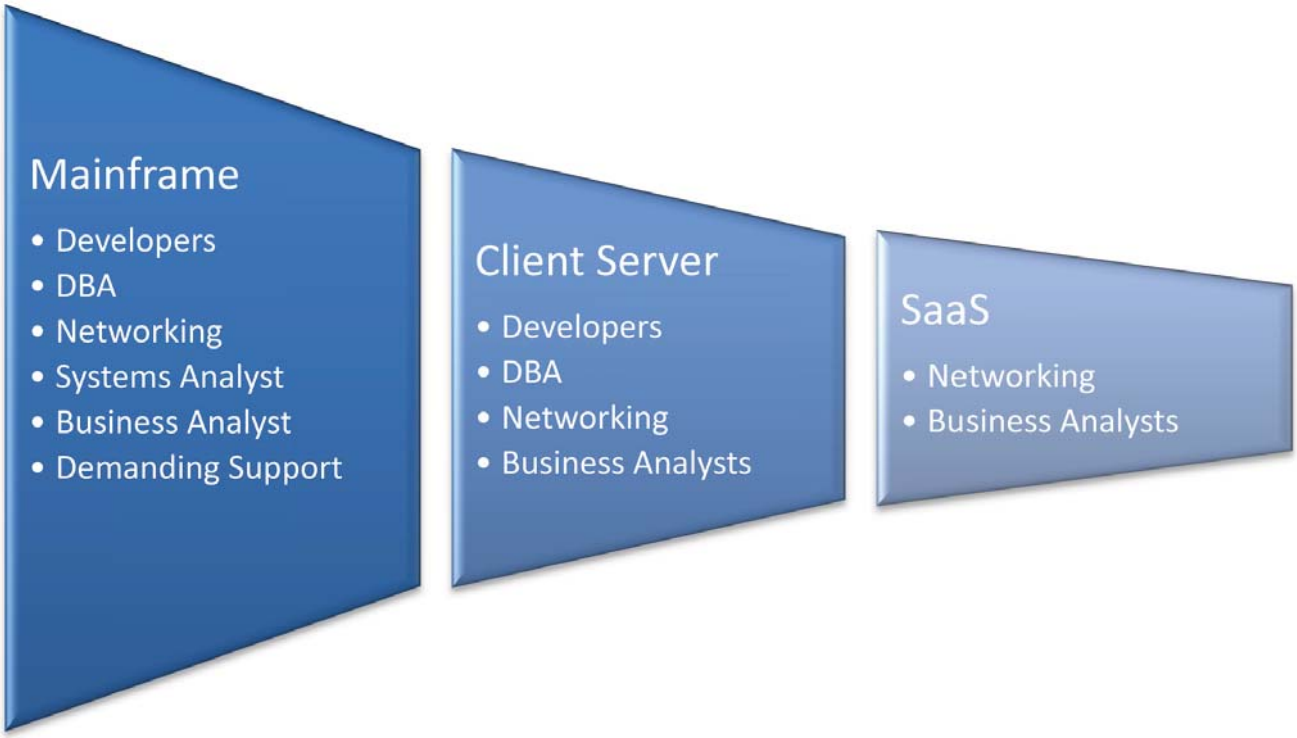
EDI has been used for years as a communication link. Metal manufacturers use this approach to send and receive material information, activate a pull system and create an effective plan. EDI used to be expensive and difficult to manage. There are benefits of using EDI today versus decades ago[5]:

> Historically, electronic data interchange (EDI) allowed expensive but limited content with a few remote partners, while Kanban provided low cost yet rich connections with many nearby customers or suppliers. Besides pressure up and down the supply chain, there was little motivation to use EDI. Today, the internet resolved these tradeoffs, and now all supply chain partners can be effectively integrated.

EDI Integration today is more cost effective than 20 years ago. There are several ways to integrate EDI, either by developing it internally or outsourcing to EDI specialists. The outsourcing alternative is to incorporate a SaaS-based system along with EDI. This will increase both the effectiveness of EDI and just-in-time inventories. A weak integration plan can result in a bullwhip effect of materials moving across the supply chain, creating excess inventory and stock outs[6, 7]. The unfavorable options are to then produce the unavailable stock with overtime, or absorbing the overhead cost of storing the excess inventory. This happens when companies fail to use production scheduling and forecasts. Demand for products becomes a speculation.

Applications such as forecast models, bar code scanners and kanbans connect internal with external processes. These applications are used in lean supply chains for one particular reason: they are a proven solution. Continual improvements of these applications need to occur in order for them to work effectively. Working with legacy systems can limit the effectiveness of using these applications. SaaS-based systems make these applications easy to learn and implement. Bar codes increase the success of a pull system by sending information that was once transferred by paper documents electronically through the supply chain. An improvement in this area is the development of e-Kanbans. Scanning the kanban instead of manually moving cards from place to place is a more efficient way of doing things. Forecast models give a better picture of material demand and inventory levels while e-kanbans track and store the information in real-time, eliminating the manual process of traditional kanbans. Connecting these applications along with a SaaS-based system and the use of EDI is a full circle lean approach to managing the supply chain.

Figure 3



Staff comparisons.

Advantages/Motivations

These technologies used either together or separately will improve communication channels and the movement of material. Accurate forecasts create leaner inventories and a better understanding of where consumer demand is moving. Visibility of suppliers, customers and processors is also increased. Instead of having to blindly estimate production schedules and demand, the bullwhip effect, handling stock outs and excess inventory are drastically reduced, and in some cases completely eliminated. Other motivations for implementing these technologies is being able to fully utilize staff, advance above competitors and introduce companywide automation. This will benefit all internal processes, as well as multiple plant locations. Customer service representatives are able to maintain their files with little to no manual intervention. Advancements above competitors require continuous improvements, whether it is process improvements or system improvements. A long-term advantage of integrating SaaS technology is continuous upgrades so there is no need for a system wide upgrade every 3–5 years. Budgets are more stable year to year, so the funds typically reserved for these costly upgrades can now be allocated elsewhere. Accurate inventory shortens lead times for customers. Less time is spent reconfiguring production levels, and firms are not left with excess inventory or having to work massive amounts of overtime to meet the demand output streams due to insufficient inventory. Customer service representatives can more accurately answer questions on customer orders and part and production processes, and receive up-to-date information on inventory levels and quality issues.

Ensuring the quality of material is important to all firms in the industry. With quality issues of material continuing to surface in recent years, it is more important than ever to research automation. Part of this has to do with how the process and material is documented. EDI and barcode scanners create a steadfast, controlled way of collecting, interpreting, and reporting material data. Production, genealogy and damage are recorded, drastically decreasing the likelihood of errors in the generated reports. Since the need for manual entry is reduced, data integrity is high, therefore reducing the need for checking and re-checking entries. The advantage of diagnosing and fixing quality problems before it reaches the customer will pay large rewards in the long run by not having to recall products or dealing with angry customers.

Newer technologies limit the amount of downtime for partners and increases security and the integrity of data. Upgrades are completed more frequently, eliminating the frustration of long periods of downtime. System upgrades result in a faster, easier, efficient way of running a supply chain. Along with process updates, security updates are also performed with SaaS systems. The level of security used for outsourced systems is often higher than firms could ever realistically implement themselves.

Who is using it?

Lean technology has a larger presence in other industries, and the same models can be applied to metals manufacturing. SaaS vendors that are industry conscious to metals manufacturing make these avenues readily available.

Retailers have been using EDI and lean technologies for years. Low-cost retailers were the first to require vendors and suppliers to use lean technologies. These advancements allow for global success. While an extreme case, the results are seen across the industry. Similarly, firms like Dell and Cisco use these technologies to capture information from customers, are able to coordinate suppliers, and improve overall leanness of their operations[8, 9]. It has been slower to market for manufacturing. Toyota is known for their Total Quality Management (TQM) and Kaizen/Continuous Improvement models. Kaizen and TQM models have been in place since the 1950s. New improvements like SaaS systems and automated techniques take TQM a step further by tracking delivery lead-times, transaction costs, and inventory turns[10]. Large steel manufacturers use EDI and other lean technologies as a way to increase supply chain visibility. As these technologies become a more accepted practice, the industry will see positive changes in supply chain costs, customer satisfaction and overall system effectiveness.

Conclusion

With today's multitude of challenges across supply chains, it is easy to see how important researching and finding lean models that meet your firm's needs benefit the supply chain. While lean supply chains are pertinent for a company's survival, it is equally important that a company remains easy to do business with. This is accomplished by having greater control of the supply chain, decreasing inventory levels, and becoming more responsive to the customer. Shorter lead times equate to satisfied customers and considerably reduce the bullwhip effect, contributing to a successful outcome[11, 12]. Introducing one technology over another may have positive short-term results; a long-term strategy would encompass a combination of all topics discussed.

Lean technologies reduce inventory and uncertainty with RF scanners and e-Kanbans; forecast models give more accurate data for demand and use new technologies to track outside processes and remote inventories. Exchanging real-time information gives greater visibility across the entire supply chain. Suppliers, vendors, processors and mills can make this happen by using internal and external solutions. Most importantly, it makes doing business easier and more effective for everyone involved.

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