Reducing Total Lead Time By Focusing On Transactional Processes

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ABSTRACT

Lean management processes have had their inception in manufacturing operations. However, when value stream mapping the entire process, one often learns that more time is consumed in the pre-manufacturing, transactional processes than actually is used on the production floor. Sometimes as much as 80 percent of the total time to produce a product after receiving the order takes place in the pre-production operations.

This paper will present the authors' experience with applying lean production principles to these pre-manufacturing operations and the dramatic improvements that have resulted. Wasted time and effort occurs because of problems with layout, information flow and availability, organization of the work area, and operational processes.

Application of lean principles to office areas can result in decreasing sales order processing times by 90 percent or more, accounting process times by more than 50 percent and office space requirements by as much as 60 percent. This paper will describe lean implementation in a sales service center for a valve manufacturer and a raw material approval process for a solvent manufacturer. The paper will describe both the methods used and results obtained.

1. Introduction and Background

Lean production practices had their inception in manufacturing operations beginning with Toyota and extending to other organizations after this approach was shown to be useful [1]. While there have been productive applications in manufacturing operations, when one completes a total process or value stream map for a manufacturing plant, one quickly sees that actual production of the product requires only a small percentage of the total time from contact with or by the customer and the customer's receipt of the product. This is depicted in Figure 1 showing that, in a typical set of production operations from order receipt by the producing facility to order receipt by the customer, as little as 25 percent of the total time is required to produce the product – <u>the real value-adding process as perceived by the customer</u>. In spite of this situation, most lean production applications have focused upon manufacturing operations. There have, however, been publications dealing with these applications [2,3].

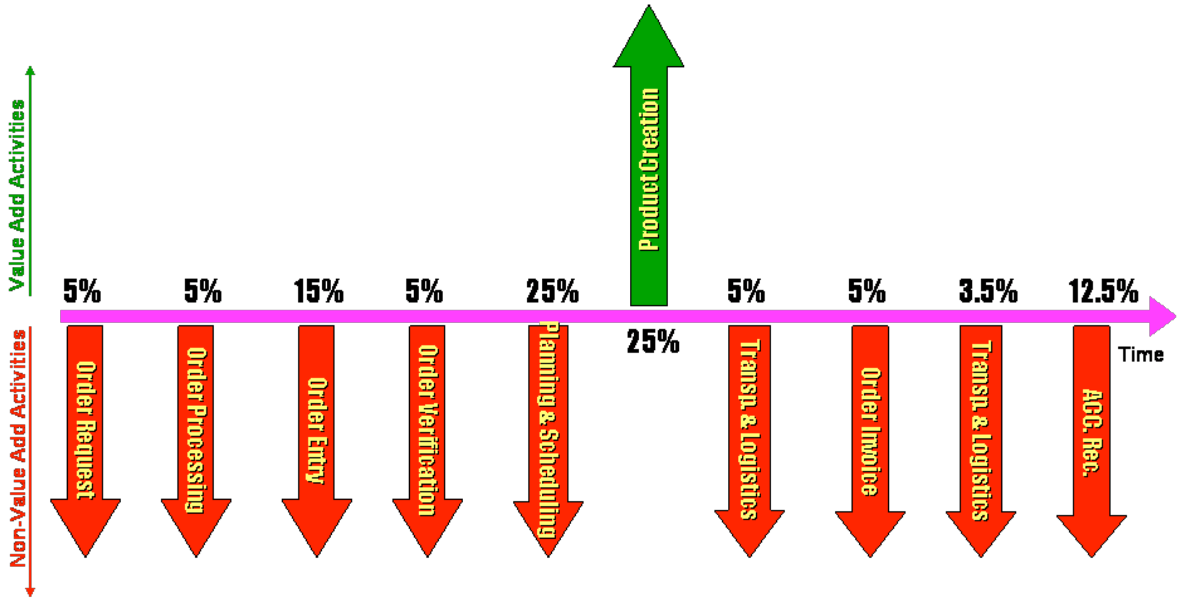

Figure 1. Representative value-added time from customer's viewpoint from customer order until receipt of product

Why, therefore, should there be so few applications dealing with non-product production? One reason is that most first applications have dealt with manufacturing operations. Another is that "waste" or non-value adding activity is not as evident in non-product production operations as it is in a manufacturing environment. Identifying material flow is substantially easier and more visible than identifying information flow. Information flow is like electricity, you know it's there but you cannot see it. Also, most organizations manage information with business systems that require human input. It is at this interface that the waste and lack of accountability occurs.

Furthermore, work is performed in batches within functional silos. See for example, Figure 2. Interface and interaction between these functional units is often erratic and involves feedback, delay and rework. A typical value stream for the order to cash value stream is depicted in Figure 3. Here one can get a measure of the waste that can and often does occur. For example, in the eyes of the customer, value-adding work to the product being produced only occurs less than 10 percent of the time.

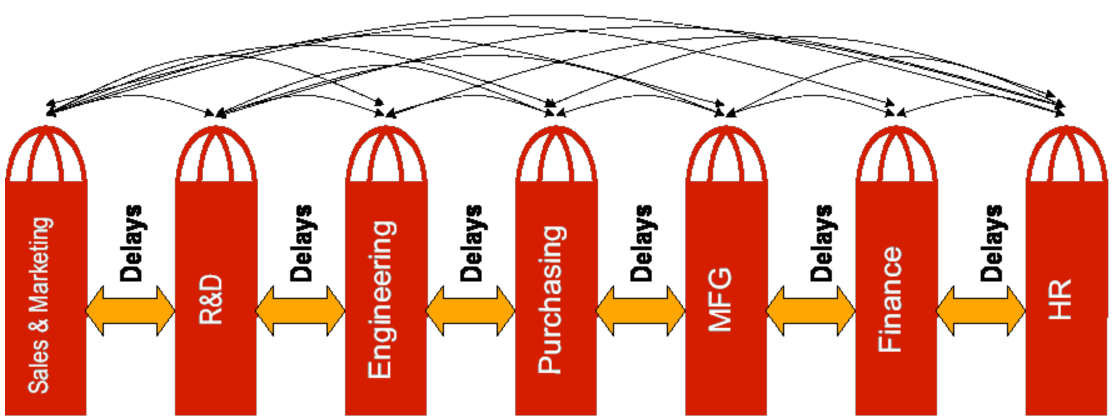

Figure 2. Functional areas often work in isolation causing delays in information flow and prompt processing of orders

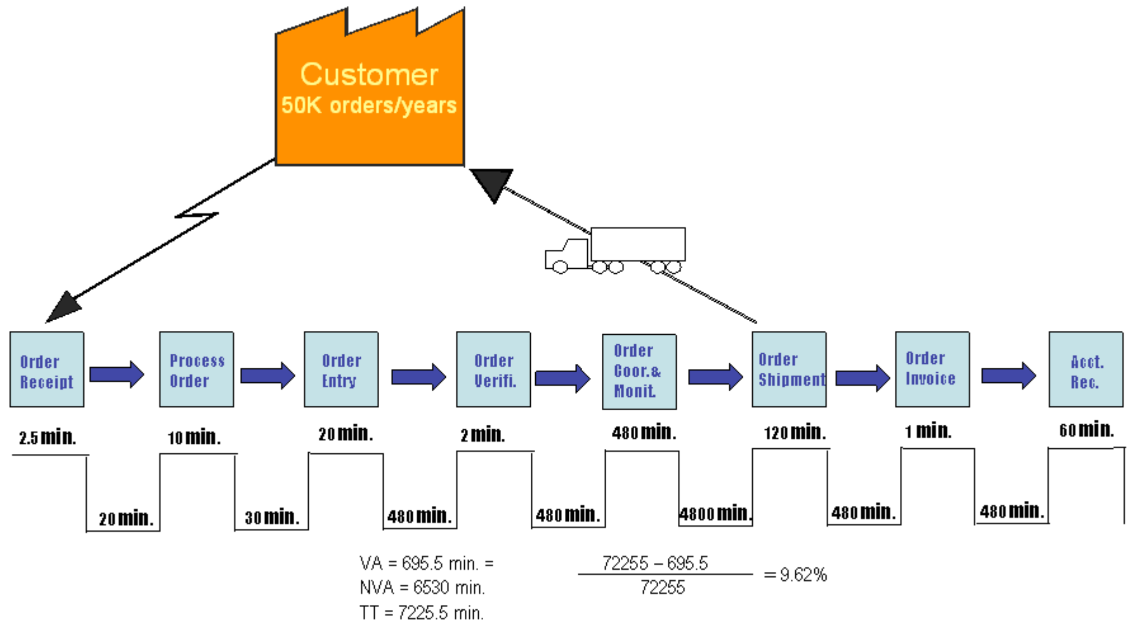

Figure 3. Typical order to cash value stream map, note the customer sees less than 10 % of time as value-adding

Figure 4 presents the relationship between the typical sources of waste that occur in production operations and those in the pre and post production operations. The sections of this paper to follow will describe some actual applications of lean production processes to non-product producing operations that occur in these cases before the product production actually begins. Each of these instances describes a single kaizen intervention or blitz application.

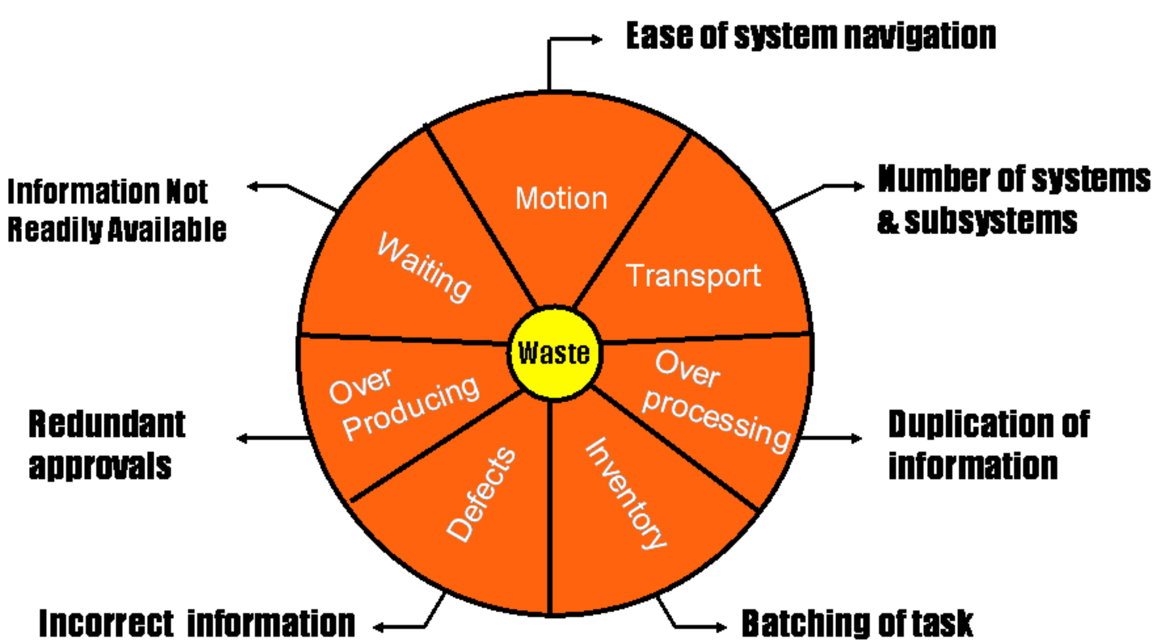

Figure 4. Representation of the sources of waste in non-product production operations

2. Inside Sales Case

This example involves the inside sales operations for a pressure value manufacturer. In this case orders were continually being released to the floor late with the average cycle time for moving through the order process being three to five days. Even then there were errors being made in the order entry process as orders were being released to production. This in turn was hurting the company's sales and customer perception.

Initially, there were 23 employees within the inside sales area conducting tasks that included customer interface, special order processing, data entry, fax service, order review, supervision and credit checking. The original process flow diagram is shown in Figure 6. For a standard order, initially, seven different people were involved in processing the order. These included the fax handler, customer service review, marketing and sales review, credit evaluation, sales final review, manufacturing verification, and data entry. The average time to complete these tasks was three to five days.

The initial layout of the customer service organization was by function, orders were batched, there was a lack of accountability, and customer service was slow and considered poor by plant management. Efficiency was low and so was morale. The customer service function was considered to be a high stress work environment by employees.

In the Kaizen improvement process, employees in the sales organization were given brief training in lean processing including definition and identification of value adding and non-value adding activity. Employees were encouraged to identify non-value adding activities in the current operation and to gather data and review functions to incorporate one-piece flow, cellular arrangement of operations and visual management in making overall operations more effective.

Evaluation of incoming sales volumes indicated that the overall customer service function could be separated into three cellular arrangements servicing the western, central and eastern United States. Cells were arranged so that each could perform all necessary functions to process and order from customer acquisition through release of the order to the production floor. Each cell would contain teams organized to handle inside sales, customer service, special order processes, and data entry for the section of the country they were set up to service. The new process flow diagram for the improved process is shown in Figure 7 (with photographs of the new cellular arrangement) and the cellular layout is shown in Figure 5. In this arrangement only three persons touched the order: a fax handler, inside sales person, and data entry person. Personnel were cross-trained to support one another when work loads varied.

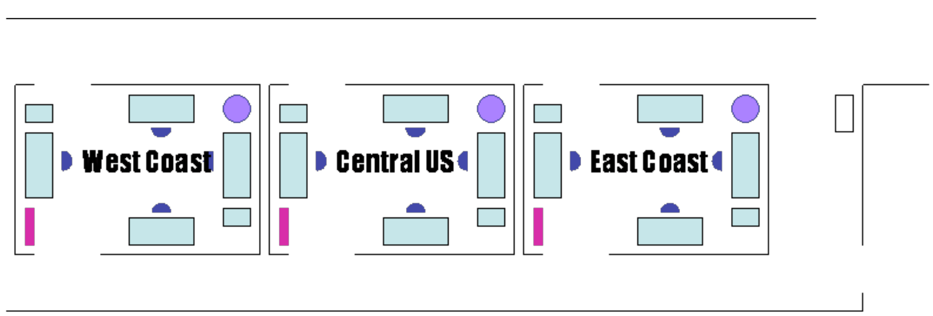

Figure 5. Cellular layout for inside sales

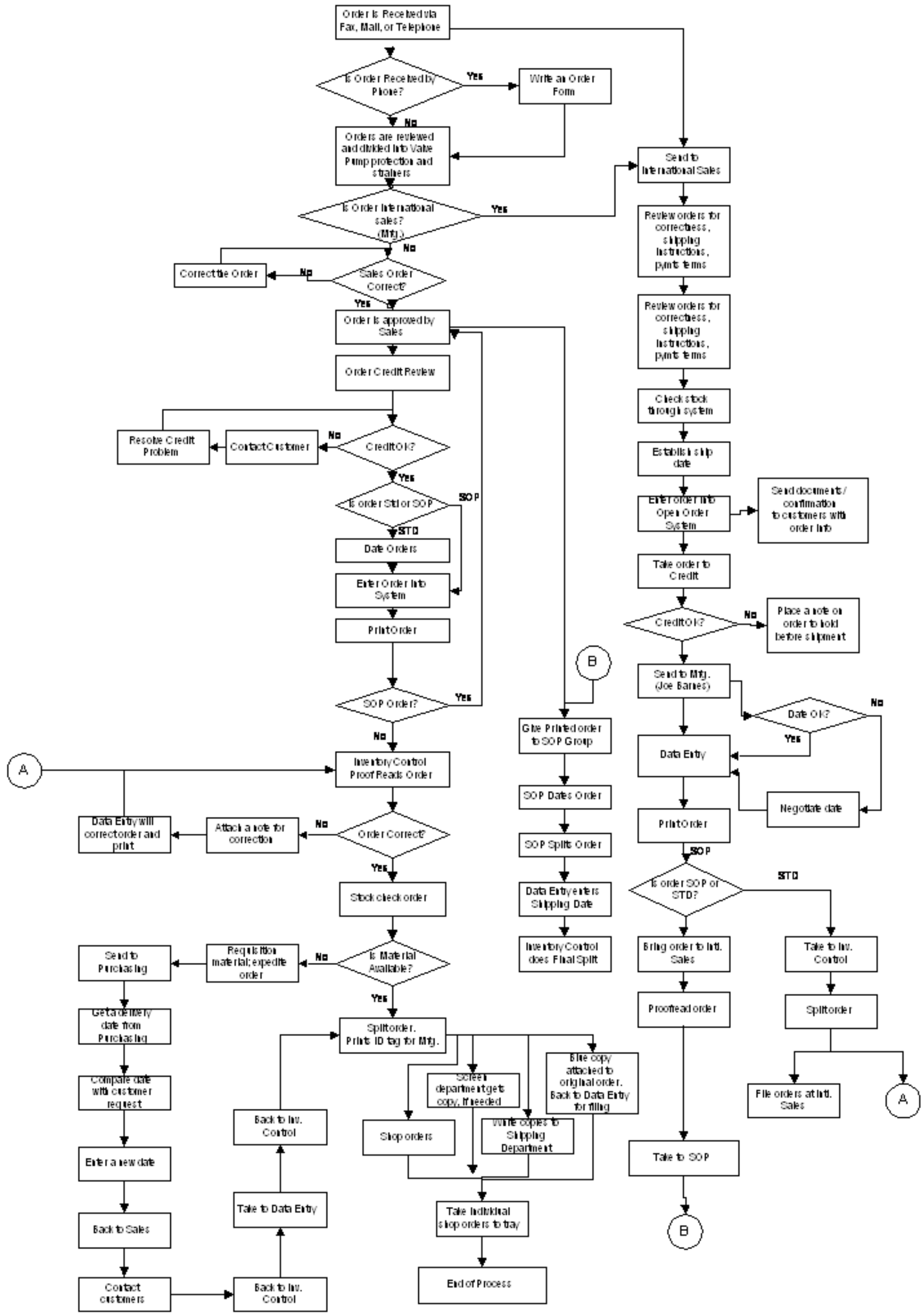

Figure 6. Process flow of initial process before lean improvement

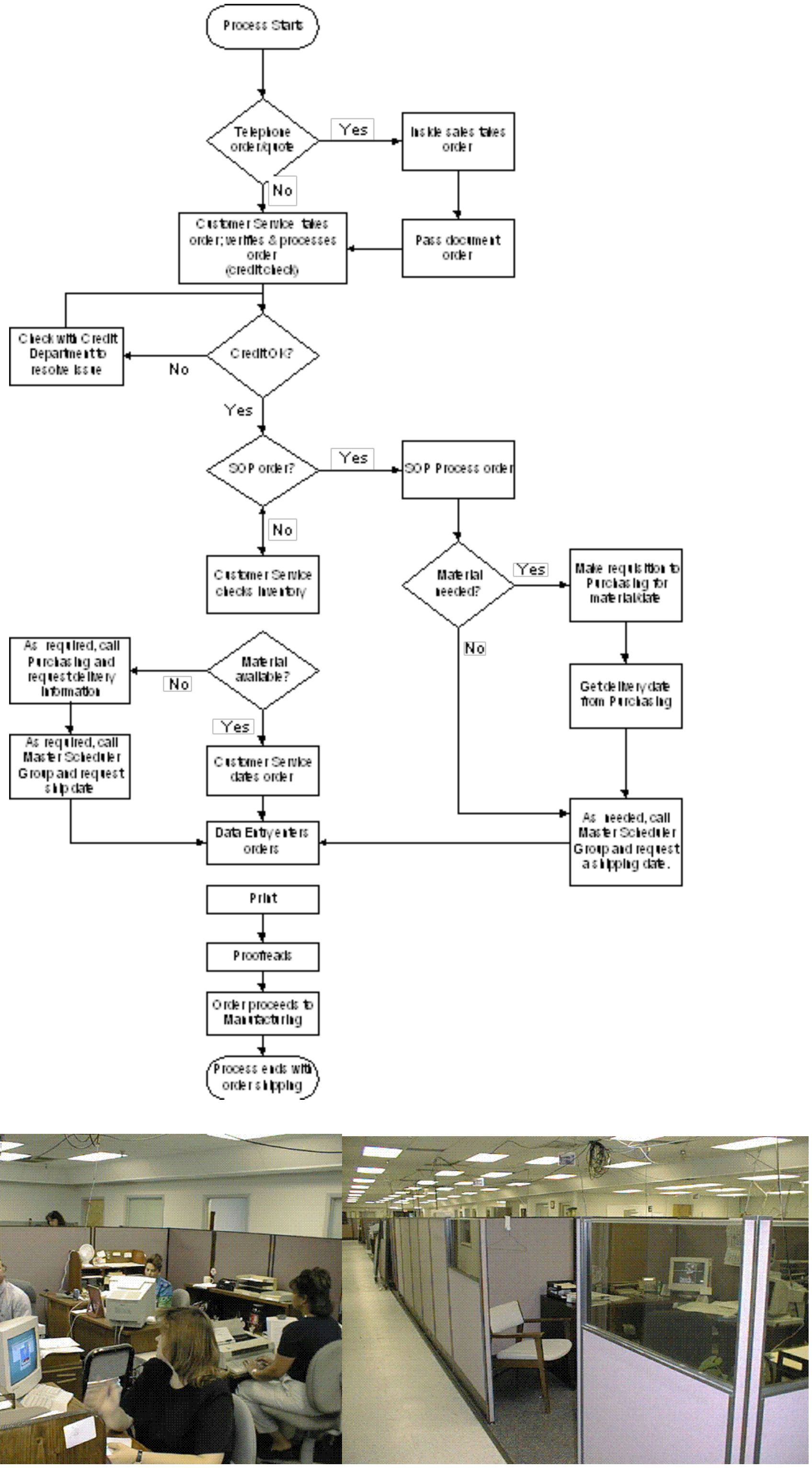

Figure 7. New process flow diagram with photos showing new layout

The results for this application were impressive with total average process times now reduced from three to five days to only about one hour. Handling of orders was reduced by an estimated 90 percent. Internal communication, accountability, and productivity were increased by at least a factor of two. The overall headcount was reduced by 40 percent and non-value adding activity was reduced by an estimated 90 percent.

3. A Raw Material Approval Process

For most organizations, the product development process is a key component to remaining competitive in the global market. A critical metric for this process is the speed at which an organization can introduce new products. This case explores the new raw materials approval process for a solvent manufacturing company. In this situation, the manufacturer of the solvent when introducing a new product must first make certain that the raw materials can be procured. Procurement involves checking to make certain that environmental regulations will not be violated when using the proposed materials. Next, a determination of the availability of the materials is made. This involves identifying potential suppliers for the materials and developing contracts with them to deliver the raw materials at an acceptable price and in acceptable quantities.

This case demonstrates the impact of time lost when information is not properly managed and is kept within functionally different organizational units. The overall process uses 11 different databases that are kept in six different functional units. The current average lead time for the process was calculated to be 82 days. The value stream map for the current state process, Figure 8, indicated that there were only 471 minutes of value added time in the entire process. Therefore, there should be ample opportunity for improvement.

There are approximately 1000 new raw material requests per year. The organization would like to reduce the lead-time for approving new raw materials as well as the time to market their new product. A more streamlined process would enable buyers and manufacturing plants to react faster to technical changes or changes in the company purchasing strategy.

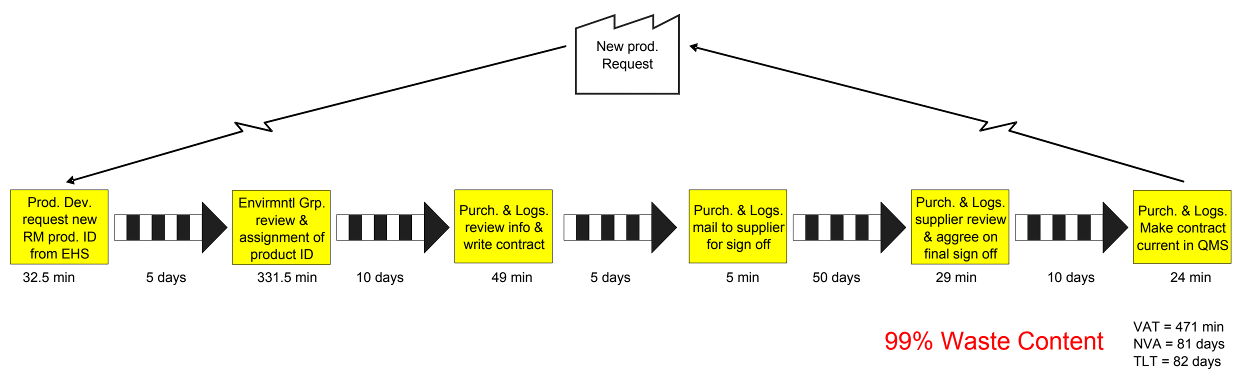

Figure 8. Current value stream map

As can be seen from the value stream map in Figure 8, the process starts with product development requesting an identifier for a new raw material. In order to assign the material identifier, the environmental group has to evaluate the potential environmental impact and risk to the business of using the new raw material since the raw materials are mostly chemicals. In many instances, product development submits incomplete information causing the environmental group to spend time researching and getting answers prior to being able to move to the material review step. The outcome of the environmental review determines whether the risk to the business is low, medium or high. Several factors influence the ranking such as material volatility, toxicity, plant capability, and governmental requirements. There are several communication loops between the manufacturing plants and the environmental group. The initial communication is done through a manufacturing council that first reviews the capability of the potential facility to produce the product. There is also feedback communication between the council and the specific facility. At this time, it is possible for the facility to decide that it cannot produce the new product. Once the environmental group has made their recommendation, purchasing and logistics prepares all the necessary documentation, including the material specifications, for a supplier contract. The contract outlines the raw material specifications and the requirements for the raw material such as certifications, test procedures, and packaging. It is at this step that the process experiences the greatest delays. The main reason for the delay is the lack of communication between the departments involved. The role of purchasing and logistics is to serve as the mediator between the various functional areas. This creates enormous delays due to the difficulty in getting the needed information. Often, purchasing and logistics spends hours seeking to identify the proper person/department from which to get answers needed by suppliers. Another complexity in this process is the fact that purchasing and logistics must deal with multiple divisions which have material specification databases that are different and do not communicate with one another. Besides multiple databases, three of the databases maintain the same information in separate locations. This combines to create long delays when retrieving and gathering information. Once all the material specifications are completed between the organizational units and the raw material supplier, a final document is signed and approval to purchase from the supplier is given to the facility or facilities that will manufacture the product. At this point, the new product can be manufactured and sold to the market.

Eleven different non-integrated databases are used and 13 decision points are part of the process. Due to the lack of system integration, three of the six functional areas verify the same information before moving it to the next functional unit thereby creating even more delays. Furthermore, material specifications of supplier contracts are reviewed every three years. The material specification database automatically calls up contracts that are due for review. The purchasing and logistics department sends the contract in question to the appropriate technical group to see if the raw material is still needed and current. If it is, the contract is sent to the appropriate supplier to get their renewed agreement. This approach follows very closely the well known “Push system.” Whether there is a need or not, work is done and pushed onto the next process.

To reduce overall processing time, a cross functional team was put together to review, recommend and make improvements to the process. The team conducted a Kaizen event that lasted four and half days. The team was trained on waste identification as well as lean tools. The team began by identifying and listing all the required inputs and outputs as well as all the suppliers and customers of the process. Once all of the requirements for the process were identified, the team created a value stream map, shown in Figure 8. This tool helped the team determine the average lead-time to process a new raw material request and also how much value-adding and non value-adding content was contained in each process. The team observed that 64 percent of the process lead-time centered on the external supplier specification approval. Only approximately one percent of the overall process time appeared to be truly value-added time.

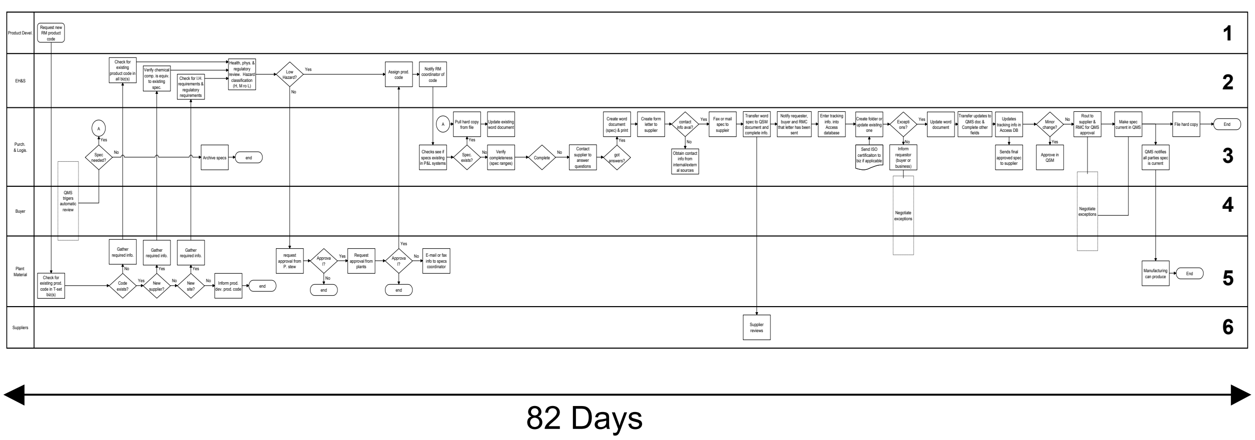

Figure 9. Current Functional Process Map. (1) Product Development, (2) Environmental Group, (3) Purchasing & Logistics, (4) Buyers, (5) Plant Material, (6) Suppliers

The team used several lean tools to identify and improve the process such as value stream mapping, functional process mapping, setup time reduction (removing steps from the critical path), standard work definition, pull production and implementation and control plans. Other tools used were affinity diagrams (for brain storming) and Pareto charts.

The team quickly came to the conclusion that purchasing and logistics was not the appropriate functional area to be the central point for managing the information to be gathered. It was apparent that this role would be best executed by plant materials managers for each division. As the process was analyzed, it was apparent that plant materials managers had more knowledge about the new raw materials than the persons in purchasing and logistics. Looking at the functional process map row 5, Figure 9, It was observed that plant materials management is involved in the process at the beginning and at the end. However, most of the activity is taking place in row 2 by purchasing and logistics. However, it is plant materials management that possesses the most knowledge about proposed new raw materials and is able to answer most questions of potential suppliers. It was also observed that, in the majority of the cases, product development people reside at the facilities where plant materials are located. Thus, there are at least two solid reasons to have plant materials management take over the activities previously performed by purchasing and logistics.

The new functional process map, Figure 10, shows the reallocation of responsibility from purchasing and logistics (swim-line 1) to the plant material managers (swim-line 3). In the new process, the plant material managers will play the role of gatekeeper and information manager. Since plant material managers and product development are in the same location, it will be much more effective to communicate between the two functional areas. The team also realized that the communication between the environmental group and the manufacturing council would be better handled by plant material managers since the manufacturing council also resides at the facilities.

The new process starts by product development submitting the new raw material request to plant materials management and not the environmental group. At this point, all of the submitted information is reviewed for completeness and accuracy. Plant materials management will send any incomplete information back to product development if necessary. Once all the information is complete and accurate, plant materials management will provide the information to the environmental group for their evaluation. Since plant materials management is reviewing the submitted raw material request, the environmental group does not have to perform any checks or verifications other than the environmental ones. When the environmental evaluation is completed and approval is obtained from the business council, the information then is passed to purchasing and logistics. At this point, all the contract documentation is prepared for the raw material supplier. Something to point out is that suppliers were not given specific deadlines for returning the required signed contracts. This can be seen in the value stream map fourth box queue time average of 50 days, in Figure 8. In the new process, the supplier is given 10 days to respond with a completed contract. It is anticipated that initially only a small percentage of the suppliers will respond within the 10 days. However, within six months, the organization expects to achieve compliance from all suppliers. Another improvement to the process is that any negotiation between the supplier and business will be handled by plant materials management since this group has a better understanding of the raw material application and its requirements.

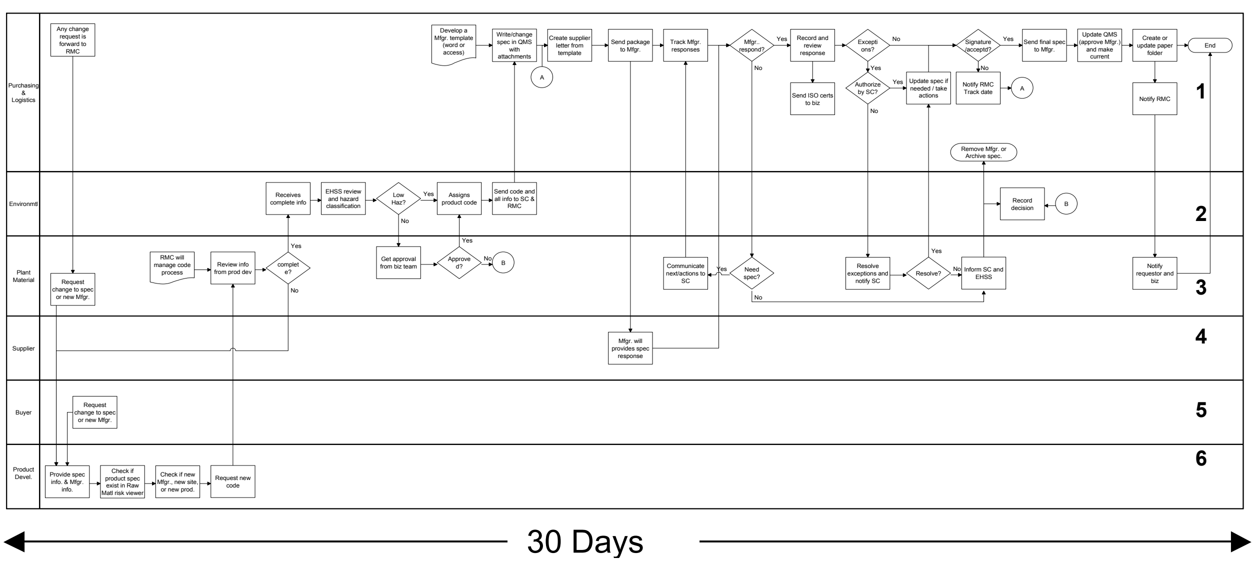

Figure 10. “To Be” Functional Process Map. (1) Purchasing & Logistics, (2) Environmental Group, (3) Plant Material, (4) Suppliers, (5) Buyers, (6) Product Development

By allocating the responsibility of gatekeeper and manager of the information to the plant material managers, the process action was able to be improved by approximately 64 percent and the lead-time was reduced by 52 days. The number of steps was reduced by six from 40 steps to 34 and the number of decision points was reduced by four from 13 to 9. By reducing the lead-time to 30 days, the organization is expecting to realize potentially millions of dollars in increased sales by being able to sell new products 50 days earlier than before. The organization also sees a gain in the ability to manage and leverage the relationship with suppliers. Although the team recognized the impact of using 11 databases, they were not able to recommend improvements due to the planned implementation of an enterprise resource planning system. With the new system, all eleven databases would be replaced by one eliminating many of the difficulties now encountered by having different systems in the functional units.

4. Conclusions

As described in this paper, the authors have found that pre and post production operations provide an unusually fruitful area for application of lean production tools in reducing overall (order to cash) lead times. In fact, if these pre and post production operations are ignored in lean process applications, some of the greatest untapped areas of opportunity will be overlooked. As shown previously, as little as 10 to 20 percent of the overall process lead time is involved with actual product production operations. Frequently, the product producing operations have been the subject of improvement efforts before while the pre and post production operations have often been ignored. Some of the reasons for this include difficulty in measuring work products, difficulty in measuring flow of information, lack of attention to these areas, traditional work processes, and organizational intransigence.

Organizations and companies increasingly find that speed in getting new and old products to customers is a compelling competitive weapon. Product speed (shorter lead-times) may be the only competitive advantage some companies have when competing with off shore organizations. Although customers are often driven by cost, orders are also won by how fast someone can meet a customer's need. Therefore, more companies are beginning to recognize that non-product production operations are a major source of non-value adding activity and are sources of large time losses increasing total production lead times.

This paper has illustrated that use of lean process tools can produce quick results and dramatically reduce total production time. Furthermore, it is important to include non-product production processes when attempting to develop a totally lean production operation. This is because in developing lean operations, everything must change, not just product production. A strong commitment to the effort is required throughout the plant and company. This commitment is critical as modifications in the non-product production operations often involve altering bureaucracies that can be difficult to change.

In conducting training and implementing lean process improvements, some of the benefits include encouraging those participating to challenge their thoughts, routines and current practices. Selection of high-quality and appropriate participants in lean process improvement projects is critical. Furthermore, these projects provide the opportunity for participants to learn about other company units other than their own.

Two principal areas of opportunity are highlighted in the cases cited. One area of opportunity involves developing cellular arrangements with both co-location and information technology support to streamline operations. Another involves noting that the basic problem often is the availability and interaction of people with information sources. This interaction and flow of information often is the critical factor in making rapid and high impact reductions in the time consumed in pre-production and post-production operations. Databases are often incompatible and information sources needed are often not readily available. There is often a lack of recognition and focus upon this as a problem.

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