LEAN PRODUCTION PROMOTES THINKERS, NOT "ANDROIDS"

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Abstract: This paper presents the role of the Lean Production paradigm as promoter of the workers' human potential. In the literature it is possible to find out many authors who have a negative opinion about Lean Production and consider this organizational model as an extension of Taylorist/Fordist model where the worker is seen as a gear in the "big machine". Based on literature review and on the Toyota Production System (TPS) principles and history (later coined as "Lean Production"), and by comparing this with other systems, it will be attested that Lean Production is a work organizational model where the worker assumes a position of thinker, continuously looking for improvement. These workers-thinkers are the base for the Learning Organization.

Keywords: lean_manufacturing; human_potential; learning _organizations

INTRODUCTION

Lean Production (LP) is a well proven organizational model implemented in different industries and services. Coined by the engineer and MIT researcher [1] John Krafcik to nominate the Toyota Production System (TPS) [2], the designation LP has become internationally known due to the book "The Machine that changed the World" from Womack et al. (1990) [3]. This book was followed by another one, from the same authors, titled "Lean Thinking" [4], and intended to guide companies so they can take advantage of LP. Lean Thinking has five main principles: i) create value for the customer; ii) map the value stream; iii) create flow; iv) pull production (customer pulls the production) and v) pursuing perfection. The implementation of these principles within the companies leads to the reduction/elimination of waste (*muda*, in Japanese). Waste is everything that does not directly contributes to add value to a product, under the perspective of customers' needs and requirements.

The paper's objective is to demonstrate that Lean Production, when compared to other work organizational models, promotes thinkers and not just workers who only execute what someone tells them to do. In order to achieve this objective, the paradigmatic work organization models will be reviewed along with the more recent systems thinking approaches that could, or not, stimulate/promote thinkers.

The paper's structure includes five sections. The first introduces the theme. The methodology is presented in the second section. The literature review is presented in the third section and the fourth section develops the discussion. Finally, the concluding remarks are presented in the fifth section.

METHODOLOGY

This paper relies on a literature review about: i) Taylorist/Fordist System; ii) Socio-technical System; iii) Toyota Production System/Lean Production iv) Agile Manufacturing and v) Chaordic Systems Thinking, based on a number of publications that were considered relevant to this discussion. An accurate analysis of the referred systems has highlighted their differences and revealed how each one of them deals with the human factor. These topics provide an exploratory discussion.

LITERATURE REVIEW

This section presents a review on the main organizational models of work (see previous section), emphasizing the role that each one of them attributes to the worker.

Taylorist/Fordist System

Taylor´s Principles of Scientific Management (1911) fit well in work organizations at a time when the number of unqualified human resources was very large (mainly due to rural people that came from countryside to the new cities). Henry Ford adopted these principles and gave employment to those people in his automobile factory. Therefore, even with unskilled workers, Ford was able to improve productivity (when compared to traditional

craft production) and to produce large quantities of his famous car model, creating thus the mass production concept (single product, high production volume). Such achievement was possible due to the principle of work division, which divides the operations into elementary tasks that anyone could perform. Each operator stays permanently in one workstation performing his simple repetitive task, within a standard time previously estimated by the time and methods staff. Functions such as product engineering, process design, production planning and control or quality control, along with decision-making tasks, are assigned to other employees or to the managers. As the operators are not involved in these functions, they have no relevant responsibilities, being thus excluded from the active participation on the improvement of processes and products. Saying that the operator *“does not have to think, only to obey and execute”* reveals an approach centred on the command-and-control hierarchic chain.

The emphasis is on the individual and on the individual specialization to the execution of one task at some point in the assembling line, i.e., one individual, one workstation and one task. This work organization model restricts the mobility of operators between tasks, their participation in solving problems and their creativity. Therefore, it imposes severe and hard work conditions, considering the worker as a gear of the “big machine”, totally dependent on the equipment. For these reasons the system was designated as a Techno-Centric System and has been extremely criticized [5], [6].

As a consequence of the Techno-Centric System, operators are isolated and do not share experiences and knowledge. The promotion of operators is compromised because they are denied the opportunity to learn in order to perform other tasks. Consequently, stress and aggressive and/or angry behaviours are prone to occur. This disequilibrium provokes musculoskeletal lesions, work dissatisfaction and absenteeism. The famous Charlie Chaplin's movie "Modern Times" (1936) is a clear critic to the hard conditions on the factories at that time, which led to countless manifestations and strikes (Fig. 1.).

Fig. 1. Scene of Charlie Chaplin’s film “Modern Times”

Socio-Technical System

The Socio-Technical System (STS) is defined as a system based on the utilization of skilled human resources and flexible technology adapted to the needs of a flexible and participative organization [7]. These authors also designate this as Anthropocentric Production System, to contrast with the Techno-Centric System previously described. The STS promotes the operators’ qualification, teamwork, mobility and the empowerment of team members. Multi-skilling, job rotation, job enlargement and job enrichment were strategies adopted to achieve this and to avoid the worker’ boredom and the injuries caused by repetitive tasks [8].

Semi-Autonomous Work Groups (SAWG) or Self-Directed (or self-managed) Work Teams (SDWT), constitute the work organization model adopted by the Socio-Technical System [9], in opposition to the individual job developed in the Fordist system. In the 70 and 80´s [10], the Volvo automobile factories of Kalmar and Uddevalla were the best known examples of the application of this system. It is for this reason that is also known as the “Volvoísm” model. According to this model, each team is responsible for the entire assembly of the car. The democratization, the self-management, the participation of all members in the local decision-making (previously assigned to supervisors or managers), are fundamental characteristics of these teams [11], [12]. The team has autonomy to manage their tasks (what to do and how to do it) [12]. Reduction of hierarchic levels of management and the promotion of cooperation and creativity are results of the team empowerment and responsibility [13].

Toyota Production System and Lean Production

The mentors of Toyota Production System, Kiichiro Toyoda, his cousin Eiji Toyoda and the engineer Taiichi Onho, visited American companies to learn how to build automobiles. They learn a few things inside the company but mainly outside, for example in the supermarket where the kanban idea has emerged. Besides the identification of several inefficiencies in the mass production system, they also recognized that the Japanese market restrictions (e.g. low volumes and relatively high diversity) would derail that production system in their factory. Thus, the need for a new type of production system became clear, and that was the starting point for the development of the Toyota Production System (TPS). Additionally, they want a different way to treat persons in order to potentiate the Japanese workers’ capabilities - Sugimori et al. [14] called this *“...the ‘respect-for-human’ system where the*

workers are allowed to display in full their capabilities through active participation in running and improving their own workshops". Later, the TPS pillars and tools were published, presenting four key concepts supporting this system: JIT (Just-In-Time), autonomation, flexible work force and creative thinking or inventive ideas, *"…which means capitalizing on worker suggestions"* [2].

Some concepts like JIT, kanban, or others, come to the West but sometimes without the proper contextualization and integration, being referred as "the Japanese system". It was necessary a book launched by the MIT to attract the attention of managers and academics for that "Japanese system" that would became known as "Lean Production" [2]. This designation arose because TPS promotes *"doing more with less"*, when compared to the mass production. Less of everything: less human effort, less space, less stocks, less investment in new tools to produce higher diversity of products. Moreover, the lean approach changes the way operators work, challenging them, continuously, to improve processes and operations. Working in lean environments means that each one has freedom to control its own work, which also implies responsibility at all levels. This could cause some stress and anxiety as workers are responsible for eventual costly mistakes. But, on the other hand, it could also signify a meaningful, fulfilling and motivating work. Of course, this work environment calls for different attitudes and for the learning of new skills, including "soft" skills like teamwork, communication skills, problem-solving, creativity and systems thinking. An ex-president of Toyota [15] said "T" in TPS is "Thinking" and TPS really means a winning strategy for developing people in the global manufacturing environment. As management tools are less important than the mindset (as explained by Toyota senior executives [16]), the implementation of TPS is not easy. Mindset has to do with people. Toyota ex-president Watanabe, interviewed by Stewart and Raman [16], reaffirms the two main pillars of Toyota Way [17]: continuous improvement and respect for people, i.e. the employees, the supply partners and the customers (Fig. 2). By customer they mean not only the end customer but also the person at the next workstation on the assembly line. Continuous improvement means being all the time dissatisfied with the status quo and making small improvements that will accumulate and may become a revolution.

Agile Manufacturing

Agile Manufacturing (AM) was introduced in a report from Iacocca Institute about the 21st Century Manufacturing Enterprise Strategy ([18]; [19], [20]).

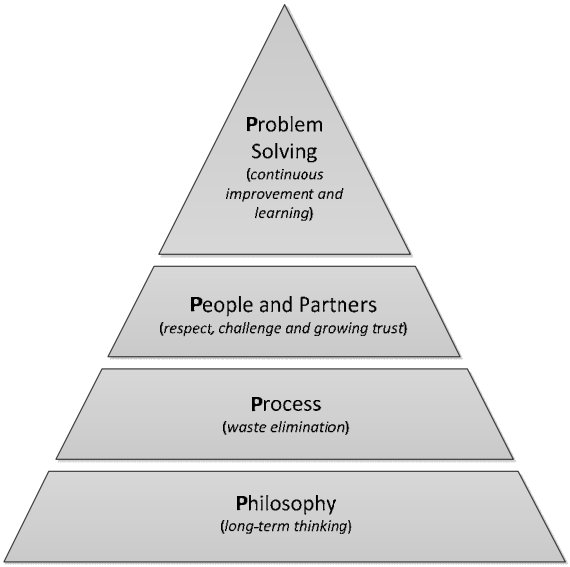

Fig. 2. The "4 P" model of Toyota way [adapted from 17]

Huang and Nof [21] refer that the agility of the company must be obtained from the business, organizational, operational and logistics systems agility. Kidd [19] reinforces the need of a methodology which integrates three fundamental elements to support the AM: i) organization, i.e., innovative structures of management and organization; ii) people supporting a knowledge base of skills and competences, and, (iii) technology (Fig. 3). Hooper et al. [22] appoints AM as an evolution of the process organizational flexibility with a focus on the client and on the product which originates the agile company.

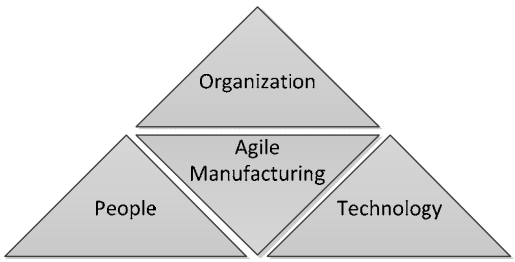

Fig. 3. The three fundamental elements of Agile Manufacturing

Agility is the system ability to easily adapt to the production of different products and/or different quantities of a same product. This implies fast changeover at reduced cost. A system with total agility means an instantaneous changeover at no cost. A system with total agility could produce mass customization products. Other definitions of AM could be found on [23]; [24] and [25].

Kidd [19] presented the AM nuclear concepts, identified as: i) strategy to achieve agility; ii) strategy to explore agility; iii) integration of organization, people and technology and iv) interdisciplinary methodology of design. The AM concurrency principles are: i) continuous change ii) rapid response; iii) quality improvement; iv)

social responsibility and v) total focus on client. The same author proposed the AM characteristics: i) integrated enterprises; ii) human networking organization; iii) enterprises based on natural groups; iv) increased competences of all people v) focus on core competences; vi) virtual corporations; vii) an environment supportive of experimentation, learning and innovation; viii) multi-skilled and flexible people; ix) team working; x) autonomous groups and empowerment of all people in the enterprise; xi) knowledge management; xii) skill and knowledge enhancing technologies and xiii) change and risk management.

Chaordic Systems Thinking

According to van Eijnatten [26], *Chaordic Systems Thinking* (CST) is viewed "*…as a holonic approach to inform human interactions in a learning organization, in which the discoveries of the "new science" – chaos and complexity – are adopted in order to better understand discontinuous growth in complex social systems*". In this context, as defined by Senge [27], learning organization is an organization where learning and thinking are continuously promoted among people so they can expand their knowledge.

van Eijnatten [26] refers that CST does not represent the invention of a new paradigm, but rather the articulation, and eventual extension, of earlier approaches. The word "Chaord" result from the "chaos" and "order" and means "*…any self-organizing, adaptive, non-linear, complex organism, organization or community, whether physical, biological or social, the behavior of which harmoniously blends characteristics of both order and chaos*" ([28] cited in [29]).

DISCUSSION

From the work organization models and systems thinking approaches previously described, it is possible to put LP as a work organization model that has a deep concern about people and completely acknowledges that people is the most important asset of the companies. LP is totally opposed to Taylorist/Fordist system relatively to the people role in the company. Also in terms of the human factor, the other models, especially the most recent and not yet widely disseminated (AM and CTS), are aligned with the LP aims, namely workers empowerment, responsibility, creativity, ability to teamwork, communication skills, etc. However, some authors do not agree that lean effectively promotes the referred aims, but the authors of the present paper consider that these opinions are based on restricted views of reality, as explained next.

Over many years, the focus of many authors studying the TPS, e.g. [30], was the JIT system, autonomation and others, i.e., the technical part of the TPS. This partial understanding of TPS leads to a limited vision (sometimes distorted) of the system, pointing lean production as an intensified mass production or neo-Taylorism (in [31] and [32], cited in [33]). The main critics about lean refer ergonomics aspects with consequences on operators' health. Stressful and de-humanizing tasks are two of the mentioned aspects, but many authors have already reviewed and demystified these statements ([34] and [35]). Some authors also refer JIT and its benefits, ignoring the human aspect of TPS, discarding (on purpose or not) the importance and influence of this aspect on the success of industrial implementations.

The focus only in the technical system hides the most distinctive aspect of lean: the promotion of system thinkers. However, some authors are aware of this problem. For example, Spear and Bowen [31] saw what others didn´t see: beyond the technical system, and supporting this, was the fact that TPS creates a community of scientists which, when facing a problem or a need to change a technique, are encouraged and stimulated to raise hypotheses and to conduct experiments following the scientific method. These authors consider that in order to understand Toyota's success, it is necessary to unravel the paradox: *"you have to see that the rigid specification is the very thing that makes the flexibility and creativity possible."* According the same authors *"…this ensure that regular work is tightly coupled with learning how to do the work better*" [31]. Spear [37] reports a case about how young managers were trained and become problem identifiers and solvers. Liker [17] points out that a common phrase heard around Toyota is *"Before we build cars, we build people."* "Building people" means to develop people so they become strong contributors who can think and follow the Toyota Way at all levels within the organization. He also refers that the base for genuine long-term success relies on the company's leadership capacity to endorse the building of a Learning Organization. In fact, the non-utilization of human potential is referred as eighth waste [17].

The search for continuous improvement is, certainly, the type of behavior that conducts to a Learning Organization. Geus [38] defines the Learning Organization as a living company which has the capacity to learn. He referred that companies have a short life time cycle, "dying" younger. This is due to the managers who focus their attention only on producing goods and services and forgot that a company is also a community of people. The companies that stay alive, achieve this through several factors such as being sensible to the world around, adapting to

this, taking conscience of its identity, making the people feel part of the whole and being receptive to new ideas, promoting this way the innovation and learning. Other definitions of the Learning Organization concept could be found in the literature and some of them are reviewed in van Eijnatten and Putnik [29]. These organizations make sense as the success can be promoted by mobilizing the intelligence available within each company. Toyota knows this and invests deeply in people and organizational capabilities. The employees are viewed *"…not just as pairs of hands but as knowledge workers who accumulate chie – the wisdom of experience – on the company's front lines."* and "*Toyota's culture of contradictions places humans, not machines, at the center of the company*."[39].

"How to change the culture: lessons from the NUMMI" is the title of a paper by Shook [40] that reports the success of NUMMI (New United Motor Manufacturing, Inc.). NUMMI was the first joint venture auto-plant between Toyota and GM where TPS principles were lived for the first time outside Japan. The first lesson was: start by changing what persons do, rather than how they think. In order to do the things right, the employees need means that companies must provide. It is unquestionable that people behavior could influence the corporate culture and affects negatively or positively the company success. Emiliani [41] wrote a paper about the lean and "fat" behaviors (making the analogy between lean production and batch and queue production) that guide a company to the company's prosperity or death. Lean is considered a philosophy by some authors, e.g. [42], since a successful implementation is a long term journey requiring the application of various technical tools, continuous improvement, and, numerous cultural changes engaging empowerment and sponsorship. Yamamoto and Bellgran [43] discuss the fundamental mindset and organizational learning behind the Lean production continuous improvement. The fundamental mindset is related to the fact that each improvement should start from a need. These needs must be felt and persons in the company are the only production factor with that capacity, being also able to develop solutions to fulfill these needs.

Lean implementations, normally, imply cultivating a Lean culture in order to sustain conversions [44]. This Lean culture only grows if adequate changing agents are permanently inside the company. The isolated application of tools by an outsider (e.g. from a consulting firm) which disappears after implementation, does not sustain a robust and lasting environment and is prone to failure. So, no one better than the company's workers may ensure a sustainable change. These situations are corroborated by several authors describing successful and unsuccessful lean implementations. The lean focus is on the continuously collective learning, and not on the permanent particular implementation. This collective learning implies teams, namely "Toyota team" and Lean teams. The different meanings of team, and the different behaviors of their members, are analyzed in [45]. These teams could promote the responsibility and active thinking, but could also have a malicious effect on the more individualist members [46].

The creative thinking in TPS was promoted by the introduction of "suggestions boxes" and many other companies adopted this practice. But this initiative is not sufficient if the system is not properly implemented, e.g., if an intermediary exists (for example: a supervisor that put the suggestion in the box and gives no credit to the operator).

CONCLUDING REMARKS

Several authors, such as Elton Mayo, Maslow, Herzberg, Schein and others, have been discussing, during different epochs, the importance of factors like motivation, teamwork, fulfilling, professional realization, and sense of ownership. These factors are more important than a money bonus or reward and, besides adequate ergonomic conditions, they are fundamental to improve workers' productivity. The people learn, feel, think and resist, and as a result, they are different from others resources and could not be treated the same manner. Additionally, in the current crisis, people could lead to the success or unsuccessful of the companies. The peoples' role must be rethought - their competences must be reviewed and improved because the demand is different, urging for teamwork, polyvalence, decision-making and assumption of responsibilities, self-learning and self-adaptation skills. After the Taylorist/Fordist system, this role has started to receive the proper attention and Lean production is one of the work organization models clearly involved in that aspect. Through this paper, Lean Production is evidenced as a model where the persons assume a role of thinkers, not "androids".

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