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# Lean Innovation Approach in Industry 5.0

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**Abstract**: It's no doubt that industry 4.0 takes a big part in our daily lives. Mobile phones, touch pad, flipped classrooms can be important examples of how we use the digital life. However, in the near future not only the knowledge and digital life but also robots behaving like a human will cover a huge time. Since, people start to get in collaboration with industry 4.0. In other words, this means that industry 5.0 is coming. Within this fact, keeping innovation in a lean form gets more importance. Complex projects make the innovation be far and far away. Thus, lean approach in innovation management makes the applications of industry 5.0 be smooth. Value management is a good solution as a method in this approach. In this paper, r&d projects' processes in industry 5.0. platform are taken into account with lean innovation approach. Therefore, the sub-processes, which do not carry value into the product, are eliminated. Simplicity is based in the lean innovation logic. Hence, every step should be thought as a bridge whether gaining value or not.

**Keywords:** Industry 5.0., Innovation, Lean approach, Value management, Collaboration

## Introduction

Most of the companies are aware of the valuable synergies by getting together lean management approach and industry 4.0. This double interaction, which is called lean industry 4.0., starts to leave its place to the lean industry 5.0 as the time passes. Since, the man meets machine in this new world.

The usage of robotics in production has been rising since the 1960s, while they were first introduced as a part of Industry 3.0. Robots grew up especially in the automotive field in which they were used primarily for welding processes so as to get the bodies together. As demands matured, robots started seeing use in other different fields, like logistics, medicine and food industries. Additionally, 2006 was the first year when more robots were used outside the automotive industry than inside. Nowadays, robots are used not only in huge facilities, but also more affordable and easy-to-use collaborative robots – in small and medium-sized businesses.

The advantages of robotic automation consists of the following;
a) Robots develop the consistency of service/product quality and manufacturing line flow, corresponding the demand for high-quality outputs at lower cost
b) They present to save workers from having dangerous tasks at work
c) Robots have the capability of generating data on process quality to optimize both a company and production processes
d) Because robots cost the same everywhere in the world, they can help companies reshore manufacturing jobs that have been transferred to low-cost labor countries and level the playing field in general

Owing a car between 1970s and 90s usually involved selecting a make and model at a car – perhaps ordering a car in a particular color and with certain extras. Granted, this is a lot of choice compared to what Henry "as long as it's black" Ford had to offer (i.e., Industry 2.0). But it's nothing like "configuring" a car online today. Today, car buyers have so many options to choose from, that any given buyer has a good chance of ending up with a car that at least appears to neighbors, co-workers and so on as one of a kind. Driven by a desire to make affordable, high-quality products that at least give the appearance of uniqueness, today's mass customization is largely enabled by Industry 4.0 technologies – including internet connections between dealership ordering systems,

supply chain systems, and even the robots on the car factory floor. The customer makes choices from a growing list of options. This set of choices is configured and packed in just the right order. The truck arrives at the car factory at just the right minute. And the forklifts deliver the parts straight to the assembly line station where the customer's "unique" car appears.

On the other hand, industry 5.0 products/services, which collaborates of man and machine, empower people to realize the basic human urge to express themselves. These personalized products can also be called as the human touch. The customers demand most and pay most for are products that bear the distinctive mark of human care and craftsmanship. Products like these can only be made through human involvement – human engagement. These consumers accept technology – they don't mind if automation, for example, is a part of the production processes. However, they crave the personal imprint of human designers and craftspeople, who produce something special and unique through their personal effort. In other words, this is called personalization.

Consequently, industry 5.0 is a return to pre-industrial production, but one that is enabled by the most advanced technologies out there.

## Literature

In literature review of this paper, industry 5.0 and lean innovation are taken into consideration in two other steps.

*Industry 5.0*

Industry 5.0 is a digital transformation of the existing era. There are many documents regarding to the massive benefits from Industry 4.0 and it is no doubt that industry 4.0 is the bringing together of robots, interconnected devices and fast networks of data within a factory environment, basically to make the factory more productive and to execute the routine tasks that are best done by robots and not best done by humans. *(https://www.raconteur.net/business/manufacturing-gets-personal-industry-5-0)*

It can be said that the industrial revolution was born between the centuries 18th and 19th centuries. It was a time during which rural and agrarian societies in both America and European countries became industrial and urban. Prior to the Industrial Revolution, production was done in people's homes, using hand tools or hand-made. Especially, iron and textile industries, along with the improvement of the steam engine, has got serious roles in the Industrial Revolution, which also saw improved systems of transportation, communication and finance. It's a well-known fact that industrialization resulted a huge volume and various of produced goods. It resulted in often grim employment and living conditions for the poor and working classes, too. *(https://www.history.com/topics/industrial-revolution)*

Finally, it can be taken into consideration as industry 5.0 is a future, also it means that the change processes directing towards closer cooperation between human and machines. *(https://medium.com/@michael.rada/industry-5-0-definition-6a2f9922dc48)*

Table 1. History of Industrial Revolution

| Era | |
|---|---|
| 1.0 | 1780-Mechanisation<br>Industrial production based on machines powered by water and steam |
| 2.0 | 1870-Electrification<br>Mass-production using assembly lines |
| 3.0 | 1970-Automation<br>Automation using electronics and computers |
| 3.5 | 1980-Globalisation<br>Offshoring of production to low-cost economies |
| 4.0 | Today-Digitalisation<br>Introduction of connected devices, data analytics and artificial intelligence technologies to automate processes further |
| 5.0 | Future-Personalisation<br>Industry 5.0 is focused on the cooperation between man and machine, as human intelligence works in harmony with cognitive computing. |

*(https://www.raconteur.net/business/manufacturing-gets-personal-industry-5-0)*

*Lean Innovation Approach*

Over the past years, the speed of innovation has been continuously increasing. The time span between subsequent product relaunches has shortened drastically (Adick, 2008). To keep their market share, companies are forced to bring products to market at an ever-increasing speed while at the same time the number of product variants is rising. In many markets, such as the automotive industry, this has led to a microsegmentation of markets. Companies offer a higher variety of products with a lower sales volume per product variant (Morgan, 2006).

The term "Lean" as a basic trend of organizing business operations was invented in 1990 by Womack et al. in "The Machine that Changed the World". In automotive field, Womack et al. investigated differences in performance between leading western and Japanese automobile manufacturers. They made comparisons about rates, plant productivities, lead-times and found that the Japanese manufacturers clearly outperformed their western competitors in all measures. For example, American and European producers required on average 25.1 and 36.2 hours to produce a car respectively. On the other hand, Japanese car companies needed a time of only 16.8 hours while at the same time achieving a lower defect rate (Womack, 1990).

Although production was only one of the areas investigated in the "Machine that Changed the World", the large differences in manufacturing performance pointed out in the study attracted the largest interest. In their effort to explain the productivity gap, Womack et al. particularly investigated the Toyota Production System (TPS). They found that its underlying principles differed significantly from traditional ways of mass manufacturing employed by the western car manufacturers. Since, as the authors found, Toyota was able to do "more and more with less and less" Womack et al. baptized the concept "Lean Manufacturing" (Womack, 1994).

Despite their close connection, the roots of the Toyota Production System go back much further than the term "Lean Manufacturing". The fundamentals of the TPS were laid in the 1950s when in the Post-World War II era Toyota was forced to manufacture a wide range of different models for small-volume markets (Leung, 2014), (Womack, 1990). Based on these experiments and the experience he had gathered when visiting plants mainly in the US, he developed a production system which was characterized by a particularly high flexibility. The principles and methods developed at Toyota were refined over the years and extended to include its suppliers

(Oke, 2015). Though the basic ideas had been published by Shigeo Shingo, called "Study of the Toyota Production System" in 1980, the new taxonomy developed by Toyota remained largely unknown in the western world until the beginning of the 90's of the 20th century (Womack, 1990).

Today, lean principles have spread well beyond their origin in automotive manufacturing in two major dimensions. Initially, Lean principles have been adapted by a variety of different sectors (Shen, 2012), (Green, 1998). Concepts like Lean Construction or Lean Healthcare which apply Lean in domains other than automotive are – although still in a nascent stage – gaining increasing attention. Secondly, in the last years there has been a growing awareness that the application of Lean to the area of manufacturing is by no means sufficient. Lean rules are increasingly implemented from a lifecycle perspective, in corporate support functions as well as in leadership processes by following the notion of the "Lean Enterprise" (Womack, 2003), (Morgan, 2006).

## Method

### Value Management

When collaboration between man and machine is thought with lean innovation approach, sources are going to be much more important than before. Since; time, raw-material, human resources, finance etc. should be implemented more carefully. In this point, finding the pivot point in relation to costs and risks, must be completed. In other words, eliminating the waste points makes us earn value. Therefore, value management may be thought as an approach in lean innovation management.

Value management was presented to analyse optional materials for the aim of selecting the one that provided same, better, or best function at the least cost. Value management was conceived and practised at the early stage of project conceptualisation as a result of the need for innovation, novelty and advancement of existing practice. There are various aspects of different values from different participants, however the aim of value management implementation is to unify these differences in order to achieve the project's stated goals using minimum resources.

The key principle of value management is to compare the analysis results of all alternatives. It also means that the more options there are and the more detailed explanation can be available about their backgrounds, the better the ability of the value management team to brainstorm and identify the best alternative, using the principle of function and cost. One of the costs regarding to value management is that of collecting information, cost (initial, annual, running, maintenance), lifespan, and the physical characteristics of elements or components to facilitate deliberation by team members.

The Society of American Value Engineers (SAVE) has adopted the term 'value engineering' as observed from their name and public reports published by the body over time. This implies that the term has metamorphosed from 'value analysis' initially proposed by Lawrence Miles during the World War II to 'value engineering' in the United States of America. Published materials from the United Kingdom (UK) have adopted 'value management' to describe the process. The Institute of Value Management (IVM), a similar one, is also tasked with the responsibility of controlling the process of the discipline in the UK. Authors affiliated with the USA, especially those from countries that adopt American English, prefer the term 'value engineering' while those from regions and countries with links to the UK and adopt British English usually use the term 'value management'.

Value planning is the first phase and an approach of value management that is associated with achieving project value during the planning stages of a project. For instance, in construction this is associated with value at the early stage, namely, conception, inception, feasibility, viability, and other planning-related activities of the project. Value planning can be thought as a branch of value control and they are both derived from the principle of cost planning and cost control, which are common terms for management of developmental projects.

Value control indicates a direct link to cost control which is not the same as value management, justifying the reason why the term is not common among value management experts, analysts, or researchers. Value analysis is associated with the post-construction or completion phase, indicating that the practice is related to the value of completed project. This is inclusive of the use and re-use stages of a project.
The most well-known definition of lean principles passes through some major ones depending on value management. The first Lean principle – and the basis for all following principles – is to specify the value as defined by the customer of the particular enterprise. As it's pointed out that providing the wrong good or service

in the right way is muda" (Womac, 19. Therefore, a company has to thoroughly analyze the needs of its customers and clarify which value the organization plans to deliver. Secondly, both identifying and mapping the Value Stream. The value stream shows all phases required to make product/service. Identifying value stream and the way value is realized, establishes when and how decisions are to be made. The key technique behind value stream is process mapping for a very specific reason: that of understanding how value is framed into the product from client's point of view.

For a company confronted with a heterogeneous set of customers, specifying value is not a straight-forward task. While one customer might value a low price of a product, other customers might favor a high quality, a good performance, fast delivery or extraordinary service. Therefore, the appropriate value proposition of a company will strongly depend on the market segment it targets and strategic considerations on how it wants to position itself. Customer value for a company pursuing a penetration strategy will naturally differ from customer value as perceived by a producer of premium goods.

## Results and Discussion

Finally, lean approach implementation requires a much more balanced approach of simultaneously minimizing waste (HR, Money etc..) and maximizing value. Applying lean principles to product/service development may play an important role in fostering innovation and long-term organizational learning. It is so important to find out the right balance between defining norms as guidelines and giving engineers the freedom to pursue unconventional solutions, otherwise this has negative consequences for organizational learning and innovation.

## Conclusion

The effective planning and management of value assets is essential. This can be achieved by the systematic management of all decision processes taken through out. This paper has been prepared for showing the economic need to achieve more efficient and effective infrastructure asset reconfiguration. What is clear is that lean management can be an important tool and has the potential to deliver integration. Lean approach still has a strong currency within the most of the fields; however, it is being applied in isolated knowledge pockets with no integrated view of how Lean processes and lean assets and design can be applied together in a whole system and multidisciplinary lean approach.

Further work may be needed by different industry practitioners, researchers and scientists to develop new integrated lean project and asset management approaches that can be used by supply chains , planners and approaches.

## Recommendations

The method, value management, was taken into account so as to compare optional materials in order to arrive at the best function one at the lowest possible overall cost. This paper revealed that the concept of value management was first introduced to lean approach for industry 5.0. However, it may be implemented in other fields. Due to the varying information and different levels of operation of the implementation, value management is the most common one of all. As advantages as the practice has been in projects, there may be some risks, undoubtedly.

In addition to this, The direct and indirect costs of conducting the exercise should also be identified. The aim of this paper is to frame on the knowledge for subsequent future studies about lean approach or industry 5.0. For instance, value management as a discipline, can be utilized while preperation of interface between industry 5.0 and implementation field.

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