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Quality function deployment an improvement tool for designing the product – Review

Dhruv Kumar [1], Dhananjay Kumar Raman [2]

[1, 2] IIMT College of Engineering, Greater Noida

Abstract- Quality function deployment is the planning and development tool for designing the product. Number of investigator has been applied quality function deployment tool at the level of product designing, industries, financial and recourses planning and allocation. A review of recent literature has been carried out these aspect of QFD.

Keywords: Quality function deployment (QFD), Technical Attribute (TA), customer need.

Introduction

Quality function deployment (QFD), that originated in Japan in the late 1960s, is a concept and Mechanism for translating the voice of customer' into product features through various stages of Product planning, engineering and manufacturing. It has been used as a customer-oriented approach to facilitating product design by analyzing and projecting customer requirements into product attributes. By describing the interrelationships between customer requirements (CR) and technical attributes (TA) of a product, and the correlation among TAs, target levels of TAs will be determined in order to achieve higher overall customer satisfaction.

Kurt Matzler and Hans H. Hinterhuber [2] Has tried to show how Kano's model of customer satisfaction can be integrated into quality function deployment. In this way product development projects can be managed more systematically and suggest that many projects fail and lead to the introduction of products that do not meet customers' expectations. (Show in Figure 2)

QFD practical step-by-step tools and methods which ensure a better understanding of customers' needs and requirements, as well as procedures and processes to enhance communication by focusing on the voice of the customer within a product development project. Also focused on the customer satisfaction and loyalty of the customer , market share is direct depend upon the customer satisfaction and loyalty

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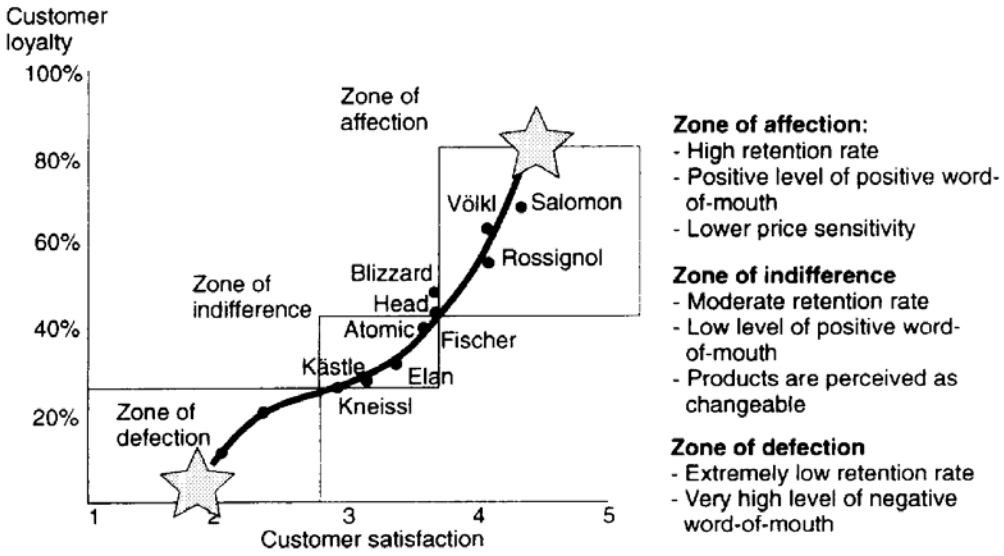

Fig 1 Customer satisfaction and customer loyalty

Karin Bergquist and John Abeysekera [19] QFD applied in the area of ergonomics and discussed to translate the needs of safety shoe users in the cold climate into product characteristics. By use QFD analysis of the safety shoes revealed that the characteristics of the steel toecap were receiving the highest overall weighting, which means that improving the design of the steel toecap would lead to higher customer satisfaction. The user needs are mapped out and integrated in the total product development process by QFD. The QFD method would therefore be a suitable complement to ergonomic methods where the aim is to identify the human needs and requirements. By this study they proposed user needs viz. thermal comfort and the fit, were highly related to the characteristics of the toe cap and sole and size of shoes respectively.

Lai-Kow Chan, Ming-Lu Wu [1] proposed a operational approach to quality function deployment (QFD) and a customer-driven quality management system for product development. Provide relevant elements in house of quality (HOQ) and 9-step model is proposed to help build such an HOQ. A number of 9-point scales are developed whose uses could help unify the various measurements in HOQ to avoid arbitrariness. Also suggest subjective assessments in the HOQ process, and symmetrical triangular fuzzy numbers (STFNs) are suggested for use to capture the

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vagueness in people's linguistic assessmenIn Chinese vegetable restaurant that involves 10 customer needs (WHATs), nine technical measures (HOWs) and five restaurants and compare four restaurants to own restaurant.

Gulcin Buyukozkan,Orhan Feyzioglu,Da Ruan [6] has proposed a new fuzzy group decision-making approach is used to fuse multiple preference styles to respond Customer need in product development by QFD. Case study has been illustrated for the development of the hatch door of a car. In this paper, a new integrated approach of the fuzzy set theory and the group decision-making enables us to combine linguistic and numerical information for QFD. Conclude numerical values to linguistic domain will decide on the priorities based on the fuzzy majority concept. Which can used for very flexible and suitable for the various QFD decision situations.

Lian-Yin Zhai-Li-Pheng Khoo-Zhao-Wei Zhong [14] proposes a novel approach based on rough set theory and introduces two concepts called rough number and rough boundary interval to address this issue. A comparative case study presented in this work shows that the proposed approach has significant advantages compared to the prevailing fuzzy number based method in this paper step by step case study for fried processing subjective linguistic assessments in QFD. Rough set theory was proposed by Pawlak as a novel mathematical tool to handle imprecise, vague and uncertain data. It overlaps, to some extent, with many other theories dealing with uncertainty and vagueness, especially with fuzzy set theory the rough boundary intervals and the lower and upper limits of rough numbers are directly calculated based on the data given.

Kwang-Jae Kim a, Herbert Moskowitz b, Anoop Dhingra c, Gerald[4] presented an integrated formulation and solution approach to Quality Function Deployment (QFD). Conclude that Various models are developed by defining the major model components (namely, system parameters, objectives, and constraints) in a crisp or fuzzy way using multi attribute value theory combined with fuzzy regression and fuzzy optimization theory. The proposed that many approach would allow a design team to reconcile tradeoffs among the various performance characteristics representing customer satisfaction as well as the inherent fuzziness in the system .Multi attribute value theory combined with fuzzy regression and fuzzy optimization theory could allow the design team to mathematically consider

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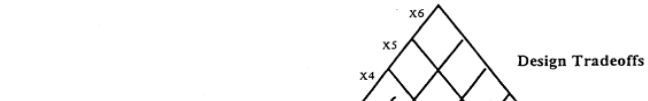
tradeoffs among the various performance characteristics and the inherent fuzziness in the system and determining how much flexibility is warranted or possible to improve a design. The fuzzy multi objective models developed and illustrated with example.



Performance Characteristics (Whats)		Relative importance	Engineering Characteristics (Hows)						Customers Perceptions (Customer Competitive Analysis)								
			Energy to close the door	Check force on level ground	Check force on 10% slope	Door seal resistance	Road noise reduction	Water resistance	ours	A's	B's	C's	D's	E's	F's	min.	max.
			x1	x2	x3	x4	x5	x6									
Easy to close from outside	y1	0.3	✓			✓			1.6	3.7	3.3	4.0	3.2	1.7	2.7	1	5
Stays open on a hill	y2	0.2		✓	✓				1.7	1.8	1.1	3.6	2.9	1.4	3.5	1	5
Rain leakage	y3	0.1				✓		✓	3.7	2.9	2.7	3.9	3.1	2.8	4.0	1	5
Road noise	y4	0.1				✓	✓		3.0	4.9	2.2	3.0	3.8	4.2	3.2	1	5
Cost	y5	0.3	✓	✓		✓	✓		4.0	2.5	3.8	2.9	3.5	4.3	3.6	1	5
Z Value									.42	.50	.46	.64	.57	.45	.58		

Objective measures	Measurement units	ft-lb	lb	lb	lb/ft	db	psi
	Our car door	11	12	6	3	9	70
	Company A's car door	9	12	6	2	5	60
	Company B's car door	9.5	11	7	2	6	60
	Company C's car door	8.5	14	7.5	3.5	6	65
	Company D's car door	10	13	6.5	2	7	60
	Company E's car door	10.5	10	5.5	2	8	60
	Company F's car door	8.9	14	8	3	6	63
	minimum	8	9	5	1	5	50
	maximum	12	15	9	5	10	100

Figure 2 House of Quality for the design of car door

Irem Dikmen, M. Talat Birgonul, Semiha [2] has been examine the applicability of QFD as a strategic decision-making tool after the construction stage of a housing project to determine the best marketing strategy, and compare between the performances of different competitors and to transfer the experience gained from the current project to the forthcoming projects. A QFD team has been formed to collect and verify the expectations of the customer profile of the sample project, which was a

high-rise building project located in Ankara, Turkey. this paper also points out the limitations and breakthroughs of the QFD methodology. Critical success factors are proposed to improve the performance of the QFD methodology in construction projects. According to this case study it has been observed that QFD can be utilized to determine the right decision marketing strategy, to make a comparison with the competing alternatives and to collect data which could increase client satisfaction level in upcoming projects.

Om Prakash Yadava Parveen S. Goel [17] Has Establish the framework for target planning for customer satisfaction driven quality improvement efforts in the product development process. Proposed a link between corporate decision making and engineering decision making by integrating best practices and structuring technical activities. Potential vehicle attributes are classified and prioritized for further improvement using Kano model and quality function deployment. The mathematical models are formulated as optimization problems to cascade down top-level targets to lower-level elements within given constraints. A case example is presented to demonstrate the proposed methodology. Case study is establish for an auto industry for efficient and effective target planning and subjective approach for frequent trade-offs and iterations. And conclude that CAE simulation and advancement of other sophisticated tools makes this methodology more realistic and beneficial during the early stage of the product development process.

E. Ertugrul Karsak, Sevin Sozer, S. Emre Alptekin[16]. In this paper robust evaluation method is proposed for the interrelationships among customer needs and product technical. His research is focussed on analytic network process (ANP) to fulfil the requirements of the customer. And incorporate other factors such as cost, extendibility and manufacturability of product technical requirements. This paper presents a zero–one goal programming methodology that includes importance levels of product technical requirement derived using the ANP, cost budget, extendibility level and manufacturability level goals to determine the product technical requirement to be considered in designing the product and also introduce a new concepts of actual achieved degree and planned degree of attainment of TAs, primary costs required, actual primary costs required and actual planned costs, a fuzzy approach to

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modelling QFD planning problems combined with consideration of design budgets and fuzzy primary costs required, and a genetic algorithm-based interactive approach has presented in this paper. With this interactive approach, the best balance between enterprise satisfaction and customer satisfaction can be achieved. A numerical example is presented to illustrate the application of the decision approach

William Ho [15]. Worked on the applications of the integrated analytical hierarchy and discuss the two main issues

(i) Which type of the integrated AHPs was paid most attention to?

(ii) Which area the integrated AHPs were prevalently applied to?

And have done literature survey on the integrated AHPs and applications from 1997 to 2006. And conclude that the AHP can be combined with other techniques, such as mathematical programming, QFD, meta-heuristics, SWOT, and DEA because of its simplicity and great flexibility. Comparatively, the combined AHP-GP and AHP–QFD were the two most commonly used integrated AHPs. Second, it was observed that the integrated AHPs can be applied to a wide variety of fields and problems successfully. Logistics and manufacturing are the two application areas to which the integrated AHPs were most frequently applied.

Jiafu Tang, Richard Y.K. Fung, Baodong Xu, Dingwei Wang [18] presents a customer-oriented approach and tool in product design. considering "financial factors and uncertainties in the product design process and fuzzy formulation combined with a genetic-based interactive approach to QFD planning. two types of fuzzy optimization models are discussed in this paper. These models consider not only the overall customer satisfaction, but also the enterprise satisfaction with the costs committed to the product. With the interactive approach, the best balance between enterprise satisfaction and overall customer satisfaction can be obtained, and the preferred solutions under different business criteria can be achieved through human computer interaction. To clarify the performance of the model and solution, a simple example is taking to developing a new type of pencil. According to the survey in the marketplace, there are four major customer requirements (CRs), i.e. easy to handle (CR1), does not smear (CR2), point lasts (CR3) and does not roll (CR4), and

"five technical attributes (TAs), i.e. length of pencil (TA1), time between sharpening (TA2), lead dust generated (TA3), hexagonality (TA4) and minimal erasure residue (TA5). The relationship between the CRs and the TAs, and the correlation between TAs and CS are illustrated in House of Quality.

Richard Y.K. Fung, Jiafu Tang, Paul Yiliu Tu, Yizeng Chen[9] considered QFD planning problem with resource allocation. The aim of the author to archive technical attribute by resource allocation for achieving higher customer satisfaction. Taking into account the technical and resource constraints, and the impact of the correlation among TAs, the operational QFD planning with resource allocation is formulated as a linear program and solved by a heuristics-combined Simplex Method. presented a procedure to help a design team to implement this QFD design planning with resource allocation in practice. This model can bridge the gap and conflicts between the design targets at the strategic level, and resource allocations in the part deployment and operational process planning level. An example illustrating the operation of the planning process is also given.

Mohammad Abdolshah and Mohsen Moradi[20] have proposed that FQFD is a powerful tool in designing and developing products and decision making from supplier selection to Eco-design product development. compare with traditional QFD, using fuzzy logic is unavoidable. Combining fuzzy logic and QFD in a new methodology named fuzzy QFD. Proposed that linear and nonlinear programming models can find the optimum solution, mostly researches tend to use this methodology.

E. Ertugrul Karsak [21] In this paper, fuzzy multiple objective programming approach is proposed as an alternative to the classical mathematical programming formulations for prioritizing design requirements in QFD planning process. The relationships between customer needs and design requirements, importance of customer needs, sales point data, extendibility and technical difficulty of the design requirements are incorporated into the model using linguistic variables, and uncertain cost data are efficiently represented employing triangular fuzzy numbers. The fuzzy multiple objective programming framework presented in this paper for prioritizing design requirements extends the single objective viewpoint of

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maximizing customer satisfaction by considering the company's other design related objectives, and thus, precludes an unreasonable QFD planning in practice. Show that fuzzy number ranking method does not provide actual result so fuzzy multiple objective programming approach is taken account for the purposes in fuzzy operations.

In this paper, importance of customer needs, relationship between customer needs and design requirements, and extendibility of design requirements are expressed using linguistic variables 'very low (VL)', 'low (L)', 'medium (M)', 'high (H)' and 'very high (VH)'. In here, the membership functions that were previously prescribed for these linguistic variables are used and show by graph

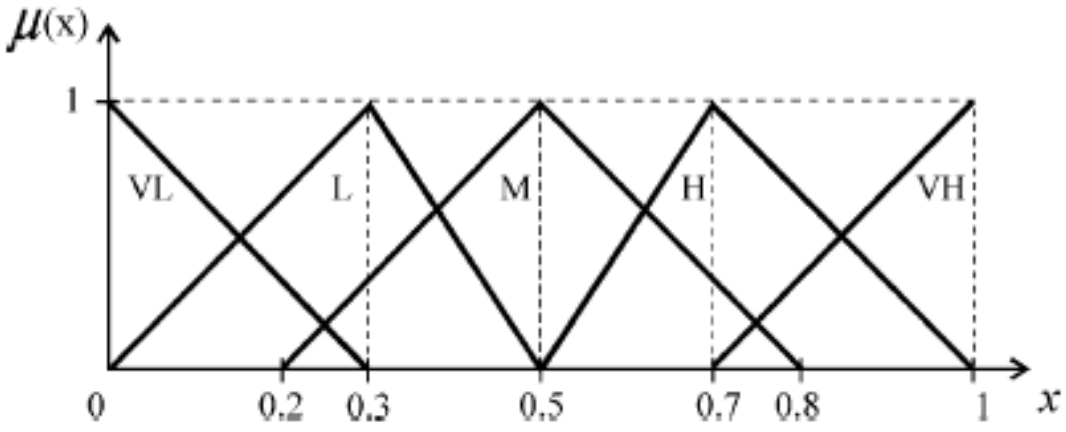

Fig. 3. Membership functions for linguistic variables regarding importance of customer needs, relationship between customer needs and design requirements, and extendibility

Chougule Mahadeo Annappa, Kallurkar Shrikant Panditrao [22] In this paper methology of 6 section QFD is proposed and applied on this procedure in the furniture industry . also compare current manufacturing technology with new proposed methodology and Average Customers Satisfaction of Computer work station before & after Improvement

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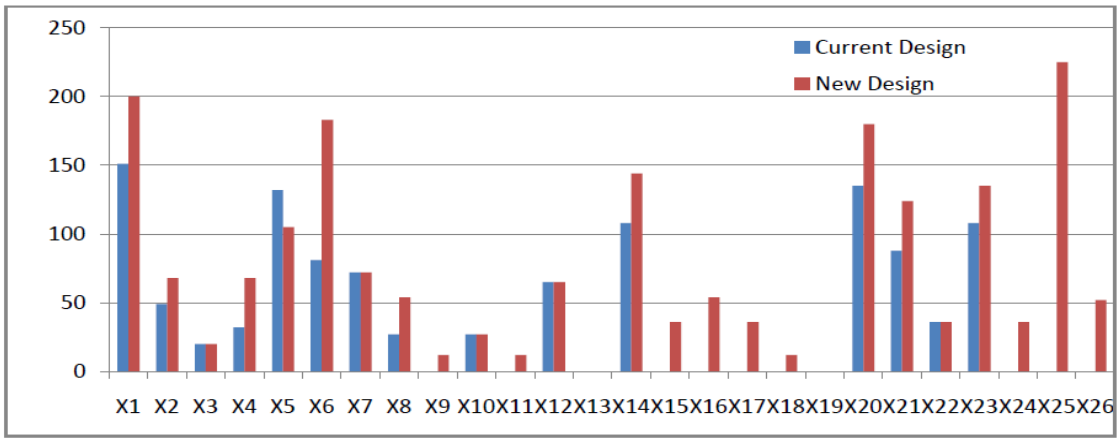

Figure 4 Average Customers Satisfaction of Computer work station before & after Improvement

His analysis shows that newly designed and developed products varied in durability, assembly, attractiveness, Additional Features, shape, Size, Ease of cleaning, functionality and quality of the materials.

Conclusion and future scope

In this paper brief review of some important papers have been investigated. From above discussion QFD can combined with other technique such as Kano model and value engineering. Number of QFD methodology is applied such as analytical hierarchy process and fuzzy logic based QFD and give mathematical model in design, manufacturing, resource planning for overall satisfaction of customer. Many researchers applies AHP process and take a case study from any specified field and some of researcher applied fuzzification and defuzzyfication by crisp method. After analysis of different models we conclude strength, weakness and literature vacancies.

We conduct such QFD study to update the needs of QFD researcher and practitioners. For most of discussed paper are study and QFD matrix based model and performed largee calculation. These calculation can be performed by QFD Designing software which makes calculation easier. QFD can also be used in logistic and supply chain management and expert system which make QFD model user friendly and small calculation

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First Author: Dhruv kumar received his M.Tech. in product design and development in 2008 from MNNIT Allahabad. He currently is in IIMT college of engineering as Assistant Professor in the department of Mechanical engineering and teaches various courses. His area of interest is functional analysis of product, quality function deployment, kano model analysis and value engineering.

Second Author: : Dhananjay kumar raman received his M.Tech. in design in 2007 from MNNIT Allahabad. He currently is in IIMT college of engineering as Assistant Professor in the department of Mechanical engineering and teaches various courses. His area of interest is effect of electromagnetic field on the fracture properties of the material, quality function deployment.