A Refined Application of QFD in SCM, A New Approach

Nooshin La'l Mohamadi

Abstract—Due to the fact that in the new century customers tend to express globally increasing demands, networks of interconnected businesses have been established in societies and the management of such networks seems to be a major key through gaining competitive advantages. Supply chain management encompasses such managerial activities. Within a supply chain, a critical role is played by quality. QFD is a widely-utilized tool which serves the purpose of not only bringing quality to the ultimate provision of products or service packages required by the end customer or the retailer, but it can also initiate us into a satisfactory relationship with our initial customer; that is the wholesaler. However, the wholesalers' cooperation is considerably based on the capabilities that are heavily dependent on their locations and existing circumstances. Therefore, it is undeniable that for all companies each wholesaler possesses a specific importance ratio which can heavily influence the figures calculated in the House of Quality in QFD. Moreover, due to the competitiveness of the marketplace today, it's been widely recognized that consumers' expression of demands has been highly volatile in periods of production. Apparently, such instability and proneness to change has been very tangibly noticed and taking it into account during the analysis of HOQ is widely influential and doubtlessly required. For a more reliable outcome in such matters, this article demonstrates the application viability of Analytic Network Process for considering the wholesalers' reputation and simultaneously introduces a mortality coefficient for the reliability and stability of the consumers' expressed demands in course of time. Following to this, the paper provides further elaboration on the relevant contributory factors and approaches through the calculation of such coefficients. In the end, the article concludes that an empirical application is needed to achieve broader validity.

Keywords—Analytic Network Process, Quality Function Deployment, QFD flaws, Supply Chain Management

I. INTRODUCTION

SUPPLY chain management is a natural extension of the right-sizing and re-engineering, performed by organizations in the past.[1] These operations involved optimization, resulting in productivity and technological flexibility. What it has also made possible is forging a cemented relationship between the customers and organizations. Apparently, one of the aims of a supply chain is to satisfy customers' requirements and a customer would be satisfied as long as the supplier ensures high quality [2].

Bringing such sense of quality to the provision of products and services is long known as a managerial strategy. What we reach while considering quality, is the development of a customer-oriented supply chain. There are various tools to be utilized in this case including Quality Function Deployment, which is more of a managerial philosophy [3], a strong tool for analyzing various factors that improve customer satisfaction, yielding graphs and matrices.

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QFD has been widely implemented in various supply chains, leading us to a *quality outcome*. This, perhaps, is the reason why its benefits have been, theoretically, extolled in many texts: higher customer satisfaction, greater customer focus, shorter lead time, knowledge preservation and documentation, promoting teamwork, analysis of the market data and so tremendously forth.

However, just similar to any other technique, it comprises of faults, which have, unfortunately, been ignored during years of practice. This study aims to identify two basic yet noteworthy flaws: Firstly, companies tend to assume unreasonably that customers with different levels of willingness and ability to cooperate in a supply chain possess the same level of importance and secondly, it is beyond doubt that time has not been kept in perspective properly and the fact that after a period of time, customers' expression of demands fall into a state of decay has met blissful ignorance.

Therefore, as mentioned above, while applying QFD, companies do not consider diverse importance ratios for different customers who express their expectations of the company. In the proposed approach, ANP utilization has been suggested as a solution. In addition, through the paper the sensitivity of customers' expressed demands to time has been thoroughly discussed and some relevant factors causing the case have been inspected and in some cases they have been determined as factors of paramount importance.

The remainder of this paper is organized as follows. The literatures on SCM, QFD and ANP will be reviewed in the next section. Then, following a brief presentation on the application of ANP in QFD, the new concept of demand mortality coefficient is introduced and further elaborated on. Finally, the concluding remarks, on a new QFD approach and a more efficient one, are mentioned.

II. LITERATURE REVIEW

A. Supply Chain Management

Struggling to gain competence, in the 1970s, companies fought their way through standardization and optimization of manufacturing processes. They strengthened the design of products and service packages and simultaneously brought integration to production systems. Following this, in the 1980s, manufacturers faced an increasing demand for a broader range of products and services. [4]

Expectedly, higher expectations of variety were to be met which eventually led to more flexible manufacturing lines in factories. Yet it was well realized that without familiarity with marketing policies, close inspections of the marketplace and logistics improvement, gaining competitive advantages and a broader market share seem rather unachievable. Ultimately, in the 1990s, supply chain management paved its way up to the stage to serve such purposes and result in a noticeable customer satisfaction.

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A supply chain consists of a number of members, including: the suppliers, the manufacturers, the distributers or the wholesalers, the retailer and finally the end customers. [5] Although all these members are, lawfully, separate from each other, they are correlated with regard to financial and information flow. And to manage a supply chain is to bring integration and smoothness to these flows.

The integrated supply chain management, in particular includes: Planning and Managing supply and demand; Warehouse Management; Optimal Inventory control; Transportation and Distribution, Delivery and customer's delight following the basic principles of supply chain management viz. working together; Enhancing revenue; Cost control; Assets utilization besides, customer's satisfaction. [6]

To be successful in the future the supply chain should be market-driven or demand-driven, where the key model is oriented toward virtual networks, information bases and perceived customer value.

B. Quality Function Deployment

Quality function deployment (QFD) has been dotted around in various companies for a long time. It was initially utilized in Japan in 1970s in ship-building industry. This method was put to use in Mitsubishi's heavy industries in 1972 and afterwards in Toyota in 1977. It then invaded the US in 1984, where it was later applied in Ford, General Motors, Mazda, Motorola, Kodak, Zirax and IBM.

In brief, QFD is a manufacturing tool that serves the purpose of translating the customer requirements (whats) into proper product engineering characteristics (hows). In fact, QFD is applied during the whole production process; beginning from the very first seconds of the design process leading to the very last seconds of the final manufacturing process.

Generally, QFD is composed of five phases: Listening to the Voice of Customer (VOC), completing the House of Quality (HOQ), Designing the Product, Designing the Process and eventually controlling the Process.

To start a QFD system, customer requirements- and not the available technology- must be taken into consideration, so the voice of customer (VOC) appears to be the driving force behind this system. As expected, companies tend to 'customize' the QFD process and unfortunately, while doing so, they exclude the initial step of listening to the customer.

They assume: "we know what the customer wants, we've been doing this for ages", and this is where QFD fails before it even starts. People who participated, end up feeling a bit cheated noticing that they wasted their time using QFD and reached the result they could easily reach even without QFD and here comes the conclusion that 'shortcuts make for long delays'. [7]

Therefore, it is very apparent that listening to the customer is an unavoidable must, which can progress by utilizing different tools including: interviewing the consumers, sending questionnaires, attaching opinion cards on the products, following customers' complaining cases, creating focused groups and telephoning.

Having done researches, in 1991 Dr. Hauser and Griffin reported that 'interviewing' can be considered the best possible method as through interviewing almost 20% of the consumers, 80% of their requirements can be recognized. It is necessary to bear in mind that at this stage, customers' expectations must be taken seriously and shall not be converted to the company's desires and policies.

Based on the belief that "products should be designed to reflect customers' desires and tastes" and to define the relationship between customer requirements and product capabilities, House of Quality (HOQ) was added to QFD as a new tool in 1972. House of quality, a diagram symbolizing a house, was actually developed to break the lengthy, time-consuming and complex process of QFD into bite-sized logical chunks.

Figure 1 depicts the basic structure of a house of quality, which includes six departments of: 1. Customer requirements (Whats); 2. Requirements evaluation (Whys); 3.Technical requirements (Hows); 4.Relationship matrix of Customer requirement and Technical requirement (Whats vs. Hows); 5.Relationship matrix of Technical requirement (Hows vs. Hows); 6.Technical Target (How Muches)
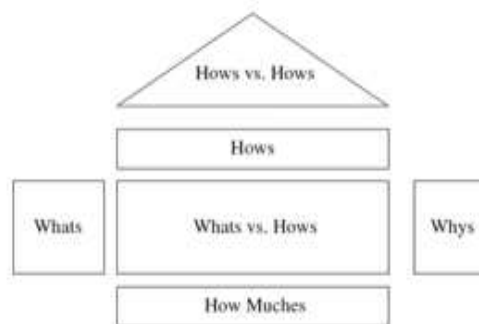

Fig. 1 The Basic Structure of a House of Quality

It is in the requirements evaluation section that we meet the flaw which was previously mentioned in the introduction. From a more precise point of view, once we gather the voice of customer and determine the requirements and customers' demands, we move to the next stage of evaluating these demands and calculating the related relative importance, without even realizing that, in the real-world, every customer's expression of demands possesses a different level of essentiality and importance due to the behavioral and environmental factors which influence that customer.

In a supply chain, QFD can be implemented among all members. In the coming sections, we consider its application between the manufacturers and the wholesalers. ANP is introduced in the following section as a suitable approach towards the process of taking the wholesalers' reputation into account.

C. Analytic Network Process

While considering multi-criteria decision analysis, ANP appears as a general theory that represents a conceptual and perfectly-organized framework.

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It has been practically applied in complex decision making processes in a variety of aspects including benefits, opportunities, costs and risks. [8]

ANP has been derived from Analytic Hierarchy Process (AHP) and is known to be a more general process. As illustrated in figures 2 and 3 bellow [9], AHP structures a decision problem into a hierarchy including a goal, decision criteria and alternatives; however, ANP structures the problem as a network.
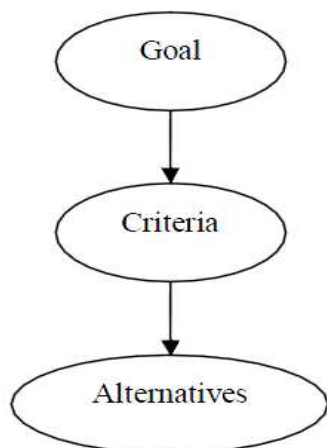

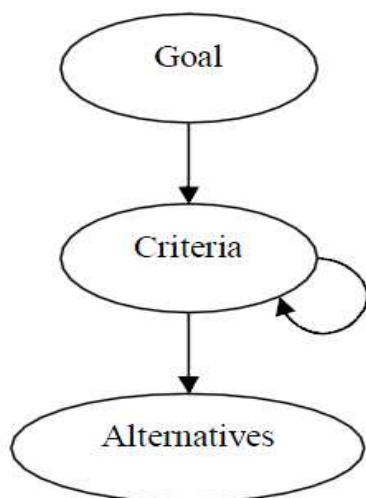Fig. 2 A Hierarchy Structure

Fig. 3 A Network Structure

Concisely, unlike AHP, ANP does not require independence among the elements in the network. Since in ANP, the decision criteria and the alternatives can be interdependent, it is considered even more effective in many real-world cases.

On the whole, there are three steps to follow in ANP: Stating the objective, defining the criteria and picking the alternatives. It is also essential to calculate the relative importance among the alternatives and determine the ranking of the criteria, which can be accomplished using judgment, pair wise comparison or any other suitable method. Additionally, the flow of influence shall be considered.

The flow of influence in a feedback network model is specified by links.

A link from one element, such as a criterion, to other elements, such as alternatives, specifies that influence can flow from the former to the latter. [10]

The alternatives are compared with respect to the criteria and matrixes are produced. By squaring the matrixes and summing the rows, then dividing each row sum by the row total, the first set of vector weights (in other words, the first eigenvector) is computed.

This process shall be iterated until the solution doesn't change from the previous iteration. Next, utilizing the Vector weights, a super matrix is created for the alternatives with respect to each criterion and the vector weights of the criteria with respect to each alternative. Multiplying this super matrix by itself numerous times until the columns stabilize and become identical, the alternative with the highest rank is chosen as the best answer.

Based on the so-mentioned benefits of ANP and the fact that the process considers interdependent alternatives, it can considerably assist supply chain managers to overcome their paucity of awareness and quit implementing Quality Systems depending on the groundless assumption that all the wholesalers in a supply chain shall be provided with similar level of importance.

In this matter, we should bear in mind that there are criteria of association that can significantly affect the success of the supply chain in the long term and applying ANP, we can take the wholesalers as our *alternatives* and then rank them with regard to the criteria given previous to this part.

Our suggested criteria here include: the wholesaler's location, its relationship with the retailers, the years of cooperation with the company, the amount of the wholesaler's sale in years, the ease o trade, and how responsible the wholesaler feels with regard to logistics services. Apparently, ANP functions in a better style, since as stated above, the criteria are interrelated. For instance, the wholesaler's relationship with the retailers does depend on its location.

D. Demand Stability Coefficient

It has been observed that demands and queries pointed out by consumers are prone to change. The truth is that customers behave differently during months and even weeks of production and unfortunately don't normally adopt a stable behavior.

Such inconstant mannerism has been so widely noticed that the reason for it cannot be announced as specific to individuals' lifestyles and it should be rooted somewhere other than their personal lives, somewhere inside the society that consumers belong to.

To some extent, inconsistency in expressing demands is related to our competitors' behavior in the marketplace, and several other factors including customer-visit frequency, customer life expectancy, technical dominance of the product, the pace and level of self-service business[11].

Relying on the conducted researches with this regard, it has been discovered that enhanced competitiveness in the marketplace for the target product is caused by a sense of haste and rush in peoples' lives.

The more noticeable the haste is, the more tangible this competitiveness, and thereby change of ideas is. Browsing further through lifestyles in societies, an understandable interrelationship can be found between life expectancy and the so-mentioned sense of haste. While there's low life expectancy in a society, consumers tend to be more receptive to brand-new gadgets and changes that seem to be aimed at making the world an easier place to live in.

It is obvious that they are actually struggling to live more easily and make the most use of life, as inside, they face the phobia of having to deal with lack of time. Customers try to get their hands on any possible experience and make the most use of the time they might be having ahead and eventually, this whole subconscious fear and phobic lifestyle leads to serious competitions in the market. The reason is, assumedly, the fact that easy-life products with new features seem more acceptable.

Moreover, due to researches, customers have always been victims of their short attention span, getting distracted and blown away from their initial purposes of purchasing products. Doubtlessly, they are directed into places where they feel impressed and excited about newly-designed products that might or might not ease their course of life. Apparently, what they are following is nothing but their emotions.

On balance, it would be essential to point out that all the above-mentioned factors among the people of the target society can heavily affect the competitiveness of the market, which ultimately leads to instability and unreliability in consumers' expression of demands.

Therefore, in applying QFD in systems of production, it is necessary to introduce a demand stability coefficient in which these factors that are specific to the target society of customers play major roles.

III. Conclusion

With regard to the implication of ANP in QFD that was pointed out in the previous section of this essay, it is undeniable that different members behave differently and have their own strategies of cooperation. In this very specific matter of the wholesalers in a supply chain do come from a diverse range of levels of importance.

Furthermore, this article recommends an added column to the matrix of House of Quality which includes a set of demand stability coefficients that can be either calculated utilizing different methods in industries or can be suggested by a team of experts.

Next to all the advantages and ease that QFD has brought about in supply chain management, there have been pitfalls and difficulties that have actually been omitted with the assistance of other methods and techniques, here ANP. QFD helps if done properly but if not, and then brings confusion, frustration and lost time, energy and efforts.

References

[1] R.K. Gupta and Pravin Chandra, Integrated Supply Chain Management in Government Environment
[2] SCM and Total Quality Management and QFD, Sabitha Z.B., School of Management
[3] M. Zarei, M. P. Fakhrzad, M. Jamali Paghaleh, Food Supply Chain Leanness using a developed QFD model
[4] OptiRisk Systems: White Paper Series; Supply Chain Reference Number: OPT 003, 24 April 2008
[5] R.K. Gupta and Pravin Chandra, Integrated Supply Chain Management in Government Environment
[6] R.K. Gupta and Pravin Chandra, Integrated Supply Chain Management in Government Environment
[7] Dr. Rowe, Six Sigma Group, QFD, What's the problem
[8] Murat BÄuyÄukyaz³c³¤ and Meral Sucu, the Analytic Hierarchy and Netwrok Process
[9] Metin DAĞDEVİREN* , İhsan YÜKSEL, Personnel Selection using Ana;ytic network process
[10] Murat BÄuyÄukyaz³c³¤ and Meral Sucu, the Analytic Hierarchy and Netwrok Process
[11] Inger Roos, Bo Edvardsson and Andres Gustafsson, Customer Switching Patterns in Competitive and Noncompetitve Service