

Lean Design Concept as an Approach to Improve the Design Function of Metal Furniture Products

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Abstract — This paper will manifest the concept of Lean Design and its roll in maximizing value added to the customer and minimizing waste which means designers will be able to design products in the smartest form to enhance the economic function of their products to achieve customer satisfaction. This requires that all Furniture Designers have to be aware with the importance of stakeholder's participation and define value added from their point of view and the waste in design process. In the other hand it is very important that design thinking need to be implemented to ensure that user requirement and expectations has been considered. This paper presented the integration between lean design process and design thinking strategy through specified seven design stages according to international standard ISO 9001:2008.

Keywords— *Lean Thinking, Lean Design, Design Thinking, Value, Waste* .

I. INTRODUCTION

Lean is one the most important concepts that influence in the engineering topics at the last years, this is because many topics like: design, product, manufacturing and production could be applied in the industry without concerning very important concepts are (Value & Waste) which means that the customers will found their requirements has been achieved in the products or services in the smartest form, and met their economic ability. To achieve this aim, designers have to think with the methodology of *Lean Thinking* which considered as a source of these concepts.

A. Research Problem and importance

Metal Furniture products have a wide spread in many important fields like: Medical, Office, Educational, and Hotel Furniture. Many of these products lack the effective value-added for the user as they carry a lot of the costs that the user does not gain added value. For this reason designers should consider a way of thinking to ensure their designs will met customer expectations and fitted to their economic abilities through their products will have maximum value added and minimum waste.

B. Research aim

This research aim to, enhance the design functions of metal furniture products through concept of lean design concept to produce smart product with highly value added to the customer and lowest waste of material, time, effort...etc.

II. LEAN DESIGN CONCEPT - PRINCIPALS - CHARACTERISTICS

A. What is Lean Concept?

Lean Word Means “Free Of FAT” Researchers in the 1980s, lead by Dr. James Womack as they prepared to write the book “The Machine that Changed the World”. Lean manufacturing was developed by the Japanese automotive industry, with a lead from Toyota and utilising the Toyota Production System (TPS), following the challenge to re-build the Japanese economy after World War II.

Lean concept has been associated with manufacturing industries, but it can be applicable to both service and administration processes. It's not a new phenomenon; Japanese auto manufacturers have been developing Lean for over 50 years. WWW.bsieducation.org

B. Lean principals

Lean concept has 5 principals can be applied on product, service and system:

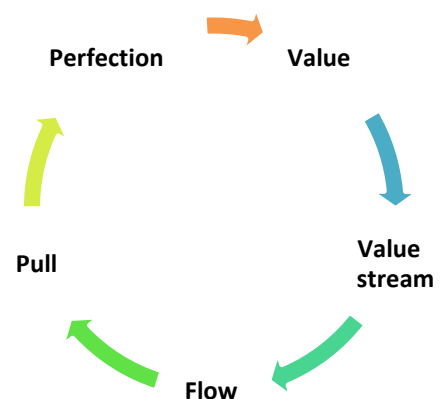


Fig. 1. Lean principals

Value - create values participated with stakeholders.

The value stream – specify the steps which adding value along the process chain.

Flow - plan the value process flow (process mapping).

Pull - define only what is needed by the customer (drive production with demand).

Perfection - produce exactly what the customer wants preventing defects and rework (preventive system).

Value means, any activity that the customer would be prepared to pay for that adds value to the product or service. Value-adding activities transform the product closer to the customer needs and expectations. An activity that does not add value is considered to be waste.

The value stream is the sequence of processes that create values to the customer from raw material to the final product. Complete supply chain process can reflect the value stream. value stream mapping is an integral aspect of Lean.

“The Value Stream is those set of tasks and activities required to design and make a family of products or services that are undertaken with a group of linked functions or companies from the point of customer specification right back to the raw material source.” (Hines et al, 2000)

Flow is a visual tool to plan the process mapping for one product or service by linking of all the activities and processes into the most efficient combinations to maximize value-added activities while minimizing waste such as waiting time between processes is eliminated.

Pull reflects customer driven concept based on a supply chain view from downstream to upstream activities where nothing is produced by the upstream supplier until the downstream customer has to be needed.

Perfection is a continuous improvement to prevent defects or standard deviation to achieve customer satisfaction.

C. What is product waste?

Product Wastes (muda) such as: overproduction, waiting time, transport, process, inventory, motion and defective goods

7 Service Wastes Source : (John Bicheno,2003)

1. Delay such as customers waiting.
2. Duplication as rework.
3. Unnecessary movement such as poor ergonomics in the service encounter.
4. Unclear communication such as need to clarify details, confusion over use of product/service.
5. Incorrect inventory such as out of stock.
6. Opportunity lost such as to retain or win customers.
7. Errors such as defects or error in the transaction, lost/damaged goods. (David N. Card,2006)

D. What are lean design characteristics?

- Value optimization and waste minimizing.
- LEAN Design process applies on the product and the service.
- Thinking should be LEAN from the start.
- The product lifecycle must be taken into mind from the start.

For example, creating a product that has good manufacturability but poor maintainability can be disastrous.

- Stakeholders participation

Stakeholders are (Design, Customer, Operations, and the Supply Chain) have to be included. According to Lean Design methodology stakeholders should participate in the design process from the start. Lean Design takes you to a higher level of thinking so that you can imagine opportunities and solutions you have never considered before. It makes potential downstream waste visible so that your team can find ways to avoid it. The stakeholders understand each other on the needs from the perspective of their area of responsibility. They have to discuss and agree on the problems upfront so that there is clear understanding of the priority of the solving the problems. (Javier Freire, 2002).

- Systematic Innovation

Designers have to understand the importance of iteration? They should have a systematic innovation process to explore and find solutions well beyond the experience and knowledge of your product teams? Iteration is one of characteristics of design thinking

- Definition of ITERATION

Iteration means the act of repeating a process to reach the design team goals or results. Each iteration process is also called "iteration," and the results of one iteration are used as the starting point for the next iteration.

Designers implement Iteration to generate value in design processes. However, not all iteration generates value. Iteration with non value added is a waste and should be eliminated. Moving towards lean design requires a better understanding of both value generation and waste reduction. (Glenn Ballard, 2000)

- Design process waste

Although the design is to convert the input to the output of the process but it is not a random process, but the process have to be organized by the design thinking and design management, so the design team have to be attention to any activities without value added to customer. Negative iteration is one of important sources of waste in design process, but can be reduced by implementing some techniques such as team problem solving, design structure matrix, batch size reduction, least commitment, and set-based design.

These techniques seem to fall into categories: restructuring the design process, reorganizing the design process, managing the design process differently than traditionally, and lastly overdesigning, when there is no better solution, generally, any random activities in the processing of design process could be waste of effort and material and so on.

III. LEAN DESIGN PROCESS

We can define Lean design as the process which promotes the elimination of waste and non-value adding activities in processes, to product or service design. Javier Freire (2002) considers three perspectives to describe the design process (Conversion, Flow, and Value) as shown in Table 1:

TABLE I. COMPARISON OF CONVERSION, FLOW, AND VALUE GENERATION VIEWS

Item	Conversion	Flow	Value generation
Conceptualization of Engineering	As a conversion of requirements into product design	As a flow of processes, inspection, moving and waiting	As a process where value for the customer is created achieving customer satisfaction
Main principles	Hierarchical Analysis, control and optimization of analyzed activities	Elimination of waste (non value activities) time reduction	Elimination of value loss (achieved value in relation to best possible value)
Methods and practices	Work instructions Organization chart, critical path method, responsibilities and authorities	Rapid reduction of uncertainty, trust, team work model, integration and participation	Series requirement analysis, systematized management of flow down requirements, optimization
Practical contribution	Definition of what has to be done	Definition of that what is unnecessary is done as little as possible	Taking care that customer requirements are in focus.
Suggested name for practical application of view	Task management	Flow management	Value management

A. Design thinking

Design thinking is a system for designers to manage the design stages with a dynamic and experimental methodology to develop compelling products and services that resonate with customers consistently producing financial rewards, and building brand loyalty. But beyond customer-centric empathy, beyond creative iteration, beyond the bias to a maker mentality, design thinking has more to offer the modern organization as a means to cultivate creativity and innovation in an organization.

Design thinking is a system that uses the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business can convert into consumer value and market opportunity. (Tim Brown, IDEO, <http://designthinking.ideo.com>)

IV. HOW TO APPLY LEAN DESIGN IN METAL FURNITURE PRODUCTS?

To apply lean design concept with the metal furniture design team we should committed with the requirements of metal furniture design process control according to international standard for quality system ISO 9001:2008 which includes seven specified steps:

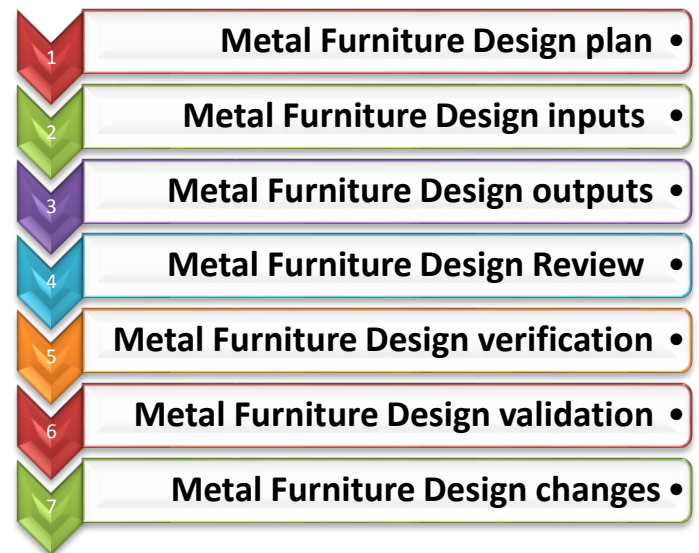


Fig. 2. lean design in Metal Furniture Products

Metal Furniture Design plan to manage the interfaces between different groups involved in design and development to ensure effective communication and clear assignment of responsibility.

Metal Furniture Design inputs to determined and records maintained of product requirements such as Functional and performance requirements, applicable statutory and regulatory requirements and information derived from previous similar designs.

Metal Furniture Design outputs shall be provided in a form that enables verification against the design and development input and shall be approved prior to release.

Metal Furniture Design Review is systematic reviews to evaluate the ability of the results of design and development to meet requirements, and to identify any problems and propose necessary actions of design and development shall be performed in accordance with planned arrangements

Metal Furniture Design verification Metal furniture design shall be performed to ensure that the design and development outputs have met the design input requirements. Records of the results of the verification and any necessary actions shall be maintained.

Metal Furniture Design validation Metal furniture design shall be performed to ensure that the resulting product is capable to meet the requirements for the specified application or intended use, where known. Wherever practicable, validation shall be completed prior to the delivery or implementation of the product.

Metal Furniture Design changes Metal furniture design changes shall be identified and records maintained. The changes shall be reviewed, verified and validated, as appropriate, and approved before implementation. (International Standard ISO 9001/ 2008)

V. CONCLUSION

In this paper, manifest the concept of lean design through focus on product design function to maximize value added from stakeholder's point of view and how to minimize waste in the design process. It considers three perspectives to describe the design process (Conversion, flow, and value generation). This way of lean thinking management requires metal furniture designers have to think with design thinking strategy depending on user needs and expectations which called design human centered and iteration process to enhance added value and minimize waste in experimental methodology. This paper proposed an integration strategy between lean design concept and design thinking through seven specifies stages according to quality assurance system. This paper presents the importance of implementing lean concept in many topics:

Lean Thinking: Designers have to think smarter not harder.

Lean Design: Metal furniture designers have to propose designs maximizing user values such as usability, aesthetic, economic and semiotic function of the product and minimizing any activity with non value added.(A function is a task or activity to be performed by people, equipment, hardware or software. A function relates to the intended use of a product).

Lean process: designers are able to plan design process more effective and efficient considering all the user needs and expectations.

Lean System: managed by lean thinking and design thinking strategy concerning stakeholder's expectations and participation, implementing quality assurance system, producing lean designs for metal furniture products maximizing value added to the customer minimizing waste.

Lean is principally associated with manufacturing industries but can be equally applicable to both service and administration processes.

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