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Editor's address: UASQ - United Association of Serbia for Quality
Kneza Miloša St. 9/I, 11000 Belgrade, Serbia
Phone/Fax: +381 11 32 36 266
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QFD TOOLS EFFICIENCY IN BUSINESS EXCELLENCE RELATED TO SMALL-SCALE PRODUCTION

Miloš Vorkapić[1], Siniša G. Minić[2], Bogdan Popović[1],

[1]*Univerzitet u Beogradu, IHTM-CMT, Beograd, Republika Srbija, worcky@nanosys.ihtm.bg.ac.rs; bpopovic@nanosys.ihtm.bg.ac.rs*;
[2]*Univerzitet u Prištini, Učiteljski fakulte u Prizrenu - Leposavić, Republika Srbija, sinisa.minic@pr.ac.rs*

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Abstract: An *overview of the application of QFD tools through the application of modular architecture in the new product realization is presented in this paper. The QFD application can be considered as an engineering method in the analysis of the buyer's desires and business opportunities in business excellence. The application of modular architecture in product design provides the realization of new and diverse products suitable for re-use as well as for materials recycling. From this point of view, we have tried to explain the significance of the new Lean philosophy from the aspect of re-use of products, reduction of waste and employees' efficiency increase. In this regard, the QFD tool represents the link between design and production process improvement.*

Key Words: *lity function deployment, House of Quality, Lean philosophy, Modular design, Business excellence*

1. INTRODUCTION

In many studies [1-5] QFD is defined as a method which ”translates” the buyer's requirements into targeted design while the product's quality is secured in its critical points. QFD method represents the tools for planning a new product development or for improving the existing product [6-8].

According to Prasad [9], a new product development enables a company to achieve: buyer's trust and gradual market mastery; loyalty and customer familiarity with products; possible collaboration and learning from customers and maintaining the prices for a longer time.

QFD method as an adequate tools for increasing a product quality is not sufficiently applied in Serbia unlike in developed countries in which it has proved to be useful in practice. The aim of this scientific paper is to distinguish the importance of QFD tools in bussiness excellence through symbiosis of engineering design and production process improvement with emphasis on waste reduction.

2. QFD – THEORETICAL FRAMEWORK

improvement; and increased productivity [8].

The purpose of QFD is to use resources to the maximum and to reduce waste to the minimum. According to the study of Zairi and Youssef [6] it is possible to reduce the following by means of QFD tools: time for product development up to 50%, number of changes at construction up to 50%, initial and engineering faults up to 30% and necessity for servicing up to 50%.

QFD, in its origunal version, is consisted of four phases [10-12]: 1.) HOQ-House of Quality, 2.) Parts deployment 3.) Process planning and 4.) Production planning, See Figure 1.

According to Figure1, *House of Quality* is the key strategic tool which helps companies to develop products adjusted to customers' needs [13-16]. Therefore, House of Quality, is consisted of six elements (see Figure 2):

Customer needs and requirements (WHAT). This element is known as „customer voice“. The concept implies the transfer of customer needs in technical requirements/characteristics of a product, production plan and the very production process.

Technical requirements of a product (HOW). This element represents the conditions of design, product characteristics, engineering requirements or a complement to quality. These requirements are accepted by project teams in an early phase and according to strategic aims of the company.

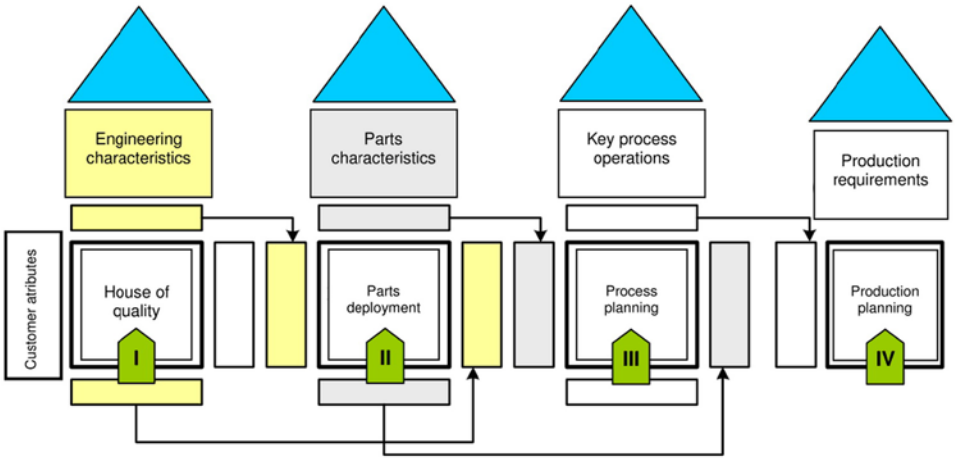

Figure 1. QFD Phases [12]

1. This element is sometimes called the "company's voice". Customer requirements tell the company „what to do" while technical requirements show the company „how to do". In such a case the company has to make certain conditions and priorities.
2. Relation matrix of WHAT and HOW. House of Quality is mapping customer wishes and requirements showing the company what to produce and how to satisfy customer final needs. Mapping process of WHAT and HOW is then continued in separate matrix. Working with these matrices enables a detailed description of a future product development, in other words, it helps a detailed description of basic design activities.
3. House of Quality Roof. Roof is used for the specification of various technical characteristics which have to be improved and it considers in what extent a change of characteristics within a function will influence other functions. The desired changes in some functions can cause negative effects in other functions. This correlation makes a compromise between engineering and customer needs.
4. Total priorities of technical requirements and additional objectives. At this point a designer can go back to any original phase related to a new product. It represents an important framework which is focused on giving priorities to the most significant customer requirements. It also innitiates a discussion searching for a compromise between a relation of a design structure and its parameters that will satisfy customer requirements maximally with limited resources.

House of Quality offers a direct connection between anticipated objectives and parameters of design. According to [17], regarding the improvement of design quality in some companies, QFD model has helped in reducing design time for 40%, as well as design costs for 60%. Traditional methods cannot guarrantee that the targeted level of customer requirements will be fulfilled through the implementation of design requirements. Namely, design can have positive effects on one of customer requirements while it can affect negatively some other requirements. [14]

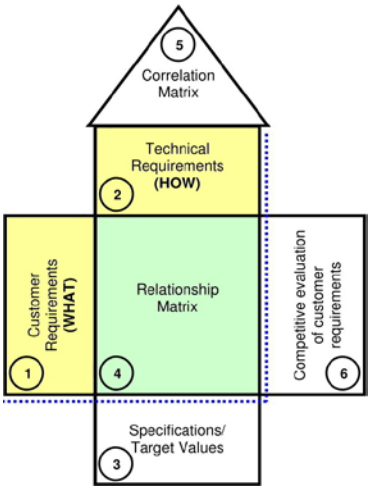

Figure 2. House of Quality [20]

3. QFD AND MODULAR ARCHITECTURE

Modular architecture is an engineering methodology which takes into consideration both physical and functional relations among the components within a product life cycle [18]. It represents a new platform which Serbian companies should more think about.

According to [19], it is necessary that all product modules are designed in order to be appropriate for re-use and recycling. A new product is therefore based on a family of different products and by dividing a module a basic component can participate in various variences of the same product. A palette of new products is obtained by considering a modular concept within QFD analysis.

Standardization of invisible or unimportant parts and modules is considered by QFD tools. On the other hand, visible parts and modules have to be open for product adjustment [20].

4. LEAN CONCEPT IN PRODUCTION

Lean koncept (LC) has been successfully implemented in a lot of big companies. However, there is still poor evidence on its implementation in small and mid-size companies. Problems related to LC implementation in small-scale production can be

justified by lack of qualified workers, lack of finances and the presence of a large palette of products.

Implementing LC in small-scale production enables the improvement of production process, better communication with customers and in general, better business performance on the market with reduced waste. Theoretic sources [21] offer guidelines for the elimination of faults in small-scale production and they can be useful for company's business excellence in Serbia:

1. Reduce delays in production process (reduce delays in the working process, avoid bad planning, eliminate lack of equipment or materials, anticipate lack of capacity and appropriate procedures).
2. Reduce transport of work object (reduce unnecessary moving of people and raw materials, improve organization at workplace, eliminate surplus of warehouses).
3. Reduce the movement of employees (provide an adequite workplace which reduces frequent pauses at work).
4. Reduce stocks (surplus of stocks results in additional handling, documentation,space and costs).
5. Reduce the production of defective parts (poor or insufficiently good realization of business processes, inadequate training of employees and lack of procedures).
6. Pay attention to product design (reduce the number of steps by the implementation of QFD tools).
7. Use human resources adequetly (intellectual potential of employees is not used enough).
8. Provide permanent control at workplace (regular control of parts and joints as well as final products).

5. ENGINEERING AND LEAN PHILOSOPHY

The development of a new product can be viewed from the standpoint of engineering philosophy based on competitiveness [22]. The aim is to develop a new product and improve the production process. QFD tools represent the most useful tools in regards to this aim.

QFD uses the House of Quality in order to transfer "customer voice" in engineering specifications. In the same time, QFD is widely used in industry as a technique within TQM. A new approach has been recently applied in strategic planning, in other words, it describes how traditional QFD concepts and methods can be used in production strategy formulation and how they can be coordinated with business strategy.

Engineering approach is not focused on the product life cycle well, therefore there is a question "what to do" but not "how to do". In addition, a focus on customer is missing and only a flow of information is improved which all results in massive pile up of documents. On the other hand, Lean philosophy implies the improvement of production processes through waste reduction and better flow of values. It considers a product life cycle by asking "what to do" for a customer and "how to do it". In Table 1 there is a comparison of Engineering and Lean production philosophy.

QFD	It is important to control the processes through the improvent of quality system and design. Emphasis is on preventing the appearance of faults.
Lean	It is important to control the production processes and improve quality system through shaping both a product and organization.

Table 1. Comparison of business philosophies

In Lean philosophy a value flow is possible only after waste elimination [23]. Regarding this, Table 1 is presenting Lean tools significant in designing organization [24].

	Lean
QFD	A method related to „customer voice" with minimum time and effort spending.
Challenges in designing	Involves "intelligence" in entire organization in order to solve costs issues.
"Maturity model" design	Leading in designer tools implementation within a company.

Table 1 Lean – designing tools

6. CONCLUSION

Customer is given a role of the main drive of company's innovative activities. A company is in permanent search for new ways of attracting customers through: costs reduction, quality improvement, increasing product reliability, improving delivery, development of new products.

Quality of new product realization is directed to the elimination of all faults both in the organization of a company and in the very production process.

With this work we want to point at the significance of QFD tools incorporated in Lean philosophy in order to maintain the company's development through the application of modular architecture. IF LC is implemented and carried out properly, it may result in : stocks reduction, process time reduction, product quality increase, increase of employees efficiency and space and machine utilization.

QFD offers clear priorities in regards to management, market research and technical evaluation of competitors. On the other hand, it enables team members to achieve new knowledge at every process step. However, management should allocate certain resources to train employees so they could implement QFD tools.

QFD tools makes possible a product analysis for multiple life cycles. It asumes a well created design which prevents the appearance of unnecessary and

unstable sub-joints and also simplifies better assembly/disassembly as well as faster product servicing.

In addition, consideration of modular architecture in product realization makes a significant advantage in the implementation of QFD through: better organization and communication and faster product launching along with waste elimination according to aforementioned Lean philosophy.

Speaking about business excellence, companies are offered engineering tools in which input size is presented by customer demands and requirements opposed to real situation and abilities of the company to satisfy these requirements. It is difficult to harmonize these opposite issues during the process of designing and production. For this particular reason the company is trying to bridge the gap between customers and designers through the realization of multiple modules.

Finally, the application of QFD tools enables company's sustainable development through: efficient management of customer requirements, improved work on design and production, clear analysis of elements related to return, recycling and storing products. proizvoda.

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