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ENABLING OR INHIBITING? EXPLORING THE IMPACT OF INFORMATION TECHNOLOGY ON LEAN MANUFACTURING

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ABSTRACT

In recent years researchers have gradually revised their assumptions regarding IT-related change. It is now contended that this is best understood as a dynamic, reciprocal and interpretive process during which manufacturing processes and institutional structures are inextricably linked. The aim of this paper is to better understand the enabling and inhibiting impacts IT has on lean manufacturing. This paper provides a rich picture of a paper mill producing liner reels and the impact of a reel administration system on the manufacturing process. It is important that an IT tool supporting lean manufacturing reflects its organization. When it does the IT tool can act as an enabler of organizational change that in turn increase productivity and the production quality, when it fails to do so it inhibits organizational change and hampers the quality of production.

The conclusion is that framing the definition of high production quality regarding product and process is important and that teambuilding would be a contribution to this end by enhancing perspective taking among the employees.

Keywords: Lean manufacturing, organizational change; quality management; production quality; industrial IT.

INTRODUCTION

The study of manufacturing flexibility and lean production has long been a central theme information technology (IT) literature [3, 7, 18]. Investment in IT is a costly business, and precarious at times, but a key for survival in hyper-competitive industries [8]. To manage high production quality a constant development is needed and thus the systems are constantly upgraded. Due to high costs and complexity of upgrades industrial organizations tend to hold on to their old albeit functioning systems. Manufacturing plants are extremely complex environments with a lot of intricate systems that need to function together on different levels. New investment in IT requires a great deal of effort to get the system running as intended [15, 23]. As the race for quality continues, different parts of the plant is typically developed and upgraded, while other parts will have to wait for their turn. In such situations the new demands for high quality output is not always supported by the old system, which implies consequences for the people involved with the system in their different roles.

The topic and potential of information technology (IT) in organizations has been the subject of considerable interest and debate and much of the existing literature is focused on the outcomes and impacts associated with IT [13, 14, 20]. Yet, despite high expectations and huge corporate investments, success remains elusive and IT failures remain a serious problem for practitioners and researchers [25]. Forty percent of all corporate IT projects are abandoned before completion [11] and unused or underused systems cost businesses millions of dollars each year [19]. The enormous potential of IT to transform the fundamental nature of organizations coupled with the high rate of IT failures raise important questions regarding its implementation within organizations.

While much previous research suggests that IT can be a critical enabler of firm performance [4, 12, 17, 24] there is a lack of understanding of how IT investments can increase firm performance. This research extends the above stream of work by studying IT and its relation to manufacturing performance with a focus on the ways in which IT both enable and inhibit change processes. There is a pressing need to better understand the pathways through which IT investments lead to increased firm performances [2].

Information technologies are a common sight in today's industrial context of today as most, if not all, industries and manufacturing units are in need of computers to help enhance the production quality. To get the edge on a market where competitors produce similar products it is critical to make the production lean to reduce costs [16]. To support such lean production information technologies in industry are growing in numbers and in complexity. This paper describes the impacts of a specific product management system, the Reel Administration System (RAS) on the quality of production at SCA Packaging Obbola, a paper mill outside Umeå in the northern part of Sweden. SCA is the leading global supplier of customized protective packaging, and the mill in Obbola is producing liner. The aim of this paper is to better understand the enabling and inhibiting impacts IT has on lean manufacturing. By providing a rich picture of the environment for lean manufacturing at SCA Packaging Obbola AB the bottlenecks will be extracted and the quality innovation potential of the reel production explored.

The structure of the paper is as follows. In section two we discuss industrial information technology, quality, and impacts of information technology on organizations. In section the details of the case study at SCA Packaging Obbola AB is outlined along with methodical considerations made in the study. Section four contains an analysis of the findings from the case study and in the last section we conclude with the implications of our findings.

RELATED RESEARCH

The setting of quality improvement in industrial context is dependent of many factors, internal and external [26, 27]. With this chapter we will give an introduction to research regarding what is important to consider in relation industrial IT in general and IT support for lean manufacturing in particular. For many years there has been a focus on the so called "productivity paradox". This paradox is a concept that implicates that IT investment does not always imply an increased amount of output or even improved quality of the product. Researchers had a hard time explaining why the increase in computerization did not continuously increase return of investment as it had when computers automated the processes of manufacturing. The conclusion finally was that the computers themselves did not account for the return in investment. The main line is that is very difficult and even inappropriate to try to translate the benefits of IT usage into quantifiable productivity measures of output. Instead what is apparent is that IT helps the output arrive at the right time, at the right place, with the right attributes for each customer [6].

Information systems in industrial settings exist in a broad spectrum ranging from office software systems to systems that managing advanced robots. Software help managers with decision management and communication structures in today's factories are largely based on information technology.

To make a social context in a manufacturing setting successful it is important that they understand other team member's situation in order to help them out. This requires a process of mutual perspective taking where distinctive individual knowledge is exchanged, evaluated, and integrated with that of others in the team [5]. The team gets all the information they need about quality, productivity and logistics, which enhances quality of the process.

Information systems have a significant impact on organizations and it is vital that the system reflects its environment. If not, the cost of the system can turn out to be far more than expected. With this in mind the value of IT investments in product management systems needs to be seen in relationship with investments in organizational capital. There is strong evidence that decentralized decision making, job training and business process restructuring have a major impact on returns to IT investments. The two complements each other and information system is an enabler of organizational changes that can lead to productivity gains [6, 9]. That is to say management must look beyond conventional productivity measurement techniques to reap the benefit of productivity gains by information technology investment, which is the current understanding of IT investments [6]. From a management perspective it is thus of importance to regard the need of the organization, or the specific the organizational unit, and make IT investments that reflects this need. Orlikowski and Robey [21] argue that IT should be conceptualized as both a product and a medium of human action:

"IT is the social product of subjective human action within specific structural and cultural contexts, and is simultaneously an objective set of rules and resources involved in mediating human action – hence contributing to the creating, recreation and transformation of these contexts" [21].

The dynamics involved in the process of IT-support of lean manufacturing is thus likely to involve not only the enabling aspects of IT but also the inhibiting aspects. IT can both enable and inhibit lean manufacturing, and in what follows we will look closely on how these dimensions can be played out in practice.

REEL PRODUCTION AT SCA PACKAGING OBBOLA AB

This chapter will give insight in the methodical considerations in this project, followed by a presentation of the Reel Administration System and the divisions affected by it.

SCA Packaging Obbola AB (Figure 1) produces liner, which in turn is used when producing corrugated board. At present Obbola has to reduce its labour force from 350 to 300 due to a declined market. The factory in Obbola produces 11 different liners, with individual quality specifications due to the constitution of the paper. During the process a specific liner is named "runbucket".

Figure 1: SCA Packaging Obbola AB.

This paper focuses on reel production which includes two divisions under the production department working in a continuous operations 6 shift, namely the winder and truck drivers. As the tambour has been made by the paper machine and leaves the pope, the reel production starts with the winder division cutting the reels (Figure 2). To accomplish their work they need a production plan. This plan is produced by the trim planner, and is called a trim plan. The trim planner is a bridge between the logistic and sales department on one hand, and the production department on the other.

Around this setting the rest of the factory, the shuttles that transport products to the terminal and the terminal itself, are factors that influence the reel production. The trim planner, the winder operators and the truck drivers are all dependent of the Reel Administration System, which is the system where all the trim planning takes place. The RAS follows the product from planned production, through the winder to rollout from the factory.

Methodical considerations

This paper project initially came to be due to complaints regarding a strenuous work situation for the truck drivers. To solve the situation this project – a joint project between SCA Packaging and a research group at the Department of Informatics, Umeå University – was initiated to frame the different factors influencing this part of the production, and to find innovation potential to increase the quality of the situation. The aim of this paper is to better understand the enabling and inhibiting impacts IT has on lean manufacturing. To accomplish this we will produce a rich picture of the production line and identify the important factors influencing the production and to identify possible bottlenecks.

Semi structured interviews works well when the respondents' freedom in answering is valued as important. This form also gives the researcher the opportunity to ask resulting questions [10]. The second author had previously worked in the liner industry and thus the setting was not unknown to us. To better grasp this specific part of the production ethnographical investigations at all divisions within the factory were undertaken. They lasted minimum 4 hours each and gave the possibility to follow the whole process. In addition, qualitative semi-structured interviews were conducted.

The interviews undertaken lasted 90 minutes each and followed a template in order to give all respondents the same chance of response. The interviewees were selected after a dialogue with the production and logistic department. Two of the respondents came from the logistic department, one of which was the trim planner. An operator from the winder, one manager from the terminal and finally four truck drivers were also interviewed. The truck driver situation was a group interview. A group interview is especially valuable as an initial exploratory technique [10]. The interviews of the respondents from the logistic department

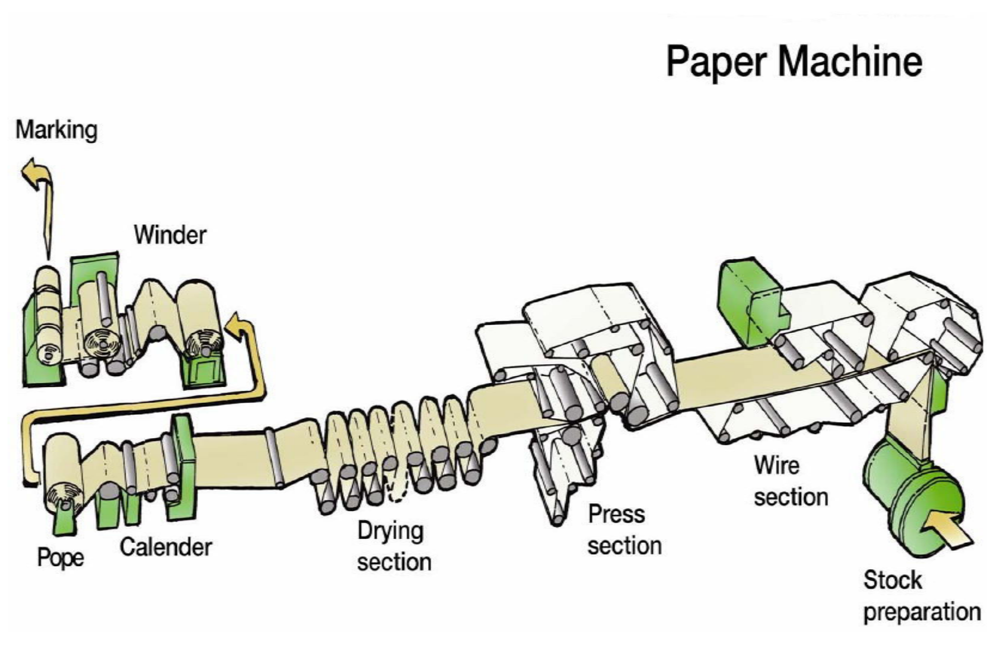

Figure 2: The layout of the paper machine and winder.

were undertaken at their office rooms and recorded. The winder and terminal interviews were conducted on the move, and not recorded. The group interview was recorded on audio tape and took place in a conference room adjacent of the working area. On all interviews notes were taken. The audio recordings have been partially transcribed.

Besides these interviews, lengthy discussions with employees throughout the factory have been undertaken with the aim to get a rich picture of the situation. This includes technical engineers, sales personal, operators from other divisions, employees of the logistic department, and representatives of the firms installing the information systems in the factory.

In the following chapters we provide the results from the case study. We begin with an introduction of the role of the Reel Administration System in the lean manufacturing processes at SCA, RAS. Then we go on to describe the production units, the winder and truck driver divisions. After that we present the logistics of the terminal to finally end with the trim planning.

Reel Administration System

The RAS (Figure 3) was constructed in the 1980's by software engineers from an external firm, Programator, as factory specific orders for the factories in Munksund and Obbola. The system was already from the start not equipped to perform all of the aspects of end line production, and as the years have gone by other systems have been added to take care of operations and communication. One of the respondents argue that.

"*The current RAS is an over aged, restricted, text based system*".

To incorporate trim plan, a module has been added that is considered a part of the system, but actually is a separate module communication with it. The other system it interacts with is from a variety of suppliers as Valmet, Siemens and ABB. At present the functions that goes under the general view of RAS is actually a collection of interaction between many small machines and systems. The development of the end line production the RAS system works against has evolved over the years, and today the system in itself does not support all the demands the production line has on product management and lacks the flexibility to adapt. A major drawback is that is does not fully support what-you-see-is-what-you-get, "WYSIWYG". Sometimes the paths are switched from plan to printout. This has the operators and the planner on their edge to take notice when it happens and prevent the printout to be produced. A printout is a very fixed media. Since the system is text based the printouts accordingly lack graphics and has more to give in order to be easy to grasp. The printouts do not provide WYSIWYG regarding the layout of the factory. For a beginner's eye this turns out a bit confusing. The RAS does give the ability to the winder operators to sort of which of the products should go to which ramp, but it does not have an internal algorithm to get the most beneficial layout for the truck drivers that are in the end of the RAS scope. This opportunity for the operators is something that some use, and some do not. The view of the system is different depending on where in the organization you are. As an operator, the navigational design is not user friendly. The system performs its objective tasks without malfunction but provides poor overview of content layout. A quote from one of the respondents describes this quality:

"*RAS is restricted software that cannot show everything, but only a part of the information that is*

Figure 3: A RAS working station by the Winder.

Figure 4: Reels leaving the winder.

important to my job".

The IT division finds the system very robust, and consequently it is a favourite, as it is a system with very few failures compared to the rest of the systems at the mill. As for the trim planner the usability is largely restricted and provides poor usability in navigational design, content layout and performing of objective tasks in an easy manner. The truck drivers don't interact with the system directly but through printouts. These follow the poor layout of the program and transfers bad content layout and navigational design. The drivers are used to the drawbacks, but still find that the environment could be improved.

Winder

The winder (Figure 4) follows the paper machine in the production line. At the moment this machine is a bit slower than the paper machine when producing products of narrow diameter. Not to slow the paper machine down, the usage of the winder has to be planned accordingly with changes between narrow and wider diameter. The winder operates according to a RAS printout that the trim planner hands to the operators. This printout shows a detailed plan over the current product that the paper machine is producing. As a tambour is delivered to the winder the operators transfer the info from the RAS to the Winder Operating System. This system adjusts the knives and operates the winder so to produce a combination of the products that are specified in the RAS plan. The winder operators have to manually prepare sockets for the specified combination in a cutting machine near by.

As the products rolls out of the winder a set is produced out of the combination. A combination can contain many sets. For each new combination the knives has to be adjusted. Sometimes it is specified in the production plan that the sockets should be plugged. Before the sockets are put into the winder the operators prepare them with plugs where it is possible, the rest of the plugs has to be fastened as the reels roll out on the winder-table. A damaged socket risks destroying the customer's machine, still the work with plugs and sockets are cumbersome and is unwanted. Few different combinations are preferably since no knife adjustment then is necessary. That contributes to faster production and less manual labour.

When some products are in urgent demand the trim planner can print a "P" for priority on the plan. The operators then know it is of the essence that this set is produced if they come into a situation where they have to prioritize between different sets to produce. As the trim plan strive to maximize the use of the tambour and at the same time produce all the products of the current runbucket, the trim planner sometimes has to let a part of the tambour be lost. If the loss is minor, it can be directed immediately to the recycling depot. A respondent said regarding directing paper waste to the cycle depot: "*That is the ideal solution, well it is not economically sound, but saves a lot of work*"

When the loss is bigger and cannot be directly recycled there are some restrictions to consider for the winder that also regards reels that are produced for sale. A reel may not be slimmer than 50 cm to avoid it from falling as it rolls out on the winder-table. The upper limit is 300 centimeters, which is the maximum width that the operators can split and return to the recycling depot. To spin the reels a chuck is pushed into the side reels. There are two sorts of chucks, long and short. The short is the normal and can handle width between sizes of 9,32 to 8,9 m. The long chuck can manage down to 8,5 m. To avoid a to slim recycle depot reel with the long chuck a trim plan between 8,8 and 8,9 is unwanted. As the reels have been cut, the operators have the possibility to manually reprogram the destination of the reels. A production leader said: "*They may steer them, but they are not required to do it*"

After mark-up the reels end up on the loading area table. The way the system works today the optimal situation for the winder operators would be as few different articles as possible. With such production it is easy to work as the sets roll out with few combinations. With few combinations that last for a long time of production, no waste reels and no need to change chuck the current production at the winder would be much easier. The operators have a hard time understanding why there have to be so many combinations and changes between them. They nurture a feeling of not being listened to by the management in some respects and that the logistic department lack understanding of the consequences of the planning on their work.

Truck

When the products have passed the mark-up phase and the scan has resulted in a choice of ramp, the reel is rolled onto the loading area table (Figure 5). The table is at a slight angle, making the reel roll to the other side, where the trucks (Figure 6) are operating. From the printout the truckers sort the products in the loading area. The loading area is just a temporary warehouse for the products until they can be loaded on the shuttles that on a regular basis travel between the factory and the port on the other side of the bay.

The truck has an aggregate that can take two products at the same time, given the conditions are satisfying. The products should be of as same size as possible. When the driver puts them down, and one is shorter, it will fall to the ground. A product often weighs several tons and thus even a small fall, can inflict serious damage. If the reels are damaged in the loading area they will have to be taped or returned the winder operators. The winder operators can then either chose to re-wind it if there is useful paper left or they can decide to return it to the recycle depot. Either way the reel has to be re-produced, or a new combination is created.

As the working condition for the loading area drivers with focus on time is tight, gripping only one product is a considerable waste of time. A single grip also often results in several more movements of the product since it has to be put to the side and moved again later on to fit into the loading of the shuttles. The loading area has fixed boundaries, which give the drivers just so much of space to work with, and each movement increase the risk of damaging the product. The way the loading area table is constructed the products are situated between airbrakes. The brakes prevent the reels to number more than two beside each other as the trucks picks them up. When the driver has to take a single product in the grip he cannot lift it from on top, without risking damage to the product that is behind. To resolve the problem the driver has to tilt the grip and with fine precision seize the product. A bad seize, risks damaging the product behind.

The risk of damage is much smaller when gripping two reels from above. As the truck drivers place the products according to the order they belong to, it is preferably if the orders come in a row. Gripping double and doing it in the same order minimize the number of movements. The drivers get the same printout as the winder operators. If a change in the production is made, this will not show on the printout. This makes it harder to grasp when an order is finished or not. Added to the work of the truck drivers their environment is challenging. They are driving a diesel truck indoors. There is a constant dusk in the warehouse (Figure 7), which makes it hard to see the product information.

Exhaust gases mix with the rubber of the tires and residues of the floor to a dust that settles everywhere. The warehouse is situated outside the factory and they have their own resting room in a barrack outside the warehouse. A general feeling among them is that single gripping is getting more and more common. They find that the production plan sometimes is irrelevant and that the trim plan make their work unnecessary troublesome. Combined with the environmental issues and the physical situation outside the factory a feeling has spread that the management lacks interest of their situation. A feeling of mopping up others bad work, as they are the last unit in the entire production line at the factory is common. One respondent argued:

"*No one listen to what we want!*" and another said: "*We cannot influence anything*".

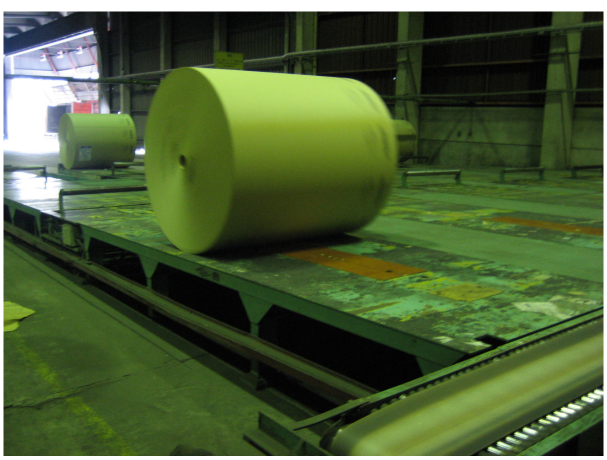

Figure 5: Loading area table.

Figure 6: Double seizing of reels.

Terminal

The factory in Obbola uses the port in Holmsund as terminal. All products that are produced are transferred via shuttle trucks to Holmsund where they are reloaded (Figure 8). At the terminal the work is very clearly oriented towards the logistic deadlines.

For transport trains and Ro-Ro vessels are selected. The Ro-Ro run under a tight schedule with the slot times at European ports as internal deadline. As these ports are very busy, a missed slot can result in several days of delay. To catch up a deadline, the vessels can fasten the pace. This possibility is limited though, and costs a lot of fuel. As the Ro-Ro ship enters the harbor all has to be prepared for fast on- an offloading. To make this easier the whole layout of the cargo to be loaded are digitally transferred to the ship 12 hours in advance and in other words, enabling the officers to plan the entire load before they have arrived. This means that all products have to be ready 12 hours in advance as well, which affects the plan of the production at the mill. All loading in the harbor have to follow the law of an international security protocol, ISPS. This protocol gives officers the possibility to reject a load if the criterions not are accurate. To complicate things further ports like the one in Rotterdam demands the slot time to be booked 2 weeks in advance, and the ports in UK have the tide which restricts time at port. To accomplish these plans the terminal sometimes has to plan the load of a vessel two weeks ahead of its arrival at Holmsund. The exact production plan of the factory is planned five days ahead and put the terminal into a jam.

To perform as good a planning as possible the trim planner mails the production plan of the entire runbucket and the more finely adjusted trim plan to his counterpart at the terminal. This is the same printout that the rest of the divisions get and as for the others it represents the production of a whole series of products. When loading a ship, a loading cassette is used. Each cassette is bound for a specific terminal, and has a fixed limit of products. The ideal situation for terminal work would be that production plan from the factory was 100% correct and was not deviated from, with a steady stream of shuttles that didn't cluster up in the loading area. Direct loading is good, when it works. If the products or orders are mixed direct loading is rejected. With the limitations given the terminal has a situation that does not have a simple solution. With the present system they can get a plan very long time ahead and be able to plan the vessels. On the other hand it is also important to get at correct plan that they don't have to rework, and this plan often has to be very fresh.

Trim plan

When the paper reaches the winder the end line starts. The trim planner makes a finely adjusted plan to make all the ordered products out of the specific runbucket produced. The orders are made at the sales offices, where the sales personal feed the database with orders. This process is made twice a week, on Mondays and Thursdays, and regards the production 5 days ahead. In a wider perspective the sales office can expect the product to be delivered in 2-3 weeks. The day after, Tuesdays and Fridays, the logistic division freeze the database and start with fine planning of the production, the trim plan. After this freeze it is forbidden for the sales department to add supplementary orders, which happen anyway. This results in new planning, and a new printout to be distributed in the organization. The trim planner

Figure 7: Dusk inside the warehouse.

Figure 8: Loading of a Ro-Ro ship at the terminal in Holmsund.

argues that “*Since I get jammed in between the sales offices and the production it is important to be very strict with the rules, but sometimes the circumstances grants the customers wish*”

The freeze, commonly named SORR (Sales Office Replenishment Requirements), initiates the work in the RAS. In the position of trim planner it becomes important to merge all considerations into the best possible solution. In an ideal situation the trim plan would produce the best possible for all the divisions affected, in general the result is a compromise. In the perspective of actual planning the system provides a situation with a lot of manual labour and an algorithm that provides minimized loss. There is no other algorithm providing other values as part of the solution. In the position of trim planner it accordingly becomes very important to have a deep know how of the factors influencing all the other departments and divisions described above to present a suggestion that satisfies their needs as well.

In view of the trim planner an excellent plan incorporate these considerations and still keep the loss at a minimum. The Vice head of logistics argues that: “*A good plan makes use of 99% of the total width*”. This would amount to a yearly loss of 500 000 Swedish Crowns (approximately 45 000 USD). The other estimates of cost regarding production and planning will have to be compared to this figure. With other factors, such as high production pace, this goal is hard to achieve. Sometimes a loss will have to be accepted by the trim planner to get the products out of the factory. In helping the Trim Planner there is a range of supporting information systems that provides information. With the current production the orders are of two sorts. Either forecast orders of a terminal or a direct order from a customer. The forecast production is turning into an increased amount of Vendor Managed Inventory, VMI. The SCA sales department handles their customer’s warehouse and make sure they always have enough liner in store. This is a way to increase satisfaction of the customers, and is “pull”-oriented as the direct order also is. An indication of the need to be close to the wishes of the customer is the argument of one respondent, “*Saying no to a customer is bad business*”.

The direct orders are often small, and urgent. To make sure that these orders are produced the trim planner produces them early in the plan, to be able to reproduce if it should be destroyed during the process. The complexity of the products increases the difficulty to make a great plan. Of each runbucket, two qualities are produced named 402 and 408. They might also in turn be divided between three different diameters: 119, 125 and 145 cm. finally the breadth of the reel decide its final unique composition. All in all the diversity of the products create a challenge of reducing waste in terms of trim loss. When the trim planner is satisfied with the trimming the plan is distributed within the factory and to the terminal.

The logistic division has some trouble with making the operators of the production understand why they make the decisions they do. The importance of customer orientation seems to stop by the corridor to the mill. Sometimes they wonder if the production department finds the process more important than the customer. This feeling is increased by constantly working to make things as easy as possible for the other departments and personal around them, without receiving any appreciation in return. That contributes to a sense of lacked respect for the work contributed.

INNOVATION POTENTIAL

With a perfect process producing perfect products high quality is achieved. In defining this essence of high quality it is essential to know what it is, and that all share the same view of this vision. In this chapter we show that this may not be the case.

The divisions

The main focus for the operators in the production department is that the production is smooth. Less labour on the winder by means of socket and plug work. Preferably no change of chuck and if possible should all the trim waste go directly into the recycle depot. To reach this end, few combinations were wanted which would also decrease the adjustments of the cutting knives. The main issue is quality of process, in other words increasing the manufacturability. The winder operators regard high quality as work that is less cumbersome and with minor adjustments needed.

The truck driver’s situation is in comparison much like the winder operators. They share the common goal in a quality of process. The workload consisting of a lot of movements due to the need of single gripping is one main issue of irritation. The other is the seemingly constant switching between ramps, as orders belonging together are delivered on different destinations. The latter also contributes to irritation. High quality in view of the truck drivers would mean even orders that came on the same ramp, enabling double gripping and easy grasping of plan layout.

Both the winder and truck division find that management and logistics lack understanding of their situation in their professional position. The truck drivers find that this lack of understanding, added with their work environment, speaks in a clear language that they are not respected as a part of the factory and that their view is not important. High quality in this case would be better environment, respect and self-esteem.

An ideal production flow would be of standard products. This would implicate fewer unique breadths on the reels, fewer adjustments, as it would be a less amount of combinations. If there also could be a standardization of diameter the amount of combinations would decrease even further.

Trim planning takes place in the office of the logistic department. The main issue is to keep the customers happy. The logistic department is in a jam, between the customers and the production unit. In the situation of trim planning both sides have to be considered in a plan that hopefully satisfies both sides. The issue of quality is complicated in the logistic division. As the other divisions demand compliance from the trim, the essence of quality is more diverse. Quality is understood as giving the customer what they want, when they want it. With all the information the trim planner is sitting with, quality is a broad concept and also incorporates satisfying cost reduction and lean manufacturing. High quality thus is giving the customer what they want, when they want it, at a low cost and finally as smoothly as possible for all involved. Quality of the product satisfies the customer and quality of process satisfies the production. Quality of compliance is important in respect of the deadlines of the terminal.

The logistic department's ideal situation, without regards of the production, would be as little loss of paper as possible combined with keeping deadlines. This would implicate a lot of production combinations in order to maximize the breadth of the combined reels. By putting deadlines first and manufacturability second an increase in combinations is inevitable. This would also make trimming easier since the current RAS is able to perform such an algorithm. The terminal wants a production that follows the production plan and is delivered accordingly. High quality is when products of the same order are kept together and that the products arrive in a steady pace when the terminal needs them. High quality would also consist of having access to the correct plan, as soon as possible. The terminal focuses on quality of process, and of compliance with the logistic deadlines clear in mind. This ideal situation matches the logistic department as to the importance of keeping deadlines, the terminal is not very fond of orders that are split though as a consequence of maximizing trim breadth.

As for a more holistic view on quality it seems as if there is no common ground on which to stand. With the current view of the ideal production, the divisions runs a risk of sub optimizing production and in that create the opposite of quality of both parties. High quality of process is on collision course with high quality as defined by the customer.

The Reel Administration System

The RAS imposes its restrictions on all the divisions and positions. The duality of its creation has inflicted its structure and the evolution has taken its turn on the usability of the system. It is thus currently inhibiting, rather than enabling, lean manufacturing [18]. The trim planner has to deal with this structure, which significantly reduces quality of process regarding trimming. Important considerations regarding the quality of process that affect the operators of the production has to be taken care of manually by the trim planner, such as planning by depth to keep orders on the same ramp, paring reels two by two specifying which reel is of which sort regarding 402 and 408 and making sure that the restrictions of the winder is respected. The text based user interface increase trouble working with the software compared to modern graphical user interfaces, GUIs. The lack of adaptability makes the RAS affecting the quality of process negatively.

The lack of graphical representation of the products produced in the RAS make it significantly more troublesome viewing the final result of the plan. This restricts the quality of process in regard of easy navigation. This is most evident for the truck drivers who due to bad work environment have a hard time seeing the product information on the reels in the warehouse, out through the window of their truck. As the current system lacks WYSIWYG, its shortcomings become apparent when production has to be rescheduled. The printout restricts this as the drivers will have to browse through the papers in order to find the correct order. As with reels on different ramps but on the same order, it causes irritation and difficulties to grasp the logic. All sums, the plan in its current state reduces quality of process. In this view the divisions agree and all look forward to an upgrade.

The opposite system situation would be a system that in real time graphically represents WYSIWYG for the specific employee, in their position. This would demand a system with a multitude of interaction and integration, which is complex but rewarding. In a system intensive environment like a process factory, this is a challenge. To take the drivers situation towards the ideal, a solution that inflicted mainly double gripping and kept orders together would further enhance their situation. This can be done by modern software sorting algorithms accompanied by the technology to carry out the orders.

Organizational challenges and information technology

Investing time and capital in information systems is risky business. If the system turns out not to reflect the organization the cost can be far more than expected as stated earlier. The current RAS obviously is restricting quality. With lack of reflection of the needs of the organization the system is covering it becomes costly. The focus through this paper has mainly been on the systems restrictions of the quality of process. The result of this process is though the risk of damaged products and production of waste. The situation by the truck drivers results in increased movement of the products, each movement increasing the risk of damaging the reel. Single gripping reels work by the same logic. Quality of process and quality of product hence is closely related. The RAS consequently inflict decreased quality of the product as well.

To reap the benefits of information systems it is important to be aware of the organizational setting that the system is reflecting. As costly as a system is when not reflecting its organization, as beneficial it can become when matching it. The value has to be seen with regards to the improved output of the organization. The two complement each other and with this view the information system is not just simply a tool for automating the existing processes as it is doing now, but more importantly an enabler of organizational changes that can lead to productivity gains. In this view it is important that management reflects the organizations needs and an organization that use this knowledge when investing in new technology. To increase the reward of organization restructuring, as with teamwork, it is essential with a product management system that can adapt and enable this restructure. And vice versa to reap the benefits of investing in a new system, organizational change is a key issue to gain increased productivity.

As the drive towards increased quality push technological evolution through out the factory to increase productivity the issue of high quality has to be thoroughly examined. “Six Sigma” is an initiative with many pragmatic approaches to reduce variation but also clearly states the importance of a common quality goal. At present Six Sigma at SCA is limited and only used in relation to technical innovation of production processes. As the factory has to reduce its workforce, the management will have to take steps to gradually maintain and increase productivity with fewer employees. In this situation, as sales and logistic department relate their work towards alignment with the needs of the customer, a clear connection can be made with one of the pillars of lean production, “Pull”. By the meaning of “pull”, the production is created to satisfy the customer and the order is produced first when need of it is registered. The “Just-in-time” concept is the ideal situation within logistics department in a situation alongside pull and could maybe be applicable on the production as well. The foundation of the lean production that we find most closely related in view of this paper though is “teamwork”.

With the current Six Sigma approach alongside with teamwork a “Lean Sigma” could be adopted that the factory could benefit from. There has already been a start in the factory by increasing the job training on some of the operator’s positions. By increasing job rotation, job training and decentralize decision-making the teams would make up a resourceful organizational unit. Within a team it is necessary to take the perspective of your workmate and make it your own to understand problems at hand, and solve them. As the employees in this study find that the other departments, divisions and in some points positions lack respect of their work, teamwork would be a solution in helping the organization take care of the innovation potential within the divisions and put them together. The gap in the perspective taking of the employees could instead be a creative perspective making of the group [5].

To make this teamwork work, it would be necessary to incorporate all of the employees that are covered of the RAS. A beginning would be representatives of each fraction solving issues together. Job rotation within the team would speed up the learning process. As the terminal now is a full member of the SCA Group, and vital part of the logistics they should also be included. We also find that the team should be a vital part in deciding what improvement opportunities are preferably. The last would increase the possibility of improvement beneficial of the entire organization, and minimize the risk of sub-optimization. Lean production was the origin of Six Sigma and we believe that many of the concepts found in the five pillars could improve the improvement situation.

CONCLUDING REMARKS

The aim of this paper is to better understand the enabling and inhibiting impacts IT has on lean manufacturing. To accomplish this we have produced a rich picture of the production line at SCA Packaging Obbola AB and identified the important factors influencing the production and to identify possible bottlenecks. In particular, we have explored the impacts of a product management system on the manufacturing process. This research constitutes one of the first studies to provide empirical evidence on the role of IT in enabling and inhibiting lean manufacturing. It makes two contributions that are distinct from previous research. First, while existing research examine the effect of IT on manufacturing performance [1, 19] this research examined the inhibiting effects of IT on manufacturing processes. The study showed how the current RAS is more of an inhibitor than an enabler of lean production. Second, unlike previous studies that examines the role of IT in lean manufacturing our research brings a sharper focus at the plant level and the ways in which the views among the different divisions are in conflict with each other. To make the best possible reel manufacturing solution come true the first thing to consider is the meaning of high quality. It is important that all the divisions share the same view, and are aware of the restrictions of each others situations. This involves both the quality of process and of product. Without such a common ground the risk of sub optimization is higher in regards of what improvement strategies are to be applied.

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