FROM DESIGN TO MANUFACTURING FOR MASS CUSTOMIZATION

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Abstract:
According to the Lean Philosophy it is important to see the waste of time not only during the manufacturing process but also during the designing cycle of a product. It is required more time for the transformation of information from the design phase to the manufacturing phase. It is advisable, that research is conducted toward waste reduction or elimination. The fundamental issues of this transformation will be supported by theoretical rules and principles. These rules and principles should have as a basic background the customer. The rules and the principles should characterize this transformation as a flexible activity that reduces and gradually eliminates the waste of time. In order to achieve this goal, beyond the theoretical base of these rules and principles, a platform should be created, which will accomplish this transformation.

Key Words: Mass Customization/ Lean Philosoph/ Waste of Time/ Disigning/ Manufacturing/ VSM (Value Stream Mapping)

1. INTRODUCTION

Many years ago when the human being, discovered the world, he was thirsty for material goods. Whoever, owned raw materials and the mining wealth, could control and rule the others. Being the unique “king”, he could create needs in the society owing the way of satisfying these needs. These needs meant products that people created and then pushed them to the others. The demand of material goods and products was even bigger after the 1st and the 2nd World War in the area of the Central Europe. For that period, mass production was the solution for the fast and cheap fulfillment of needs. Nowadays, plenty of products exist and people have their own opinion wishing always something different. This differentiation is shaped by Mass Customization and Personalization. It is a public and a social right to have different thoughts, political and religious beliefs and of course customized products and services. It will be wise, to provide room for enabling and accommodating differentiation, because otherwise there is the probability that the society may be led in social and political turbulences. The history has proved it. Nowadays, the industries try to produce customized products usually at a very high cost. The aim is to decrease the cost. It would be useful, the industries focus on the value of products that customers desire and to the decrease of the waste of time during the creation of products. Many researchers as S. Yao, X. Han, Y. Yang, Y. (K.) Rong, S. H. Huang, D. W. Yen and G. Zhang create a concept for “Computer-aided manufacturing planning for mass customization”, G. Qiao, R. F. Lu and C. McLean for “Flexible Manufacturing Systems for Mass Customization Manufacturing” and J. Jiao, L. Zhang and S. Pokharel for “Coordinating product and process variety for mass customized order fulfillment”. The Lean Philosophy can alleviate the waste of time and cost from the industries, in collaboration with the agility and the flexibility, needed to support the manufacturing phase for Mass Customization. The Design of a product can be supported from Marketing information, through contact with the customers, focusing on the value of the product, that the customer wishes. More important is the coupling between the Design and Manufacturing. The translation of information from the language of the Design to the language of Manufacturing for Mass Customization is usually a heavy process regarding cost and time. Perhaps, it would be useful to create a platform, theoretical and then practical supported by a tool. Achieving this, the time of the transformation process can be decreased. Adopting the concept of Open Innovation for the construction of the tool, the transformation
of the information from the Design phase to Manufacturing will be improved more and more, reducing considerably its cost of construction and optimization.

2. THEORETICAL RULES AND PRINCIPLES

The planning and the creation of most systems is based on theoretical rules and principles. The first contact with the customer is the basic information which can support the Design and the Manufacturing. The guarantee of imperishable transport of information, through the processes, is the purpose for the successful construction of the desired product. The effort, the Lean Philosophy makes, through its techniques and its tools, is to recognize and produce the value that the customer wishes. But this suits better standardization and not processes flexibility depending on the demand. The continuous improvement is a characteristic of existing processes and existing products and not for the continuous design from the initial base of the Design phase of new products and their corresponding Manufacturing phase. Agile Management, on the contrary, is focused on the customer and at the same time has the possibility of offering flexibility. It is based on dynamic systems that always want to be adapted in the data of each season and in the different value that the customer wishes. Of course, the Agile Management does not exclude Lean Philosophy. The one can supplement the other. The diversity can be ensured with the techniques of Agile Management and the activity of diversity via the Lean Philosophy. A conceptual figure, that can express the common points of each other, could be the following:

![Figure 1: Agile meets Lean Philosophy.](image)

Research should be investigating if this coupling is common for all the customized products or for some of them. This is a responsibility for the companies worldwide to answer through their own experiences. The industries know their possibilities and the value that their customer wish, so do the customers themselves. The rules and principles can be characterized from:

1) The guarantee of the imperishable information of the value in all phases.
2) Approaching the design of Manufacturing with Agile Management, integrating the flexibility.
3) The guarantee of designing processes of Manufacturing with Lean Philosophy’s methods and techniques, integrating the quality into the process.
3. BASIC PLATFORM

A tool – system that might satisfy the value and the needs of customer, is the answer in the reduction of time and cost from the Design phase to the Manufacturing phase. It concerns a common flexible tool that may be used in the particular phase of creation of a product for all the companies except if research proves that this tool cannot function for all industries and therefore, customized tools should be developed separately for each industry. The aim is:

1) The elimination of waste of time and the waste of cost.
2) The reduction of total time of the design and manufacturing of products.
3) The improvement of quality of products and processes of manufacturing, as the customer conceives it.
4) The achievement of flexibility of Manufacturing processes, via a basic platform - tool, satisfying first of all the above parameters.

The reduction of time of the process “from Design to Manufacturing” will decrease also the total time of the delivery of products. Moreover, the preparation of the production will become faster, with certainty and safety, ensuring the quality of products and processes. In the following figure, a conceptual Value Stream Map (VSM) is presented, where the processes from the design process to the distribution process of a product appear. A regulation of time is presented under the processes. The time that is placed in the lower scale represents the actual value that the customer expects and the processes that develop the product. The upper time is referred to the processes that do not add value to the product and this time should be decreased, since the waste of value and the waste of money is hidden behind the waste of time.

Figure 2: The value of customers and the reduction of lead time.
The flexible process is the process which can change quickly. This process will have set up time = 0. In order to achieve this, the process should be supported by flexible tools. The most flexible resource that has almost set up time = 0, is the human being. The human being could decrease the time in this process and hence the lead time. Until now the brain, the thought, the paper and the pencil have covered the processes from the Design, in order to begin the Manufacturing phase. One however, can also use software tools depending on the needs. The only move that should be done is to notify the need for the creation of such a tool. The objective is to develop a software tool, since the most flexible tools that can help the industries in the elimination of time creating the product, are IT-based tools. This particular software might have the possibility of design Manufacturing processes according to the demand. This tool should be able to propose Manufacturing processes for a family of products, so that from a set of mixed modules a combination of machines, tools, materials and workstations of all customized products could be optimized. A way for designing manufacturing processes is to use Flow Manufacturing techniques and practices, decreasing the time of production of all products and at the same time eliminating the waste and the cost of production. Suitable tools for needs of industries up to now are frequently covered by the techniques of Lean and Flow Manufacturing. But the Lean Philosophy refers to the continuous improvement of the processes. For Mass Customization the continuous improvement of processes, suits the way of designing the product and the manufacturing. The designing techniques of Agile Management are, until now, closer to the concept of Mass Customization named for this purpose as “Flow Customization”. Henceforth, the needs change and the people have the need of differentiation within the consumer society. As a characteristic example could be a research study in Greece, that shows the customer escape to the traditional way of buying cloths. In other words, tailor-made cloths are in high demand by people that visit the couturier of their neighborhood, order cloths that fit them. The price is relatively low and the supply of this product happens within 3 days.

4. CONCLUSION & FURTHER RESEARCH

The elimination of time and waste from Design to Manufacturing could be achieved with the help of rules – principles and a flexible tool – platform. The industries could organize their processes according to the desired value of the customers with less cost. The Design of a product and the simulation of the related Manufacturing processes would be done with an optimized way from the beginning, without the use of the most commonly used process of trials and error on the prototypes. In this way the control of quality choosing the suitable product for the customer can be suppressed. Through the Agile and Lean Philosophies, the capability to design and produce the desired quantity of customized products with Mass Production cost can be realized. In order to achieve this objective, it is believed that further relevant research in the following directions should be pursued:

1) Development of basic theoretical rules and principles from Design phase to Manufacturing phase.
2) Determination of the basic rules that are common for all the customized products or for categories of products and industries.
3) Creation of a platform - tool (probably an IT tool).

This research should not be done only inside the laboratories away from the industrial community and far away from the final customer. It will be useful to set up a network of collaboration of exchange information from industries to the scientific society so that research could be led to the right direction. Open Innovation will be useful as a fundamental concept from all industries, in order to set up tools, which will contribute to the achievement of the Mass Customization and Personalization of products and services.
REFERENCES

