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LEAN PRODUCTION, ITS RELATED PRODUCTION MANAGEMENT APPROACHES AND OTHER CONTEMPORARIES

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Abstract: *Lean production has been denoted to be the most effective way of manufacturing and running ones business in the present time. The concept has been internationally studied since the late 1980s. Late 1980s to early 1990s literature listed a plethora of production management approaches. This paper will show that many of these approaches were one and the same thing with what is now known as lean production. The study will also describe and discuss some contemporary alternative approaches to lean.*
Key words: Lean production, production systems, production management systems, contemporary approaches in manufacturing.

1. INTRODUCTION

Lean production has been denoted to be the most effective way of manufacturing and running ones business in the present time. Lean makes up a new manufacturing paradigm after the paradigm of mass production [1, 2, 3]. Mass production, in this context, means the traditional way of manufacturing as it was started by Henry Ford in 1913 when he opened his first moving assembly line at car manufacturer Ford's Highland Park plant in Detroit, USA [1, 2, 4].
Friel has summarized the benefits of lean in the following way: "Lean production enables firms to meet the challenges of the 21st century by enabling them to respond faster to changes in markets. At the same time, it eliminates levels of middle management, empowers workers and creates an organizational basis for dramatically improving productivity. It also creates a solid basis on which workers can fight for higher wages, albeit through greater cooperation with management." [5].
Lean production was first described by James P. Womack, Daniel T. Jones and Daniel Roos in their ground-breaking book "The Machine That Changed the World" published in 1990. The term "lean production" was coined by John Krafcik, researcher in a five-year International Motor Vehicle Program (IMVP) study of the car industry in the late 1980s, results of which were later summarized in the named book [1]. Lean was called "lean" because it allowed for manufacturing and carrying out one's business with minimum resources while achieving outstanding results.
Late 1980s to early 1990s literature on production systems lists a plethora of production management approaches besides lean production. This study seeks to aggregate prior research to clarify these concepts and to simplify the jumble of different production management systems.

2. THE MANY PRODUCTION MANAGEMENT APPROACHES

Late 1980s to early 1990s literature lists a plethora of production management approaches. Flexible manufacturing, JIT, agile manufacturing, dynamic manufacturing, time-based competition (TBC), quick response manufacturing (QRM), innovation-mediated production, world class manufacturing (WCM), lean production, post-Fordism (or post-Fordist system), Toyota Production System (TPS),

Toyotaism, Total Quality Management (TQM), Total Quality Control (TQC), Six Sigma, Computer Integrated Manufacturing (CIM), and reflective production are only some of the more frequently named. At a closer look, most of these terms turn out to be one and the same thing, or parts of the same concept.

2.1 Lean Production and Its Related Production Management Approaches

Lean production essentially denoted the specific production system at Toyota, called the Toyota Production System (TPS) [1, 2, 6]. The system rested on two concepts, "two pillars", called *jidoka* or autonomation or "automation with a human touch" developed by Sakichi Toyoda, the founder of the Toyota Group, and just-in-time (JIT) developed by Kiichiro Toyoda, son of Sakichi Toyoda and founder of the Toyota Motor Corporation [7, 8, 9]. The aim of *jidoka* was to safeguard production against defects while making man's work in a manufacturing system easier and safer [9]. JIT meant the principle of producing and delivering an exact amount of product exactly when needed and where needed throughout the process; that is, in the end of the manufacturing process as well as at every workstation [7].

TPS and TQC together are two of the key concepts which make up a wider and more comprehensive modern day definition of lean. TQC was the quality control system at Toyota. Quality control was an American invention and taught to the Japanese by the Americans after World War II. However, the Japanese applied it more broadly [10]. TQC was about managing quality comprehensively. In addition, TQC at Toyota interactively combined the concepts of defective work (process) and defective parts (product) [7].

The term quality control, as used in Japanese, refers to the same guarding principles (namely, active involvement of the management) which are called quality management in English [7, 10]. From 1950 to 1980, most Western companies did not trouble themselves with quality issues. The new management philosophy "TQM" was born in the last part of the 1980s when Western countries began to study "what happened in Japan" [11].

According to Price, innovation-mediated production, post-Fordism, Toyotaism, and flexible production are all early synonyms of lean production. Price adds management-by-stress to the listing and denominates the lean techniques as lean intensified Fordism or LIF [2].

Shah in her analysis identifies an overwhelming overlap between the techniques of world-class manufacturing, TBC, agile manufacturing and dynamic manufacturing, and the domain of lean production [3]. For example, she concludes that "the domain of world-class manufacturing is almost identical to that of lean production and includes JIT, TQM, employee involvement, and TPM (Total Preventive Maintenance)" [12]. Her conclusions are confirmed by Black who links WCM to TPS and later to JIT/TQC [13].

Quick Response Manufacturing (QRM) is an expansion of the concept of TBC [14] and thereby is related to the concept of lean production. Similarly to lean production, QRM lists lower costs, better quality and faster delivery than traditional manufacturing as results of its implementation. Quality in QRM is divided into process quality and product quality, just like in Toyota TQC.

2.2 The Contemporaries

Six Sigma is a business management system characterized by rigorous quality management methods (including statistical quality control), typically large-scale projects led by specially trained individuals, a clear commitment to making decisions on the basis of verifiable data, focus on achieving measurable and quantifiable financial returns from any Six Sigma project, an elaborate hierarchy of mastery ("white belt", "yellow belt", "green belt", "black belt", "master black

belts") and a quality target less than "3.4 defects per million opportunities". Six Sigma was developed at Motorola, a telecommunications manufacturer in USA in the period 1983 to 1989 [11]. Although Six Sigma has its roots in the Japanese TQC practices [11], the course of the two methodologies is materially different. While Six Sigma rests upon individual, large-scale projects led by highly trained specialists, the lean employee suggestion system relies on regular frontline employees with only modest drill compared with the Six Sigma black belts. Nevertheless, companies which practice both approaches, report 80 percent of their financial savings to come from the lean employee suggestion system and only 20 percent from Six Sigma projects [15]. Friel refers to Six Sigma as to an attribute of mass production which companies might resort to once their lean initiative has failed [16].

Computer Integrated Manufacturing (CIM) is an approach in manufacturing in which the entire production process is controlled by computers [2, 17]. One can say that the forefather to CIM was flexible manufacturing. Indeed, today a heavily computer saddled manufacturing processes are also called flexible manufacturing or flexible design. It appears that the early exploration of lean was like the story of a group of blindfolded men trying to describe an elephant: the one who got to feel the tail, said that elephant was something snake-shaped, and the one who got to feel an ear, said that elephant was a large leaf. Similarly, whoever walked around a Toyota plant in the early days of discovering TPS and was truly fascinated with computer technology, while not prone to noticing the unique actions of a man in the system, saw the technical automation as the secret catalyst to the Japanese high productivity. This is how the school of CIM was born. Today, despite the solid proof to the contrary, the dominating understanding in the Western management is that the path to exceptional productivity runs via heavy automation and the elimination of the man from the system. In comparison, the Japanese TPS has always regarded automation as an aid to making a man's work easier and safer in a manufacturing system (the principle of *jidoka*). In TPS the machine is an aid to the man, while in CIM the man in a servant of the machine. According to Price, automation is perceived as the main means of improving productivity in the Fordist labour process [2]. Kucner contends that both mass production and CIM take a mechanistic view, while lean takes an organic view [17].

In the late 1980s, the Swedish car manufacturer Volvo made an attempt to create an alternative, European manufacturing system to the Japanese TPS [6]. The goal was to achieve better job enrichment and increased "humanization" of the production system. Two newly equipped plants were opened, one in Uddevalla and the other in Kalmar [18]. Work in these plants was arranged in the cellular manufacturing style [6] with teams of ten workers assembling an entire vehicle from the point it emerged from paint oven [1]. Instead of a moving conveyer to take the car carcasses around, the cars were assembled on stationary assembly platforms [1, 6].

The manufacturing method came to be called the Uddevalla production system of Sweden or the reflective production system [6]. Womack, Jones and Roos shortly dubbed the method the "neocraftmanship" due to its close resemblance to the method used in Henry Ford's assembly hall in 1903 [1] before the moving conveyer-line brought the world of manufacturing into the age of mass production in 1913.

According to Buchanan, the Volvo Uddevalla plant did not have bad productivity [18]. However, Adler and Cole argue that the well known GM-Toyota joint venture, NUMMI, had higher productivity and quality than did Uddevalla and that quality of work life there was not poor [19]. Jang, Rim and Park concur that

although productivity at Uddevalla was high by Swedish and European standards, it was not high enough to compete with Japanese factories [6]. The Uddevalla factory opened in 1989, but was closed in 1993 after only four years of operation. The Kalmar factory closed in 1994 for good. Partly, the short lived operations were due to a factory like the Uddevalla factory requiring a higher initial investment cost. Differently from the Ford factory in 1903 which still applied rather basic handicrafts equipment, the Uddevalla factory was furnished with expensive modern equipment, such as the general purpose automatic guided vehicles used to transport materials to the cells [6].

Of the methods and models described above, lean production and reflective production have been viewed as anchoring two extremes of modern day production models which companies in the automotive and other manufacturing sectors draw upon [20]. TPS (lean) drove superior organizational learning, innovation, and control with positive implications for customer-oriented outcomes. Volvo's reflective production model aimed at leveraging and developing workers' unique abilities both at individual and team level with positive benefits for employees. Pil and Fujimoto maintain that over time these systems have had to converge due to external pressures - Volvo has returned to conveyer-line incorporating manufacturing and Toyota has carried out several radical changes at its manufacturing sites to improve the employee experience [20].

3. CONCLUSION

This study aggregated prior research to clarify a seeming multitude of production management systems. The aim of this was to simplify the abundance of various concepts and to give some reference to which production management system concepts were, in fact, closely related. The study found that many of the production management approaches listed in the late 1980s to early 1990s literature were one and the same with, or parts of the concept of lean production.

The study covered only some of the more frequently named terms. Therefore, further research must be carried out to clarify and simplify the relation and development of production management systems.

Some alternative contemporary production management approaches were described and discussed. Scholars must detect and study the development of any novel approaches to assess their relation to existing methods and potential to shape the future.

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