THE INTEGRATION OF LEAN MANAGEMENT AND INFORMATION COMMUNICATION TECHNOLOGY

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Abstract
In companies, Information and Communication Technologies (ICTs) accelerate the speed with which information is exchanged between employees, facilitate the processing of data and improve the quality of intra-company communication. As such, ICTs are powerful management support tools and can help to boost firm’s performance. Definition of Lean Management from Bussines Dictionary is doing more with less by employing lean thinking. Lean manufacturing involves never ending efforts to eliminate or reduce 'muda' (Japanese for waste or any activity that consumes resources without adding value) in design, manufacturing, distribution, and customer service processes. This article analyzes the differences between the strategies of lean management and application of information and communication technologies. It describes the principles of their integration.

Key words: Information and Communication Technology, Lean Management,

INTRODUCTION
ICTs have been widely adopted by industry over the last ten years. Most companies see ICTs as useful tools for improving the performance of their organisation. Those companies generally use ICTs to process information in a centralised way, thereby enabling managers to access information collected on production, and logistics.

Lean Production is defined as a business system for organizing and managing product development, operations, suppliers, and customer relations that requires less human effort, less space, less capital, less material, and less time to make products with fewer defects to precise customer desires, compared with the previous system of mass production.

On the contrary, lean companies give priority to the local processing of information. They thus make little use of the digitization of information and adopt chiefly visual tools for communication purposes.

Nevertheless, it would seem that the wish expressed by lean companies to process information locally is not inconsistent with the adoption of ICTs within their organisation. It is, in fact, possible to introducing technological tools that would be adapted to the lean informational approach. The introduction of new technologies, whose characteristics would contribute to supporting the decentralised management of the information system, could have positive effects on the functioning of lean companies. The digitization of information, made possible by ICTs, would, for example, facilitate knowledge sharing between employees. In addition, the adoption of new technologies consistent with the lean approach may possibly help managers to control operators on the production line.

The integration of new technologies consistent with the lean manufacturing approach inevitably calls for a study on the diversity of ICTs, with a view to ascertaining whether the characteristics of use and the technical properties of the new technologies can make ICTs compatible with different industrial approach.

THE PARADOX BETWEEN LEAN AND ERP
Historically, lean and ERP has been seen as opposites, and the simultaneous implementation of both ERP and lean has been called a paradox. The paradox stems from the ERP planning module’s focus on fixed lead times, lot-sizes and need for buffer inventory, whereas lean focuses elimination of lead time, one-piece flow and just-in-time supply. On the other hand, others have argued that ERP and lean can—and should—coexist. Powell [3] modern ERP systems can support lean implementation, and even make its implementation better. Argument that ERP supports the implementation of lean in companies can be a hard message to accept for “lean purists” who traditionally avoid all use of IT and prefer simple paper-based planning and control systems. In much research, found that lean and ERP are not contradictory in nature any more; modern ERP solutions have evolved much from the MRP-solutions. ERP and lean production fundamentally offer the same benefits to an organization [1]:

1. Inventory reduction,
2. Lead time reduction,
3. Quality improvement
4. Customer service improvement.

He finished his defense with the following remark: “The paradigm shift from mass-to lean production was a revolution. Now we are witnessing the evolution of lean, as we know it. We are moving towards an era of ICT-enabled lean production.”
The suggested benefits of Lean and ERP systems are almost identical, and include reduced cost, reduced inventory, and increased productivity. However, they are often considered to be mutually exclusive management principles. With this in mind, we aimed to address the paradox that exists between lean production and ERP systems, by taking an MPC system view in order to compare and contrast the two production management methods.

Though in the traditional sense the two approaches have been labelled as contradictory, there does appear to be a synergistic impact to be gained as a result of combining and synchronising the two. This is because of the increased processing speed, capacity, and visibility of contemporary ERP systems that allows for closer co-ordination between shop floor activities and the supply chain, as well as the continuous elimination of waste within lean production.

The lean–ERP paradox leads itself nicely into several areas for future research – for example, the combination of both production management approaches will allow opportunities for development in several areas: firstly, lean thinking can be applied not just to manufacturing processes, but also to ERP systems, in order to align lean production control principles effectively within the MPC system; secondly, other emerging advanced ICTs can be applied within the MPC system in order to take advantage of the ability of ICTs to increase processing speed, capacity and visibility.  

**DIFFERENCES BETWEEN LEAN AND ICT**

Practitioners of the lean method put in place original tools. Many of these communication tools are visual. Here are several examples [4]:

**The labelling system** is known, in lean companies, as Kanban. Companies that adopt this system place a label on each batch of pieces. This document contains various pieces of information: the article's reference, the quantity of articles in the container, the destination of the container (downstream machine or storage), a plain description of the piece, the number of containers in the batch treated, its location in the storage area, information concerning the route of the piece in the production unit or information on the packaging of pieces.

The aim of this label is to send a signal that enables the company to produce only parts to replace parts which have just been used and in the order of their use. This system is therefore a tool, which determines the way in which production is initiated by orders based on product output. In practice, a production unit may have to produce several items and the rate at which items are used can vary. In such cases, the labelling system becomes slightly more complicated in order to manage production priorities. Practitioners consider it to be ideally suited to working on pull production flows. In their view it has several advantages: the labelling system enables them to inform each operator about what he or she must do, when this must be done and the volumes required. Practitioners also like this method for its simplicity.

**The andon cord,** generally located above each operator's head, enables the operator to send a visual and/or sound signal to the line supervisor to warn of a problem on the production line. This cord can also be used if the operator wants to speed up the supply of inputs. This method of signalling problems lies at the heart of the problem solving approach of lean companies. When an operator takes the initiative of pulling the andon cord, it is the supervisor's responsibility to go to the workstation involved and resolve the problem. If the supervisor cannot solve the problem, the production line is stopped at the next workstation.

This cord automatically triggers a warning signal that can be seen by everyone and requires action to be taken at the source of the malfunctioning. Lean practitioners believe that the most effective way of dealing with problems is to identify the source in the production area. It is very expensive for a company to stop the production line, but stoppages in this context are justified by supporters of this method, who argue that it is preferable to bear this direct cost at the time the problem solving approach of lean companies. When an operator takes the initiative of pulling the andon cord, it is the supervisor's responsibility to go to the workstation involved and resolve the problem. If the supervisor cannot solve the problem, the production line is stopped at the next workstation.

One example of the benefit of this system is the ability to identify the source of the problem. Lean practitioners believe that the most effective way of dealing with problems is to identify the source in the production area. It is very expensive for a company to stop the production line, but stoppages in this context are justified by supporters of this method, who argue that it is preferable to bear this direct cost at the time the problem solving approach of lean companies. When an operator takes the initiative of pulling the andon cord, it is the supervisor's responsibility to go to the workstation involved and resolve the problem. If the supervisor cannot solve the problem, the production line is stopped at the next workstation.

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For decision-makers this means operating on the...
any waste in the operator's work process as readily. Although statistics may provide information on the operator's results, they cannot provide managers with information about ways of improving those results. This management method contrasts with "management by figures". It is therefore common for lean companies to use video and make a visual analysis of the gestures and movements of operators on the production line in order to identify ideas for improvements and potential productivity gains.

The A3 report. Lean industrialists use a widely codified document to communicate information on process defects observed by operators on the production line. When a team member observes defects in a process, lean managers ask him or her to draw up a precise report on an A3 sheet. This report is designed so that (1) the malfunctioning is analysed in great detail, (2) the causes of the inefficiency are established, (3) countermeasures are proposed (4), information on the way in which the company could measure the gains resulting from implementing a new process are given, and finally (5) the results of the new process must be observed and compared with the old results.

Enterprise Resource Planning - ERP. An ERP solution has several key functions. In terms of production management, an ERP solution can deal with production scheduling, product receipts/deliveries, as well as inventory movements. In terms of planning, ERP solutions manage problems of capacity and supplier needs. Finally, as regards finance, an ERP solution can manage invoicing and value products and inventory.

An ERP solution has a twofold advantage. It facilitates the transversality of information recorded on the one hand, and the integration of all the company's functions on the other. The arguments used against ERP solutions by lean practitioners do not concern all the possible applications of these integrated management software packages. It is therefore necessary to distinguish between their views on production management applications and those on planning applications. With regard to production management, an ERP solution can be used to assess inventory levels, issue production schedules and manage automatically receipts/deliveries of parts.

ICT AND THE LEAN MANUFACTURING APPROACH

There are several attempts to address the ever-developing support functionality of ERP systems for lean production in the scientific literature. For example, Powell [3] develops a theoretical framework for ERP support for lean production (Table 2), in which they specify 15 keys for ERP support for lean production, based on theoretical and empirical insights. Though in the traditional sense the two approaches have been labelled as contradictory, there does appear to be a synergistic impact to be gained as a result of combining and synchronizing the two. This is because of the increased processing speed, capacity, and visibility of contemporary ERP systems that allows for closer coordination between shop floor activities and the supply chain, as well as the continuous elimination of waste within lean production.

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<th>Automation of necessary non-value adding activities</th>
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A study of literature on lean manufacturing and an observation of practices on the shop floor highlight considerable wariness, if not hostility, on the part of lean companies towards ICTs. Classic Lean companies use ICTs only for the global processing of planning and prefer to adopt traditional methods such as labelling for local management. In other words, the lean manufacturing approach gives priority to the local processing of information rather than a global, model-based management approach.

Prioritising information and making it immediately visible. The lean manufacturing position with regard to ICT relies on a twofold
argument based, on the one hand, on the wish to make useful information immediately visible and, on the other hand, on the determination to give production information priority over other types of information. The andon cord alert signal illustrates this idea. It is a signal that is visible to everyone and obliges managers to act on the shop floor in order to identify the causes of the malfunctioning observed. Advocates of the lean approach consider that an alert signal generated by a computer software programme would be ineffective, since it would only be visible to the people receiving the message. They believe that receiving an alert via a computer message can encourage the people receiving the message not to act or to delay taking action. Making information immediately visible for everyone and prioritising production information are among the reasons cited by both lean authors and practitioners to justify the use of visual tools. However, these two objectives could be achieved by using computer software. Therefore, these arguments are not completely satisfactory, but they are nevertheless accepted by lean practitioners and upheld resolutely by lean authors.

Managing the company on the shop floor. Lean practitioners and authors also see ICTs as tools that promote "management by figures" whereas, in their view, it is preferable to act on the shop floor. They justify their approach by pointing out that the quality of managerial decisions is even higher when the manager is fully aware of the reality on the shop floor. Whereas ICTs submit to decision-making bodies abstractions from reality, which, by definition, cannot correspond exactly to reality. In fact, lean practitioners and authors are ready to support a high opportunity cost for the company, by asking managers to collect correct information directly from the shop floor, with a view to ensuring the quality of the information that will influence the manager's decision. Naturally, such reasoning does not leave much scope for the use of ICTs.

The use of ICTs in controlling operators. The attitude of lean companies towards ICTs and global centralised information systems poses an obvious problem as regards controlling operators. ICTs are tools that enable companies to supervise employees indirectly. As the micro-optimisation ensured by lean operators at their workstation is not based on a model, the management does not control it. Operators are therefore in a position to extract value from this micro-optimisation. As operators cannot be controlled by ICTs since such technologies are not mobilised by the lean manufacturing approach, the agency problem has to be addressed in another way. More specifically, it is important to point out that lean managers require production line operators not only to execute their production tasks in compliance with work standards, but also to reflect on possible improvements that could be made to the process. Managers therefore have a twofold requirement as regards operators. Knowing whether operators comply with working standard seems easy when the company uses ICTs to control operators a posteriori. On the other hand, ascertaining the level of effort made by employees to improve the production process seems more difficult. The communication of information on this task is vain and the use of ICTs in this area therefore seems pointless.

ICTs and the sharing of codified knowledge. ICT the accumulation of knowledge in databases and codify the knowledge of operators. New technologies consequently facilitate the sharing of codified knowledge between a company's employees. Lean companies make little use of the digitization of data. They therefore do not use ICTs to transform the codified knowledge of operators into collective knowledge. Lean companies have processes whose aim is, for the company, to integrate the knowledge of employees: continuous improvement exercises. Operators are encouraged to propose to their line manager ideas for improving their workstation. However, there are no reasons why ICT could not be used in lean companies to support the continuous improvement philosophy, not only to facilitate the sharing of codified knowledge between operators, but also as a way, as of controlling private information in the possession of employees.

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