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Lean and Lean Quality Tools Redefining the Product Development

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***Abstract*— This paper explores the phenomenon of Lean Product Development . In the current era of growing global economy, Industries are in need of improving their development processes and innovate their resources. Each company have worldwide customers who deserves better products and services all the time. Extant literature shows that product development has enormous scope for enhancement in quality in products of all industries and lean philosophies can be a immense boon for such industries . The benefits of lean philosophy in product development are unseen by numerous organizations. The organizations applied lean into the manufacturing and logistics operations but the lean thinking have much more to offer in product development and life cycle management of the company and in its products.**

Keywords—Lean; lean product development; Lean Tools; Quality Control, Quality Managment

1.1. INTRODUCTION

This A business structure consists of several phase starting from conceiving of idea to the consumption of product by customer. Globalization and instant access to information, products and services have changed the way of all customers' conduct businesses, Conventional business configuration no longer work satisfactorily. Today's competitive environment demands low cost products with greater quality. All production base organizations must delight their respective customers and should relentlessly look for new ways to exceed their expectations. [S. Elonen, and K. Artto, 2003]. In this regard application of Lean philosophy by its tools in business can be a big boom for mounting product quality by reducing the waste and enhancing the value at the same time. Lean can be applied in all phases of a business structure but in this paper the focus is on application of lean in Product Development as a product having defect in development will lead to an unsuccessful production and Customer Dissatisfaction. A product does not fail at the end (market) it fails in beginning which is its development. Business managers, promotion and marketing, academics of numerous organizations consider Product development as the key of an organization's long-term survival. [Y. P. AGGRWAL, 2013]

2. PRODUCT DEVELOPMENT

Product development is one of the most powerful but complex activities in business [3]. PD is a phenomenon of converting an idea into a product. All production steps, processes and their sequence, Design and specification, their conditions, parameters are decided and documented during the product development activity. Product development and production can be usher into the product in different and numerous forms such as new features/functions, new looks/feel or new technologies and new processes, all bestowing to the origin of keeping customers excited this affects the results in maintaining or leveraging market share. [2,4-6]. The development of excellent product not only increases the satisfaction of existing customers but it also opens new markets and mean while attracts new customers. Development of a good product leverage existing assets and expand an organization's capabilities.

2.1 CONVENTIONAL PRODUCT DEVELOPMENT

Extent literature elaborates and defines the conventional product development and all stages involved in it. From The prospective of Crawford [8] product development had been classified as "Opportunity identification and selection, Concept generation, Concept or project evaluation, Development, and Launch, While Ward [9] represents Design system, Design sub-system, Test sub-system, Test system, and Launch" as the foremost stages of PD in his article "V development processes". Aggrwal [2] also defines the seven different stages involved in PD of a customer design base product -

1. Customer need analysis
2. Defining the design data
3. Selection of the Processes and Sequences
4. Making of Prototype
5. Testing and Evaluation
6. Documentation
7. Handover to Production.

From extent literature it is pointed out that Traditional companies made all design and development decisions affecting quality and cost of product at the individual design engineer level. Customer need analysis was introduced only one to two decade earlier. It was assumed that design and development does not significantly affect quality and Success of product, which was a trend of evolution not by the innovation. Whatever the stages involved and however they are classified, there is a need to implement lean for reducing the waste involved in the product development processes. The principle of product development is to generate or add value to the company/ organization, and the Lean tools should be used accordingly when applied to a development process.

3. LEAN

The very first meaning of lean is "which it doesn't have anything more the requirement": only consume what is either necessary or enhance the value. Credit of introducing Lean into its production technologies was taken by Toyota production System (TPS) which was known as first lean production system [10] and it involves the "supplanted" traditional production methods and delivery of goods and services [11]. This concept has driven a great interest of scholars throughout the world; therefore researchers have conducted a number of studies to examine lean philosophy. The literature on the lean concept primarily focuses on principles derived from manufacturing, especially the Toyota Production System [12]. As a technique, lean was introduced in production department in year 1990 [13]. And with the passes of time the definition of lean has been changed, it evolved the concept of waste elimination with those of the traditional philosophies. For example the waste involved in the phases of product development as discussed in [2] might be: 1. Wrong interpretation of customer need which leads to the dissatisfaction of customer, 2. Any error in conceptual design or in design analysis, 3. Error in evaluation and testing .

4. APPLICATION OF LEAN PHILOSOPHY TOOLS IN PRODUCT DEVELOPMENT

The LPD is sturdily a customer oriented concept which converted the customer expectation into a product. Thus it not only leads to a successful launching of a product but it also exploits the customer professed value in the product as well as in organization [6]. Comparatively implementation of lean in product development is harder than to implement lean in manufacturing as lean focuses on the elimination or minimization of waste which put the objective, innovativeness and quality of the product development at threat. The concept has been argued that has potential to reduce time to market of new product with higher quality and manufacturability. Performance Measurement system is a key factor in evaluating processes. Managing and measuring performance in product development has been seen as a mean to ensure survival of business by increasing quality, reducing time and cost. Scholars argue identifying right metrics and measuring performance of Product development processes play a key role in success of Lean Product development [14].

Lean Product Development is a technique to develop the products with the application of lean tools and techniques in order to eradicate the waste involved in product development processes by enhancing the value at the same time. Lean is an endearing tool when applied in manufacturing processes. Considering at the product development process, the LPD concept apply an integrated system with close collaboration and good communication between different functions and stakeholders this integration refers both to different process steps and to different functionalities within the same process step [11]. Wang et al. (2012)[18] also developed a framework for implementing lean in product development activities. The purpose of product development is to create value in the product. There are several ways in which that task can be accomplished. LPD is one of these concepts. The LPD concept includes many tools that can be used to add value and minimizing the waste at the same time.

4.1 Lean Tools

In order to implement lean Philosophy in product development/manufacturing there is a need of several quality tools which help in a concurrent manner to establish lean Product development/ Lean Manufacturing. Few necessary Quality tools in order to apply lean is Value Stream Mapping and Pull System. Lean Philosophy is not an entirely separate thing from Quality Management and Control. Lean Can only be implemented by the Quality Management and Control tool/Theories and techniques. The use of these tools depends upon the implementation condition of Lean in product development. Lean Philosophy may use one or more than one of these tools at the same time in order to increase value and reduce the waste. Few tools are listed in the given table.

TABLE 1: Several Lean Tools Description

TOOLS	DESCRIPTION OF TOOL
Kaizen	Kaizen is a Japanese term meaning "to change and make good". In English kaizen's mean is continuous improvement. Kaizen seeks to continually improve product development and production processes [15]
Value Stream Mapping (VSM)	It is a basically pencil and paper tool which represents material flow and information of manufacturing as a product passes [16].
Pull System	Production and inventory control can be classified into two groups, that is to say "push" system and "pull" system.
Six Sigma	Six Sigma program was first time introduced in Motorola company in the mid of 1980 [17] for improving product quality.
Total productive maintenance (TPM)	TPM is a methodology for achieving minimum machine downtime (ideal time) by involving everyone in maintenance.
Single-minute exchange of die (SMED)	It is a technique of reducing the time to required change a process for one specific type of product to another.
5S or Workplace organization	5S is one of the simplest Lean tools to implement, provide immediate return on investment, cross all industry boundaries, and is applicable to every function within an organization.

5. CONCLUSION

Lean product development (LPD) has been initiated as a technique which is competent to advance Product development processes and organizations competitiveness in global market.

TABLE 2: Deviation of Conventional PD From LPD

CHARATCERSTICS	CONVENTIONAL PRODUCT DVELOPMENT	LEAN PRODUCT DEVELOPMENT
Design Attributes and Decisions	Made by designer or development team on knowledge base.	Made by customer need analysis and delayed or neglected if not necessary. [2]
Selection of the Processes and Sequences	Sequence was defined as the product to be manufactured Bottle neck and idle man/machine time was biggest issues.	Removes all type of wastes from the process (Bottle neck and idle man/machine time) [19]. Batter utilization of resources.
Prototyping and Testing	Verification to determine what needs to be fixed. Aim of testing was to find the problems in product.	Build knowledge to make decisions and achieve optimal designs Aim of testing is now to check design characteristics.
Manufacturing Involvement	Manufacturing is follower and advisor – receives design	Customer drives and sets tolerances and key characteristics

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