

Change processes towards lean production

The role of the management accounting system

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Introduction

This is a study of a major change process – the adoption of lean production. Lean production is a complex managerial concept, which spans the entire company, from product development to strategies[1]. We can thus expect such a radical change to be fraught with difficulties, since major organizational changes are difficult to realize[2]. One area where such difficulties are likely to arise is the management accounting system, since the present management accounting systems were designed for environments dissimilar to those which face today's companies[3].

The basic model underlying the traditional system assumes that the production setting is given and existing in a stable environment[4]. In contrast, lean production does not assume the production environment as given, in which “optimal” decisions should be taken. Instead, the aim is to change the conditions of the production system. Thus, the adoption of lean production requires changes in the management accounting system. The need for making these changes has been known at least since the early 1980s[4,5]. However, the nature of these changes is not obvious and is the subject of a continuing debate among management accounting scholars[6,7].

While the debate on the nature of an appropriate management accounting system under a lean production strategy continues, many live with systems that are inappropriately designed to support the progress currently taking place within manufacturing. If we consider that an important role of the management accounting system is to act as a communication vehicle between production and other functions, a well-designed system should support the adoption of a new production strategy[8]. Consequently, an inappropriately designed management accounting system is likely to have a negative effect on the process of adopting a complex production strategy such as lean production.

Although much work has been done on possible solutions to the problem of obsolete management accounting systems, not much work exists on how these systems interact with and effect an attempt to implement lean production[8]. The research presented here was designed to study the process of adopting a complex production strategy. As an example of such a strategy, we have chosen lean production; however, our conclusions apply to other similar concepts.

The purpose of this article is to explore the role of the management accounting system in the adoption process. That is, the focus is on the changes taking place in the production system and the role of the management accounting system in these changes and *not* the management accounting system itself. Our research is exploratory in nature. We create hypotheses for further investigation as well as systematic experience for practitioners to learn from.

Methodology

Conducting exploratory research is facilitated by a longitudinal research approach with sustained participation in the organization[9]. Given our interest in studying an ongoing change process, we find the clinical methodology useful. The clinical methodology is characterized by the active participation of the researchers in formulating and observing organizational change[10]. The psychological contract that arises between the researchers and the organization gives the former access to data that is not usually available[11]. Through their high degree of penetration and involvement in the organization, researchers are able to gain access to a richness of data which is denied to other approaches. The sustained interaction with the organization also provides better opportunities for observing many aspects of the situation and for tracing through the connections between phenomena[9]. This offers a unique possibility for conducting exploratory research.

The study has been performed in Office Machines, an international manufacturing firm producing mechanical and electronic office equipment, mostly for export. Practically all the manufacturing activities are based in an industrialized European country, Sweden. We spent two to three days per week in the company, over a period of two-and-a-half years. Our role in the change process was to introduce academic knowledge and theories about production organization into the company, mainly in the form of seminars but also through daily interaction.

Three different methods were used during the empirical study: direct observation, interviews and content analysis of documents, to study a single phenomenon but overcome the weaknesses of a single-method design[12]. Interviews provide depth, subtlety, and personal feeling. Documents provide facts, but are subject to the dangers of selective survival. Direct observation gives access to group processes, and can reveal the discrepancies between what is said and what is actually done[13]. In addition to multiple methods, we have striven for the use of multiple data sources and multiple levels of analysis[14].

However, before beginning the case description, we would like to elaborate on the theoretical framework of this article.

Lean production

Since our interest in this article is on the role of the management accounting system in the process of adopting lean production, it is first necessary to discuss the meaning of the term "management accounting system". As conceived of here, the management accounting system consists of all the information that is officially gathered to assess the performance of the company and to guide future actions. Thus, the term encompasses more than just the accounting system required for legal reasons; the management accounting system also includes what is often termed "cost accounting" or "cost measurement systems" as well as performance measurement. Furthermore, the management accounting system is not confined to monetary measures. It also includes non-financial measures, like quality and throughput times.

Lean production we see as consisting of five different parts: lean product development, procurement, manufacturing and distribution, as well as the lean enterprise[1]. As agreed on by the company and the researchers, the company in this study is currently implementing lean production according to this definition. However, henceforth we equate lean production with the activities that take place within the manufacturing function of a company, since it is there that the effects of the management accounting system are likely to be most discernible. Lean manufacturing consists of the following principles, which are elaborated below (see also [15] for a richer description):

- Elimination of waste.
- Continuous improvement.
- Zero defects/JIT.
- Pull instead of push.
- Multifunctional teams.
- Decentralized responsibilities/integrated functions.
- Horizontal and vertical information systems.

A major purpose of lean production is to use less resources as compared with "traditional" production systems[1]. A basic principle in achieving this is through the *elimination of waste* – everything that does not add value to the product, for example inventory, transportation and unnecessary movements[16]. The reduction of waste takes place constantly. The production system is being *improved continuously*; perfection is the only goal[17].

Although quality is in itself an important performance variable in lean production, it is also a prerequisite to attain high productivity[16]. *Zero defects* denotes how a lean company works with attaining quality, for instance through making quality assurance the responsibility of everyone, not only the quality control department. Closely associated is the principle of *just-in-time*, since

fault-free parts are a prerequisite to achieve *just-in-time* deliveries. This implies that each process should be provided with the right part, in the right quantity (ultimately one part at a time), at exactly the right point in time[18].

Material is scheduled through *pull instead of push*. In a push system, a master schedule and more detailed production schedules control the production of the forecasted number of parts, whether they are needed or not. In this sense, material and parts are “pushed” through the factory. The pull principle stands in stark contrast to this way of scheduling material. With pull, the starting point is a customer order, which goes to final assembly who orders parts from the preceding process. This process, in turn, orders parts from its preceding process, and so on. This means that nothing that has not been ordered is produced.

The most salient feature of the work organization is the extensive use of *multifunctional teams*; a group of employees which is able to perform many different tasks. These teams are often organized around a cell-based part of the product flow. Each team is given the responsibility to perform all the tasks in this part of the product flow. Furthermore, *responsibilities are decentralized* to the multifunctional team which is expected to perform supervisory tasks through rotating team leadership among employees especially trained for the task.

A second principle concerning the multifunctional team is the *integration of different functions* into the team's responsibility. Tasks previously performed by indirect functions, such as procurement, materials handling, planning and control, maintenance, and quality control, are integrated into the team's tasks. Finally, *vertical and horizontal information systems* are used, since information is important for the multifunctional teams to perform according to the company's goals. Therefore, elaborate systems are necessary to provide timely information continuously, directly in the production flow.

A crucial starting point for this article is that the process of adopting the above-mentioned principles is likely to be affected by the management accounting system (as previously defined). The role of the management accounting system in the process of adopting lean production has been studied in an empirical case, to which we now turn.

Lean manufacturing at office machines

The company in the study has two manufacturing facilities which were functionally organized; parts manufacturing was physically separate from assembly activities, which were organized along lines. The cost accounting system was designed to value inventory. The fixed costs were allocated to cost centres in relation to their use of fixed resources. From there, manufacturing costs were allocated to the different products on the basis of direct labour costs. The measurement of manufacturing performance was mainly made through the productivity measure. Productivity was measured by the company as the number of hours spent on operations as compared with the standard number of hours.

In November 1991 the company began the adoption of a new manufacturing strategy: lean manufacturing (as described above). Some of the major changes that were to take place included:

- Installation of flow-lines around families of similar products, containing both equipment and activities for parts-manufacturing as well as for assembly.
- Physical relocation of manufacturing tasks and equipment between the company's two facilities.
- Inauguration of multifunctional teams responsible for the production of the complete products. Tasks previously performed by indirect personnel were to be integrated into the multifunctional teams' responsibility, for example production planning, materials control and handling, purchasing, maintenance, as well as quality control.
- Supervisory tasks were to be shared among team leaders, a role that would circulate among employees in the teams.

However, no changes to the management accounting system were planned. Figure 1 pictures the organizational structure under the new manufacturing strategy.

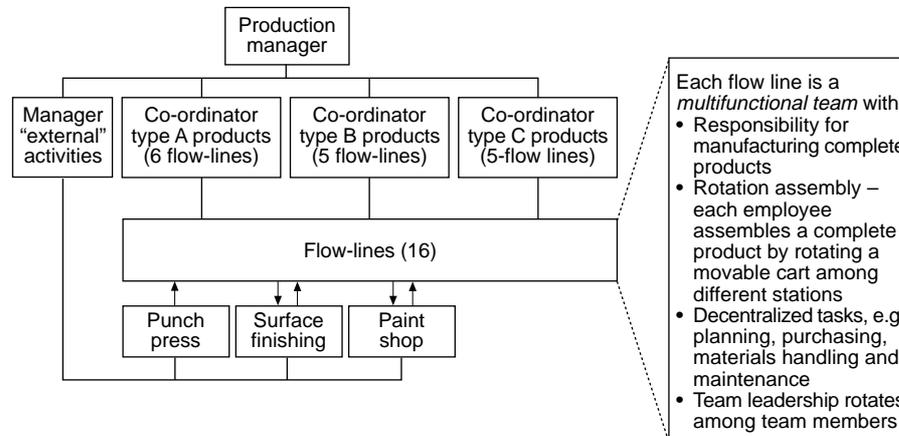


Figure 1.
The vision of the organization under the lean manufacturing strategy

The first year of the project, 1992, was filled with preparatory work, such as analysis, information and training. April 1993 marked the beginning of the physical changes. These changes concerned three main areas:

- (1) *Relocation of manufacturing activities.* To prepare for the creation of flow-lines for all products, it was necessary to move different kinds of parts manufacturing and assembly activities from one facility to another.

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- (2) *Rotation assembly.* As an intermediate step towards flow-lines, the assembly of some products was reorganized into rotation assembly. Instead of line assembly each employee assembles a complete product, using a movable cart that is rotated among the different assembly stations.
- (3) *Flow-lines.* Finally, three flow-lines were created as a pilot project.

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Observations from the adoption process

This section contains a selection of observations on the management accounting system's role in the adoption process. The way the description is made is important. Consistent with our methodology and to utilize the in-depth nature of our data, we have chosen to use a narrative format to indicate some interesting findings that later on will be expanded into conclusions of more general interest. The observations are presented in the order in which they were made.

The inadequacy of the management accounting system

The changes in the organization that took place in April 1993 had profound effects on many areas. The issue that received the most attention initially was the drop in productivity. Since productivity was measured by the company as the number of hours spent on operations as compared with the standard number of hours, it now took longer to perform the same tasks than it did before the changes were implemented. In the analysis made by company management, this drop in productivity was attributed to several factors. One was the inclusion of indirect tasks onto the team. However, no adjustment was made for this in the productivity measure.

As mentioned above, the management accounting system was traditionally designed. Quite soon it became clear that the system needed to be changed in a number of ways. However, the nature of these changes was not immediately clear; making changes was also a difficult task. In the early phases of the project, immediately after the pilot projects were launched, managers in the administrative function of the company expressed the view that "no changes could be made in the manufacturing organization that could not be incorporated into the existing information system". Thus, they gave priority to the computer system.

However, adjustments to the management accounting system became increasingly essential. The first adjustment was made to the productivity measure a few months after the physical change. A percentage to account for the indirect tasks now included in the team was added to the standard number of hours. The motivation for adjusting the old measure was twofold. One reason was to increase the accuracy of reflecting the tasks performed by the team. The other reason was that the productivity measurement was important to many in the organization because it was traditionally used as *the* performance measure.

Both managers at different levels and workers were accustomed to this measure.

The argument of losing control

Approximately at the same time as the adjustments to the management accounting system were begun, the managers in the administrative function expressed the opinion that they were "losing control over what was happening in the organization", often saying that there was a risk of "ending up in quicksand". A proposed change in the cost accounting system was also resisted.

From the manufacturing function, there was a suggestion to simplify the reporting from the flow-lines. They no longer felt that there was a need to report the time it took to complete different tasks within the flow-lines. Since the lead times from when the material entered the group until it came out in the form of completed products had been lowered drastically, there was no need to keep track of details. This suggestion initially met with resistance from the administrative function. They still saw a need to keep track of the individual tasks performed by the employees. Thus, there was a perceived need for having the employees making reports in the management accounting system every time they changed to another task, which could be several times a day. However, after a few months this view was reversed and the simplifying changes were begun.

Performance evaluation shifts to multiple factors

According to the lean manufacturing project's original plan, flow-lines were to be created from the beginning of 1994, but the company's board members postponed the decision to continue, since they were unsure of the value of the changes. A highly contributing factor was the decrease in productivity that occurred. Subsequently, however, productivity started to rise slowly. There was also a shift in attention in the evaluation of the flow-lines, since other performance measures besides productivity were being incorporated into that evaluation, for instance work in progress, quality and time-accuracy, which all indicated positive outcomes of the change.

With both productivity and other performance measures showing that the changes thus far were beginning to pay off, the situation stabilized. In May 1994 the board decided to plan for the installation of flow-lines in the whole manufacturing operation. This led the managing director to inform all employees personally about the progress so far and the plans for the future. At these meetings, all performance measures were given the same attention.

The beliefs of important managers start to change

Around the summer of 1994 the managing director had problems interpreting the information he obtained from the management accounting system: "I see that our total production costs are lower than before, and our operating margins are higher. We also keep our delivery times and our products have a higher

quality than before. Still our productivity is lower than before the changes”. Change processes towards lean production

This led him to wonder whether the system measured the appropriate things. This worry became pronounced in the autumn, when the management accounting system showed that the production department had consumed 32,000 hours more compared to the budget. This report was sent to the board by the administrative department, which caused turbulence in the lean manufacturing project. The overrun was attributed the drop in productivity that had followed the lean manufacturing project.

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The analysis that was made in conjunction with this pointed to variations in the product mix and work with new products not included in the budget as likely reasons for the number of hours spent exceeding those of the budget. However, most bewildering for the managing director was that the actual total manufacturing costs were lower than the budget costs. This made him really worried about what exactly the managing accounting system was measuring. This worry was highlighted one month later, when the figures looked better than ever before.

These difficulties in interpreting the data from the management accounting system led the managing director to question seriously the design of the productivity measure. There had been indications that this measurement had a number of shortcomings. An important one being its susceptibility to faulty time standards. If actual time is compared with faulty standards, the productivity measurement can be deceptive.

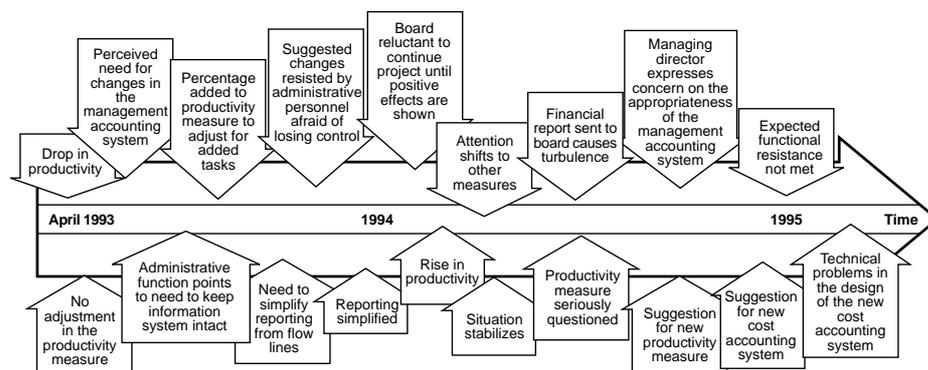
A number of instances with faulty standards had been found. For this reason, there were suggestions to use the number of products manufactured in each flow-line and compare it to the total number of hours spent in the flow-line. However, the implementation of these changes was met with resistance from several persons, both in the administrative function and in the production function.

Changes in the management accounting system start

The managing director also proposed the design of a new cost accounting system in November 1994. In this system there would be no difference between direct and indirect costs in the flow-lines. What exactly the workers spent their time doing was felt to be of less importance than them reaching their goals. All costs that were allocated to the flow-lines were to be split up evenly between the number of products manufactured. This would be possible since the installation of flow-lines made it easier to trace costs, and also because each flow-line would produce family-like products. This suggestion was not met with resistance from the administrative function, as had been anticipated. Instead, discussions began on how this system should be built up and how it could be implemented. These discussions took place among representatives from the administrative function and the production function. However, the changes were more difficult than initially thought, due to problems of a technical nature. The management accounting system did not collect enough information needed for the change to be made. To make these changes would take quite some time.

Figure 2 summarizes the observations that were made during the process described previously. The focus is on the role of the management accounting system in the adoption process. Abbreviated statements are placed at the approximate point in time when they were typically made. The reader should, however, bear in mind that these statements often represent observations made over a period of time. Figure 2 will be used later in our analysis section.

Figure 2. Summary of observations on the role of the management accounting system in the adoption process



The management accounting system's role in the adoption process

The first and perhaps most obvious thing that surfaces in the analysis of the adoption process is that the management accounting system has had a profound effect in the adoption process. This will be elaborated on below. Our analysis of the adoption process is divided into three sections, where each section is based on a group of factors that have evolved from our observations.

The impetus for changing the management accounting system

Taken as a whole, the management accounting system has been a major impediment to the desired changes in the manufacturing strategy. Perhaps the most important and obvious instance of this is when the productivity measure indicated increased costs for the new way of working in manufacturing, causing the appropriateness of the lean manufacturing strategy to be questioned. The way productivity was measured was not questioned, at least not initially. It was not until the productivity measure had reached a "comfortable" level that other measures were incorporated into the evaluation of the operations. When in turn other measures, such as work in progress, quality, and time accuracy, showed positive signs, the way performance was measured became seriously questioned.

Thus, the process was such that the physical and organizational changes had to produce effects that reached a certain threshold before changes in the management accounting system were conceivable. This threshold mainly concerned productivity, since traditionally it was *the* performance measure in

the company. The old measures were not discarded immediately after the physical and organizational changes. This can be interpreted as a need to maintain some stability in the face of drastically changed ways of working. The desire to compare performance over time also affected the decision to maintain the performance measurement system. Since uncertainty existed about whether the proposed changes would be beneficial, it was perceived as important to have the possibility of making comparisons with historical performance. The argument was that if the implemented changes did not produce the desired results, the decision could still be reversed.

Both these observations point to the inertia inherent in the management accounting system as having impeded the adoption process. However, one must also take into account that the role of the management accounting system to a large extent is to compare the present with the past. Thus, the system should not be changed too easily. Some stability must be maintained.

In the literature there are assertions that management accounting systems can be driving forces in the type of changes referred to here[7]. However, their design then needs to be congruent with the chosen production strategy. This was not the case in the process studied. Instead, uncertainty of the appropriateness of a new strategy resulted in the use of the old performance measurements under the new strategy. To change the performance measurement as well as the organization required a certain threshold in the old performance measurements being reached. When that threshold is reached, and changes in the management accounting system takes place, it is possible to imagine how the system can drive the changes. By measuring in a new way, the manufacturing strategy and the management accounting system can become increasingly congruent. This can be likened to a self-reinforcing loop: better results point to the appropriateness of the changes, which further leads to changes in the management accounting system, which now is able to detect more positive results and so on. Figure 3 depicts the relationship.

The importance of raising the level of the unit of analysis

When the threshold was reached at the company in this study and the management accounting system was changed towards an increased congruence with lean manufacturing, there is one common denominator in the changes that took place – the level of the unit of analysis was raised. This is consistent with the aims of lean manufacturing. Achieving high load factors in terms of utilization of single machines and employees is no longer relevant. The output of the total system is important and the focus lies on the production of fault-free products in the right number at the right time.

The first instance where the level of the unit of analysis was raised concerns performance measurement. Although the traditional productivity measure was still kept, it was modified to incorporate an estimated percentage to account for indirect tasks now performed by the operators. This was one step towards raising the level of the unit of analysis, since the productivity measure included a larger part of the total production system. The suggestion was to raise the

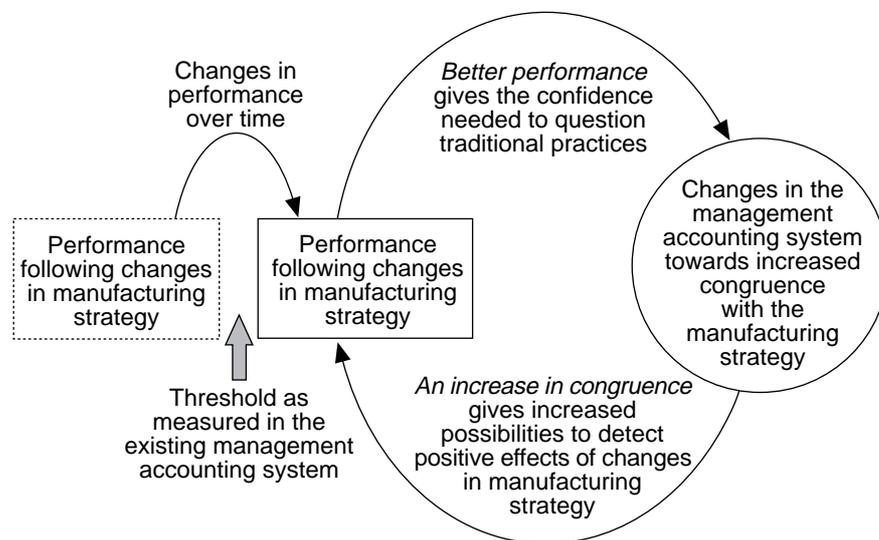


Figure 3.
The impetus for changing the management accounting system

level of the unit of analysis further, by comparing the number of products manufactured to time used. What is more important, other measures than productivity were incorporated into the evaluation of manufacturing performance. Traditionally, the company relied predominantly on productivity. Over time, more attention was given to quality, time accuracy and work in progress.

The second illustration of how the level of the unit of analysis has been raised concerns the cost accounting system. When the flow-lines were created, it became less interesting to record in detail what was made to the product within the flow-line. Hence, the cost accounting system could be modified, which came after initial resistance. The operations included in the flow-lines were no longer separated, but treated as a whole. The next step that was proposed was to take all costs that are allocated to the flow-line, and split them evenly between the number of products manufactured.

Taken together, these two instances show that raising the level of the unit of analysis in a management accounting system for lean production is done along two dimensions, as shown in Figure 4. The figure illustrates some important principles of lean production, as discussed above. The triangle symbolizes the organization. The core is the multifunctional team, which is made responsible for the production of a complete product from raw materials. The necessary machines are grouped according to the production flow and the indirect tasks are included in the team's responsibility. These teams are provided with strategic information, in order to be able to perform well.

The first dimension in raising the level of the unit of analysis is the horizontal, indicated by the arrow beneath the triangle. There is a need to shift the focus from single machines and/or operators to the whole production flow.

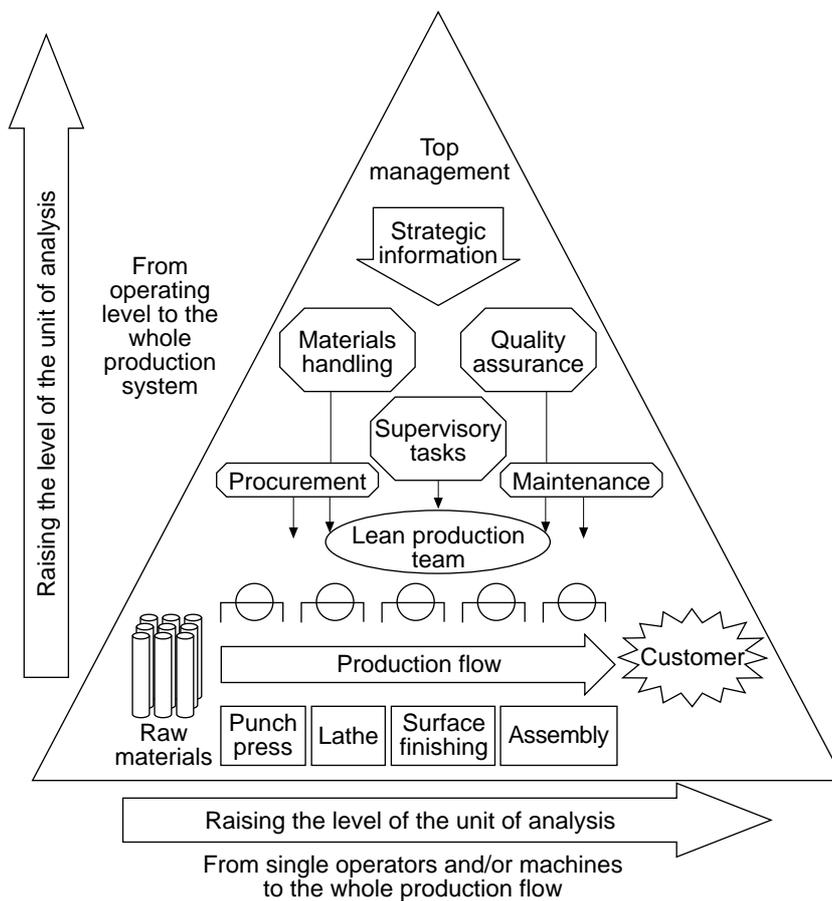


Figure 4.
Raising the level of the
unit of analysis in a
management accounting
system for lean
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The focus should be on the performance of the multifunctional team, not individual operators. Second, there is a vertical dimension, indicated by the arrow to the left of the triangle. There is a need to shift the focus from the operating level to the whole production system, including the higher levels. This is necessary since tasks previously performed by and responsibilities belonging to indirect personnel are integrated into the multifunctional teams.

The management accounting system influences the adoption process in three ways

Our analysis of the adoption process indicates that the management accounting system has influenced the adoption of lean manufacturing in three concurrent ways: technically, formally and cognitively. These three ways can be seen as co-existing and interdependent perspectives on an organization.

Technical influence. The technical perspective refers to the management accounting system as such, that is its design. As has been described above,

traditional management accounting systems are ill-equipped to be able to function appropriately in a lean production environment. In this case the turbulence caused by the mixed signals that the managing director received from the system around the summer of 1994 represents an instance where the design affected the process. A more recent observation is when the suggested changes in cost accounting principles were stalled because of the management accounting system's inability to record the desired data.

Formal influence. The formal perspective represents the formal role and purpose the management accounting system has in the organization. The formal influence may sometimes be difficult to separate from the technical. A common theme in the present case is that the administrative function, which includes both the accounting department and the computer department, has had a "controlling" role. For instance, they saw a trade-off between keeping control of the operations and the changes taking place following the lean manufacturing strategy. In this trade-off they gave the highest priority to control.

As mentioned above, inertia is by definition built into the management accounting system, since one of its tasks is to assess the performance of the company, much of which is done by comparing the present with the past. However, it is also possible to imagine how the management accounting system can contribute to driving changes in manufacturing. One important feature of the Japanese view on management accounting is that it should play more of an "influencing" role than an "informing" role and be subservient to corporate strategy, not independent of it [19].

Cognitive influence. The cognitive perspective, finally, concerns the way the management accounting system is used and how different actors in the organization think about issues related to management accounting. The cognitive influence is perhaps the most fundamental, since it is highly interrelated with the technical and the formal influence [20]. A further example here is when key actors' views on the management accounting system changed in the direction appropriate for lean manufacturing. An important example is the concern expressed by the managing director, when he questioned the appropriateness of the management accounting system. This observation represents an instance of unlearning, which is a prerequisite for learning [21].

Another example is when the administrative function resisted changes in the management accounting system, since they were afraid of losing control. Finally, we have the instance where focus continued to lie on productivity as the sole performance measurement, even though there were indications that the measure was not correct. Thus, the way people thought about the management accounting system and its role in the organization impeded attempts to change the system in the appropriate direction. It is also possible to see how the formal role of the management accounting system has affected the usage of the information it has supplied. Thus, the cognitive and the formal perspective were mutually reinforcing.

Conclusions and managerial implications

From a production management point of view, it would be ideal if the management accounting system could support the transition towards lean production. However, traditional management accounting systems are likely to affect the adoption process negatively, since they are ill-equipped to interpret the changes made when implementing a complex production strategy.

This article reports the results of a study designed to explore the role of the management accounting system in the process of adopting a complex production strategy, lean production. We have found that the management accounting system indeed has a very important role to play in the adoption process. For the most part it serves as an impediment to the necessary changes, much due to its inability to accurately portray the results of these changes. In order for the management accounting system to support the adoption of lean production, we propose the following:

- The management accounting system can create impetus for changes in the direction of lean production, but not until traditional performance measures have reached a certain threshold (see Figure 3). Therefore, an important managerial task will be to influence the location of this threshold, by making it easier to reach. The mere awareness of its existence is a good starting point.
- Another important way to create impetus for change is to raise the level of the unit of analysis in the management accounting system. First, there is a need to shift the focus from single machines and/or operators to the whole production flow. Second, there is a need to shift the focus from the operating level to the whole production system.
- When making these changes it is important to take into consideration that the management accounting system affects the adoption process in three concurrent ways: technically, through its design; formally, through its role in the organization and cognitively, through the way in which actors think about and use the management accounting system.

In order for the management accounting system to be congruent with lean production principles, all three of these perspectives need to be changed. Thus, it is not enough to implement a technical change in the management accounting system; if the formal role of the system does not simultaneously change, no lasting effects are likely. Perhaps most important is making sure that the cognitive perspective changes, since it affects the other two perspectives. If the values and beliefs of key actors do not change, the management accounting system is likely to continue to have an adverse effect on the possibilities of adopting a lean production strategy.

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