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JOINT OF QFD & DEA & SUPPLY CHAIN

Kambiz RADMAN *

SCM is both a theory and an applied style. That's an approach that reduces cost or saves money for increasing customer satisfaction. Nowadays, the progress of technologies is faster than in the past. So, it seems to be very necessary that the supply chain has to convert to a supply network. Therefore, the use of several techniques such as QFD&DEA can progressively control and evaluate a company to compete with other companies. Quality Function Deployment (QFD) is a powerful tool that translates the Voice of the Customer (VoC) into the Engineering Characteristics (ECs). Their important criterion is customer satisfaction. One part of QFD matrix that compares competitors, is called benchmarking. This part helps a company in decision making and choosing strategies. Also, to use of Data Envelopment Analyses (DEA) models (especially CCR), transshipment process etc. from identification of business process types, Inputs/Outputs, until identification of optimal transshipment and deployment plans of Supply Chain Network. This paper presents a suggestion of a systematic method accompanied by a short review of joint of techniques.

Key words:

Supply Chain;
Supply
Network;
Benchmarking;
QFD;
DEA;
Systematic
Method

JEL classification: O21; M11; L81; L11; L15

1. INTRODUCTION

In today's global economy, improvements in how supply chains are managed allow raw materials for a personal computer to be sourced in Brazil and India, manufactured in China, assembled in the U.S., and shipped anywhere in the world. Such a complex flow requires planning in order to be successful. The internet and web have opened the new gate in SC that can transfer on line information between several groups of SC. Therefore, SC has changed and grown into SN. Therefore, organizations and companies have to

accept that they live in an IT era and have to use it, because nowadays, the progress of technologies is faster than in the past, so, it seems to be very necessary that the supply chain has been converting into a supply network. Therefore, the use of several techniques such as QFD&DEA can progressively control and evaluate a company in order to compete with other companies.

The advent of the Internet has allowed a number of companies to further reduce inventory and increase customer options with relatively short order-to-delivery cycles. This process is often

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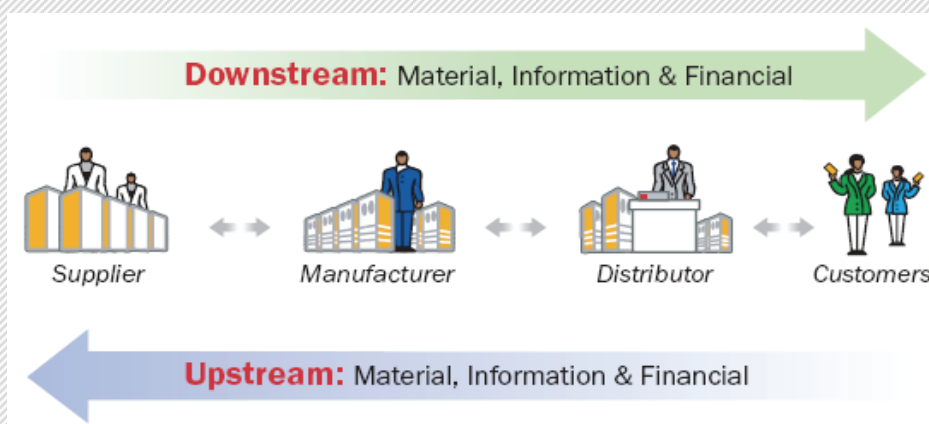


Figure 1. Supply Chain Flows

referred to as 'just-in-time' inventory management, considered for a long time as the holy grail of manufacturing businesses. Just-in-time processes allow manufacturers to source components from suppliers only when they are needed on the assembly line. Professor Hausman says: "In the future, competition will be supply chain vs. supply chain, not company vs. company."

A supply chain is a network of partners that produces raw materials, subassemblies, and finished products, then distributes them via various sales channels to customers. Along this chain, there are three major flows: material, information, and financial. (Figure 1)

As known, the financial flow in a typical supply chain includes thousands of invoices and payments in a given year. The scale of this problem is challenging corporations to find ways of streamlining their processing. There are also considerable savings to be obtained in other categories besides processing improvements.

In addition, the financial flows have not been addressed with the same sense of urgency as material and product flows. As a result, business-to-busi-

ness payment has not seen a corresponding increase in efficiency in the last 10 years, despite the availability of automated payment programs from organizations such as Visa. Most companies have not integrated payment into their supply chain management systems, resulting in inefficient financial processes. This is a curious anomaly since, as will be discussed later, from the automatization of financial systems can benefit not only the payment process but also the supply chain as a whole (Radman *et al.* 2004).

This paper has been divided in two parts: one is the e-dimension and another one is the technical dimension on the next sections that have been used and prepared by Planning and Project Control unit of Commissioning Department of "SAFF Offshore Industries Company (SAFF Co.)".

2. E-DIMENSION

The author believes that the suggested model can increase the efficiency of the SC, but it has to be improved. It includes three groups: Users, Goods/

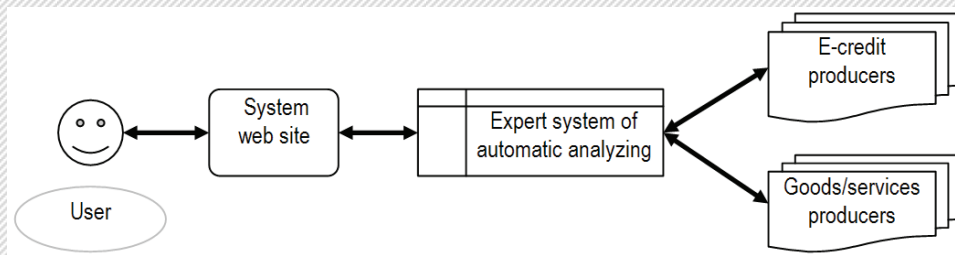


Figure 2. The Suggested System Parts

Services producers and Money Suppliers (Figure 2).

Customer's requests are achieved by the web site and then the information of producers is taken on web site. To be noted, this information is updated and upgraded continually. The third part of the system are the e-credit suppliers, which is important for increasing flexibility in improvement several money and e-credit cards (Radman, 2004).

Nowadays, one of the most important problems is e-credit and lack of accepting them from some organizations, which confuse users. In this system, cost of goods or services are taken by

system and the producers can receive its cost from system. In these interactions, the system recognizes e-credit producers first via its relationship network and secondly benign assured. Finally, the system allows the producers to satisfy users' needs.

In order to reach this target, the system has to include several databases to keep the information added via WWW (a web site of the system) and related organizations. One of the system's duties is information updating and analyzing. You should pay attention, because its results remain in this database, in order to be immediately accessed (see Figure 3).

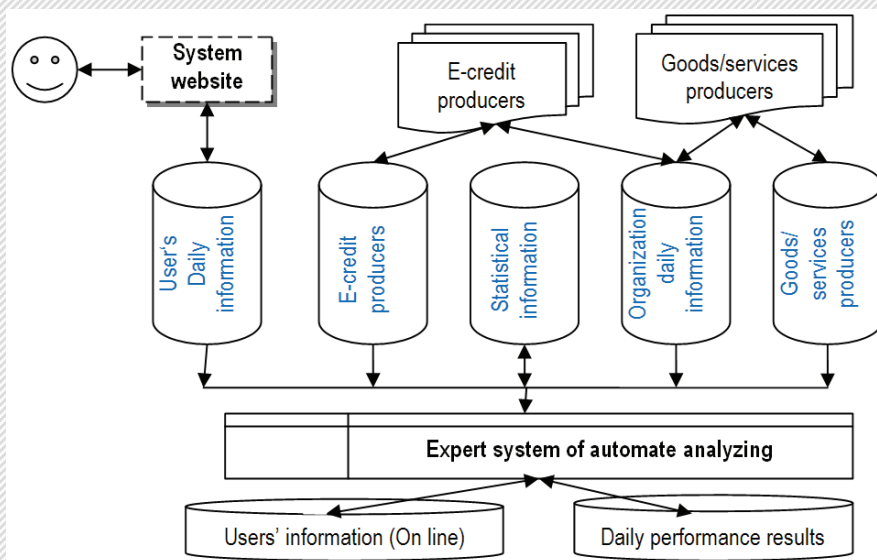


Figure 3. The Structure of Suggested System

For quicker research, there are two separate databases for goods/services producers. For example, the producer A produces goods B, but after a while regrets. Therefore, the producer A should not be in the database list. But this producer has produced B and we cannot remove it from the list. In order to solve this problem, we use two-producer's databases. One of them is an active producer's database, and another is the regretted producers. This is useful to search for goods/services because the on line users' database has to preserve the created active user's information as long as the system can follow out the users' performance. After the users exit, this information is transferred to the "daily performance" database and the expert system checks it and then it is transferred to the "statistical" database.

Altogether, the web site system should be user friendly in order for all users to can have a fast and amazing tour versus the boring chore acts. Meanwhile, the system can get the customer's interests, estimate the market situation by its expert unit, and finally information is transferred to the "user daily information" database. The usage of this information will enable the estimation of the customer's requests and interests and then the web site of the system would be updated and upgraded. Nowadays, web site managers can play an important role aiming the company's target via the creation of web sites, in order to increase the customers' satisfaction. In the next part of this article we will present the seven standards i.e. disclosures, product/service availability, privacy & security, confirmations and notifications, help and customer support, additional enterprise practices that can help some organizations to obtain success in the IT era. It should be noted that only a local

e-commerce does not have a positive influence upon organizations. Therefore, passing from the supply chain (SC) to the supply network (SN) is a real fact and undeniable, so paying attention to e-commerce and Internet trade is very important and vital. If a company does not use e-commerce, it will lose its market share and the world of competition, which equals to losing money and income. Using expert and on-line systems can help them in the items below:

- 1- They can predict the market requests on the added information.
- 2- They can lead customers to select the best items.
- 3- They can inform organizations in order to know customers' needs etc.

3. TECHNICAL DIMENSION

3.1. DEA (Data Envelopment Analyses)

The supply chain is an alliance of independent business processes, such as supply, manufacturing, and distribution processes that perform the critical functions in order to fulfil the process. The effective design and management of supply chains consists of production and delivery of a variety of products at low cost, high quality, and short lead times.

Studying the phases of SC obtained, the efficiency of the SC can be increased by using a mathematical programming approach and QFD tool. This paper is a result of an effort lagging behind in the development of formal decision models for SCN design. Primarily, SCM involves three planning phases: strategic level planning, tactical level planning, and operational level planning (Advanced Manufacturing Research, 1998). Strategic level planning involves SCN design, which determines the location, size, and

optimal numbers of suppliers, plants and distributors to be used in the network. The survey in the *Figure 4* shows that we can use DEA models (especially CCR), transshipment process a.s.o. from identification of business process types (Inputs/Outputs), up to the identification of the optimal transshipment and deployment plans of SN. For this, assume that p suppliers, q manufacturers and r distributors are selected in phase II; the transshipment scenario can be represented as shown in *Figure 4*.

The efficiency scores obtained from the CCR model may not accurately portray the performance of some units because the input and output weights are unrestricted. That unit can place for them a maximum emphasis on a relatively less number of input and output measures and achieve a high efficiency score. Furthermore, the study shows that PEG (Pair - wise Efficiency Game) model is an effective model, among several other models (Banker *et al.* 2004).

A model of multi parameters like *Figure 4*, is converted to a simple model of single parameter by CRS (Constant Return to Scale) model. In the next lines we show the non-linear planning for *Figure 4* (Charnes *et al.* 1978):

$$\text{Maximize } \frac{u' \times y_i}{v' \times x_i}, \quad (1)$$

Subject to:

$$\frac{u' \times y_j}{v' \times x_j} \leq 1 \dots j = 1, 2, \dots, q \quad (2)$$

$$u \geq 0, v \geq 0$$

$[U]_{r \times 1}$: A vector of distributors' weight factors, $[V]_{p \times 1}$: A vector of suppliers' weight factors, $[X]_{p \times q}$: A matrix of suppliers' weight factors, $[Y]_{r \times q}$: A matrix of distributors' weight factors, U', V' are transpose of U, V .

This model is solvable via several methods, but if $v' \times x_i = 1$ then the non-linear problem is a linear problem with added limitation:

$$\text{Maximize } u' \times y_i, \quad (1)$$

$$\text{Subject to } v' \times x_i = 1 \quad (2)$$

$$\frac{u' \times y_j}{v' \times x_j} \leq 1 \dots j = 1, 2, \dots, q \quad (3)$$

$$u \geq 0, v \geq 0$$

3.2. QFD

(Quality Function Deployment)

Quality Function Deployment (QFD) is a powerful tool that translates the Voice of the Customer (VoC) into the Engineering Characteristics (ECs) and it can help the organization to systematically determine the design requirements in order to develop product with higher customer satisfaction.

The quality function deployment (QFD), introduced by Akao in 1972 at

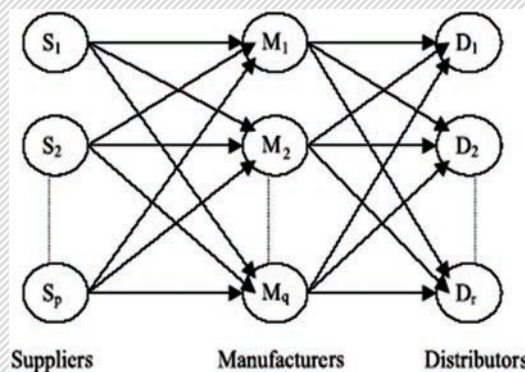


Figure 4. SC Network

Mitsubishi, is a tool to help the product development team systematically relate to the customer's attributes. These attributes represent the overall customer regarding the design of the requirements that represent technical performance specifications of a developing product. It has several models, but the American Supply Institute has selected a four matrix methods, because:

- 1- It is more famous than other methods;
- 2- It is user friendly;
- 3- It shows reasonable relations and several parts together;
- 4- It covers important product steps with other parts.

As companies strive to create better value for their customers in today's competitive marketplace, managers are beginning to realize the important role that the SCM plays. As they seek new ways to compete, one technique that has made headlines in the management community is benchmarking.

Benchmarking is a systematic management process which helps managers to search and monitor the best practices and/or processes. The search for the best practices may not be limited to direct competitors. The goal is to emu-

late and exceed the "best in class". Therefore, the search goes beyond the practices of direct competitors, and encompasses all leading organizations regardless of industry affiliation (Revelle *et al.* 1998).

The first matrix of QFD is House of Quality (HoQ) or benchmarking matrix that identifies the importance of design requirements for product development as a critical factor, because it leads to successful products in the shortest possible time. So, its elements are summarized in the following seven steps (Rezaee *et al.* 2002):

- 1- Determining the customer attributes.
- 2- Obtaining the design or engineering requirements (ER).
- 3- Relating design requirements to the customer attribute (CA).
- 4- Completing the customer competitive survey.
- 5- Determining the relationships among design requirements.
- 6- Performing the competitive technical benchmarking.
- 7- Calculating the technical targets of design requirements and estimated cost (Figure 5).

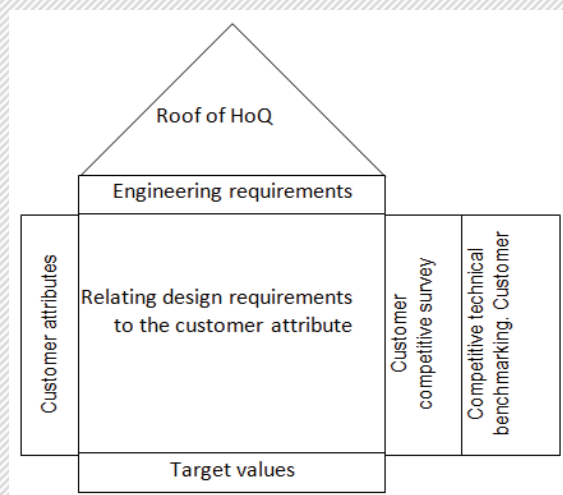


Figure 5. Traditional HoQ

The author considers that creating a feedback cycle of costumers to producers, designers, suppliers and support services can be a desirable opportunity to evaluate costumers' changes in order to obtain good and permanent parametric process. Hence, it has suggested that the QFD is combined with SPC (Statistic Process Control). Having a point of view for updating the dynamics of production and the process parameters by costumers' characteristics is an important parameter in SC efficiency. (Figure 6)

Using dynamic QFD can restrict the rejected productions, waste time, increase costs and reduce benefits while it is one of SC's (or SN's) subjects. SC efficiency needs continuous improvement in the manufacturing process, suppliers' process, and the dynamic reply to costumers' feedback.

The dynamic QFD has the liables above, which assess the limitation tolerance by SPC. The dynamic QFD approach seems more reasonable and liable in the SC within the feedback cycle with costumers' satisfaction data. Dy-

amic QFD mechanism can finance flows in order to get high quality of SC efficiency (Adiano *et al.* 1998). (Figure 7)

Also, most of the times, qualitative numbers appear in the relationship matrix. So users have to convert them to quantitative numbers via desirable methods such as fuzzy logic. (Radman, 2005)

4. CONCLUSIONS

The high speed of technologic growth has caused the analysis and estimations on each market, while is important and necessary process. So using techniques like DEA, QFD, SPC etc. can improve productivity and increase risk power on optimum decision making. Therefore, using them can be a powerful tool in choosing the market and its factors. There are analysed factors and choices via mathematics and industrial engineering methods. Revised and corrected processes are decisions finally made in order to get

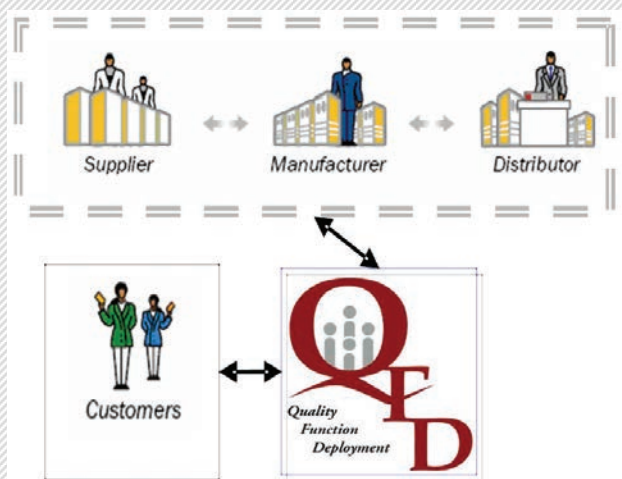


Figure 6. Dynamic QFD

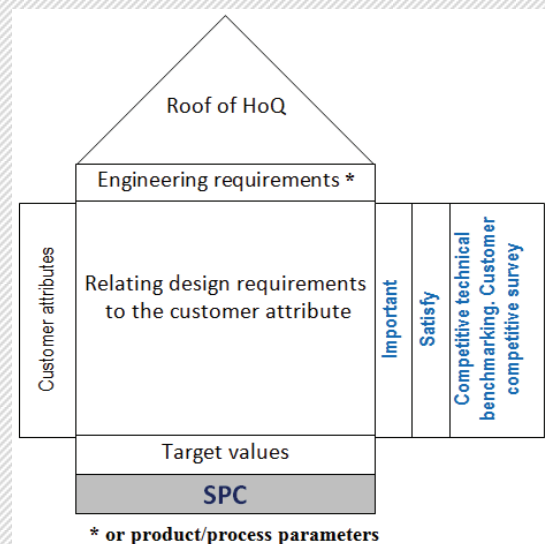


Figure 7. Dynamic HoQ

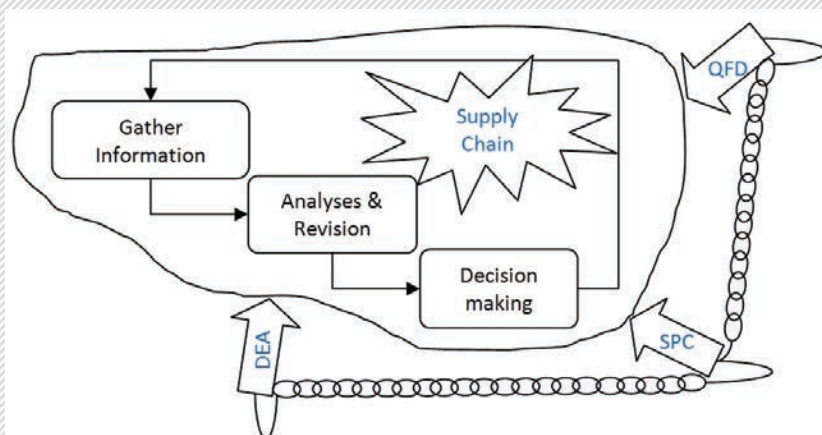


Figure 8. Jointed Techniques Chain

productivity (Figure 8).

In the Planning & Project Control (P&PC) unit of Commissioning Department of "Offshore Industries

Company (SAFF Co.)", these techniques are used and formed especially in the Procurement Engineering Department (PED).

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