"Analysis of Market segment with Quality Function Deployment"

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Abstract: The professional disc jockey industry is a specialized market where isolating the customers needs is of great concern. Learning, and satisfying customer requirements is challenging to any industry but what makes this industry different from the others is the actual customer identification process is unclear. Unlike the automotive industry, where the customer is well defined and products are marketed towards a specific client, the disc jockey industry has many different types of customers. Some of the customers are known and some are unknown.

The breakdown of the customers by ranking per product is hard to calculate as well. There is an area of opportunity in the disc jockey market to provide industrial engineering tools in the form of quality function deployment to help identify customer needs and wants and convert those needs and wants into feasible and profitable finished goods to be sold worldwide.

National, a professional disc jockey audio company in Cumberland, RI, has expressed their interest and need for the improved method of product development. Specifically, National would like to reduce the number of engineering changes during the product development process thus reducing costs and production lead time. National has also expressed interest in developing relationships between disc jockey (DJ) product features and their customer requirements to aid in paradigm shift decisions.

Currently the DJ market includes older technology items such as turntables and vinyl and also includes innovative technology products such MP3 media, computer controllers, and hard drive integration. These market behaviors suggest a paradigm shift to include the technologies of today, as well as the interface of the past, which must be identified and evaluated. The QFD process has been selected for this evaluation due to the historical and theoretically potential QFD benefits to the project. This selection of QFD must be evaluated and justified to create a new paradigm that satisfies the DJ products market. The following literature review will show that QFD is state of the art. Following that, the methodology used is shown, including a justification for QFD, and the detailed implementation

Keywords: Quality Function Deployment, Market Segment.

INTRODUCTION

Since the 1960's, Quality Function Deployment (QFD) has been implemented in various industries worldwide providing a tool to aid in the research, development, and production of various products and systems that they are developed in (Karlsson, 1997). QFD often utilized matrices in the form of competitive analysis charts as well as house of quality diagrams. The combination of these tools aid in new product development, and show companies where new hybrid products can be developed to maximize profits (Bergquist and Abeysekera, 1996). QFD keeps the customer focus through all sections of the process.

QFD has typically been used in larger corporations and has been integrated across all products. Recently, QFD has been implemented in smaller firms with more specified markets (Chan and Wu, 2002). The purpose of this research is to perform a case study in a smaller market to a new product in the development stage where there are many constraints to the traditional model that are not typically present in larger corporations.

This Paper is also intended to provide a clear methodology of implementing QFD into the disc jockey product market. Upon completion the results of the QFD implementation will be measured based on comparing the output results to historical data for similar projects.

LITERATURE REVIEW

This literature review has been categorized into three basic categories in regards to the primary use to this research. Much of this literature, however, has useful information in regards to all of the categories.

Overview Literature

Salheigh and Monplaisir discuss ways the marketplace has shifted towards global operations. Their work goes into detail regarding how the Internet has been able to integrate the market from global perspectives. It is suggested that design engineering should be based on methodologies that can analyze current practices to then estimate the capabilities of performing certain operations concurrently with collaborative efforts (Salheigh and Monplaisir, 2003). The framework suggested consists of six modules that provide a plan for computer-supported collaboration.

Gonzalez *et al.* discuss the concept of incorporating intelligence on markets, consumers, and technologies in strategy environments are discussed (Gonzalez *et al.*, 2004). The paper links marketing and manufacturing strategies by developing continuous improvements strategies.

The idea of putting marketing and manufacturing together to provide the competitive advantage in the market is discussed. This paper is very important to the proposed research because it provides the solid groundwork for keeping the organizations goals and the end customer in mind. The work provides a good start to showing how to bridge marketing and manufacturing in a technology driven industry. Customer feedback is also discussed. Tan and Shien discuss how the quality of a product or service is directly correlated to customer satisfaction (Tan and Shien, 2000). QFD is implemented in their research specifically in the form of competitive analysis charts and methodologies which can be implemented in the proposed research. There is also an example of how to use customer perception with the Kano model. The Kano categories include rating features as 'must- be', 'one-dimensional' and 'attractive' which is used to describe features in consideration for products in development. This model is illustrated further in regards to its implementation with this specific QFD study.

Bergquist and Abeysekera discuss how to use QFD to determine the importance of product characteristics (Bergquist and Abeysekera, 1996). The paper discusses target values for product characteristics as well as relationships. Scaling scores and weighting methodology for relationships are referenced which lead to the desired outcomes. Their case study is a shoe design ergonomics study conforming to customer requirements as well as meeting required safety standards.

Matzler and Hiterhuber discuss how to use Kano's model of customer satisfaction for use in product development projects to increase success rate (Matzler and Hiterhuber, 1998). The approach described comes from a management background as compared to an engineering background.

Concepts of competition, customer retention, and customer satisfaction are described. Easy to follow steps are also presented to use the method including: identifying the product requirements, constructing a Kano questionnaire, conducting interviews, and evaluation. The paper gives a brief overview of the QFD approach and provides benefits to combining Kano's method with the QFD approach.

Griffin and Hauser discuss patterns of communication among marketing, engineering, and manufacturing using the QFD process (Griffin and Huaser, 1992). At the time of printing, scientific research suggested that new product teams for development are more successful if the communication between different areas of the development process is increased. A comparison of new-product strategies is presented in a figure which illustrates the placement of projects based on their success rate verses the percent of company sales from new products. There is also a figure showing OEM-to-Supplier communication changes as a result of the implementation of QFD. According to Natter et al., incentive schemes are affecting firms that do not use QFD more than firms that use the QFD process (Natter *et al.*, 2001). Incentive schemes can determine the weights for performance measures. In other words, as the QFD process proposes implemented features, it is expected that there are less changes as compared to trial and error testing (Natter *et al.*, 2001). Searching strategies, product evaluation methods, learning environments, and performance measures in relationships to QFD are also discussed.

Housel and Kanevsky discuss the promise of business process reengineering (BPR) and how it needs to relate to return on investment process (ROP). ROP is the process for which the return on investment (ROI) is calculated. The ideology of reducing unnecessary operational costs is a critical element to providing competition in any market

(Housel and Kanevsky, 1995). Their paper provides sections that cover topics in regard to BPR and ROP. A relationship to thermodynamics is illustrated with the concept of entropy, allowing changes in the environment can be controlled by numerous elementary changes. This paper provides information to QFD by helping to answer the question "Where and how much investment should be made by a company's processes results in a significant increase in return on investment in the process final consumable product/service?" (Housel and Kanevsky, 1995)

Methods Literature

Reich and Levy discuss developing a single intuitive method for using non-linear programming to manage product development projects under active and constantly changing constraints (Reich and Levy, 2004). Their model is an improvement on existing models that use QFD, while extending the capabilities of the house of quality even further. There is a brief description on good company profiles for candidates to use the method in a real project. No case study is provided. The software developed to use this methodology has been used in computerized manufacturing industries.

Rajala and Savolainen discuss a new approach for applying QFD methods with the addition of the IDEF0 business modeling (Rajala and Savolainen, 1996). Five basic steps are presented which include: modeling the business process and transforming it into a simulation model form; determining the customer's preferences and requirements; performing statistical analysis to model the customer preference distributions; choosing variables to be varied in simulation experiments; and comparing the results from the experiments with the customer preferences. The paper also discusses how to separate the voice of the customer into categories based on the business process. Tu *et al.* show how to implement the house of quality using Microsoft Excel software combined with Lindo linear programming software (Y. L. Tu *et al.*, 2003).

The roof of the house of quality is used in the optimization of customer requirements and technical attributes to the products for decision making purposes.

Rangaswamy and Lilien discuss various software tools used in product development (Rangaswamy and Lilien, 1997). The software tools reviewed are specifically used for product development decision making. Multiple software packages are summarized with a useful list of benefits and limitations. The actual software packages named in this paper may be outdated. However, the methods described for selecting appropriate software is useful information for product development software evaluation.

Govers' discusses the value of the QFD process separate from the value of QFD as a tool. (Govers, 1996). The paper covers the importance of team building and roles of team members. The house of quality is explained and the process of implementation is compared with the Kano model showing how functions can satisfy customers relative to what amount of investment goes into the respective functions. This directly relates to the ability of functions to satisfy customers. There are also remarks on implementation requirements of the company for successful QFD implementation.

Tang *et al.* describe how to take into account financial factors and uncertainties in the product design process using fuzzy optimization and genetic algorithms (Tang *et al.*, 2002). This is primarily used to develop resource allocation to meet the goals of the organization. Fuzzy formulation for costs and budget constraints are modeled to maximize the overall customer satisfaction. The difference between overall satisfaction and enterprise satisfaction is discussed as well.

Cristiano *et al.* discuss the results of over 400 companies using QFD for product development to show the positive impact (Cristiano *et al.*, 2001). Useful data show percentage of success rates for QFD as well as team size. The importance of the cross- functional team understanding the importance of the relationship between independent activities is stressed. They also show how companies who had a stronger and broader set of reasons to use QFD were more likely to report reduced lead-time as a result of the QFD exercise.

One alternative to QFD found in literature is developing taxonomies for design requirements in a corporate environment (Gershenson and Stauffer, 1999). Taxonomies are used to classify large bodies of information. They can provide order to massive amounts of data and can be arrange in a variety of

ways as discussed in the paper. According to the abstract, they claim for it to be able to facilitate a "broader and clearer form of QFD…" (Gershenson and Stauffer, 1999). This theory seems very similar to IDEF0. It also seems to be a good tool to provide QFD meeting notes on subjective decisions in the matrix and why the decisions have been made for validation purposes.

Crow illustrates a step by step process for going through the QFD method for his company which uses the technique when consulting for clients (Crow, 2002). This work is listed online and has been noted in various papers including a literature review by Chan and Wu (Chan and Wu, 2002) as legitimate. There are many valuable explanations on how to implement the theoretical QFD process in real world exercises. The main points include: gathering customer needs; product planning; conceptual development; and developing the deployment matrix. Specific areas of interest are suggested in real world experience which is valuable to any QFD case study (Crow, 2002).

Karlsson discusses using QFD to manage software requirements in regards to issues and explanations for forming cross-functional teams, as well as additional notes on every step of the QFD process using the house of quality (Karlsson, 1997).

An interesting point discussed is how the complete traditional framework is not always applicable to software development and integration into all companies. It is mentioned that evaluating QFD can be used to pick the useful concepts and then customize a framework for the specific needs of the organization.

Kaulio discusses seven different methods used in the product development process of different business worldwide in the spirit of focusing on customers in the total quality management approach (Kaulio, 1998). The seven selected methods which are discussed include QFD, user-oriented product development, concept testing, beta testing, the consumer idealized design method, the lead user method, and participatory ergonomics. These seven methods are compared and contrasted. Many of them have been adopted by firms to use with product development and most are related in at least one respect.

Reich and Levy published a paper improving previous models for QFD by incorporating realistic cost functions and allowing continuous use of these functions throughout the project (Reich and Levy, 2004). The shortcomings of the roof of the house of quality have also been reduced through weighting importances based on the voice of the customer. There are many specific case studies compared as well as illustrated methods to use their improvements. One specific area of importance to this paper is that Reich and Levy address engineering constraints which can have partial investments allowing the amount of investment to a specific engineering constraint to be variable in the QFD process.

METHODOLOGY

Why QFD?

Current Methods for Product Development

In this research, a method for determining the voice of the customer (VOC) is needed to provide the best quality products to the market. Customer focus is one of the key components in a total quality management approach (Kaulio, 1998). There are various methods that firms use to develop products. These methods can be classified by specific components included with the methodology. Some of the basic classification points include: specification phases; concept development phases; and prototyping phases (Kaulio, 1998).

There are many procedures used in practice which fit into multiple classifications. "The issue of selecting methods for customer involvement in product development is, however, not a matter of selecting a specific method, but a matter of designing a whole system of methods linked together in an overall process that focuses design efforts on the customer's future satisfaction." (Kaulio, 1998)

Feasible solutions found in the literature include: QFD; user-oriented product development; concept testing; beta testing; consumer idealized design; the lead user method; participatory ergonomics; IDEF0 programming; and taxonomies.

QFD has been described as a customer-oriented approach to product innovation (Govers, 1996). According to Govers, the roots of the method are based on a slightly different concept of Total Quality Control (TQC), which was introduced by Feigenbaum. This separate version utilizes

"Company Wide Quality Control" (Govers, 1996). This method allows the voice of the customer to be implemented throughout the entire process in relationship to various aspects of the business model including the entire product development process from idea conception through manufacturing.

Traditional QFD provides a house of quality which relates customer requirements, and design requirements as shown in Figure 1. Figure 1 also shows how the matrix provides a competitive analysis which makes QFD a very useful tool when trying to pick features that provide direct competition to an existing competitor's product while adding features that are shown as a breakthrough opportunity (ReVelle et al., 1998). A breakthrough opportunity provides a competitive advantage to the firm relative to the customer requirements.

There are many ways to calculate the values of the customer requirements and different heuristics to select features depending on the specifics of the problem, providing flexibility to the model. QFD can also accommodate projects with large parameter sets including hundreds of technical attributes and hundreds of customer requirements (Angeli *et al.*, 1998).

Figure 2, from the National Standards Association, shows how different matrices are formed to compare customer requirements to design requirement, design requirements to part requirements, part requirements to process requirements, and process requirements to the

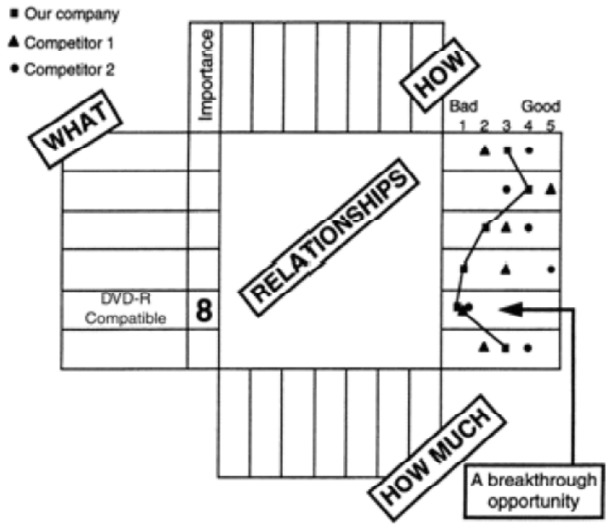

Figure 1: Basic QFD Relationship. (ReVelle *et al.*, 1998)

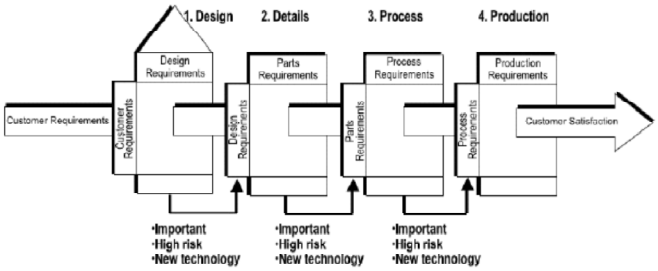

Figure 2: QFD Progression. (Qimpro Standards Association)

output of the customer satisfaction. The bottom line to this relationship is outputting customer satisfaction.

QFD offers a specification phase which directly relates the customer requirements with customer satisfaction through four or more basic phases. For this project at National Industries, only the design process and the details are needed. However, the process for manufacturing and production are handled through an OEM manufacturer so modification will be needed to the QFD model to account for this. The concept development category of QFD as shown in Figure 2 is through the first and second step. There is not a means for cycling concepts suggested back into the process for further evaluation and refinement.

National Industries typically receives a prototype for mass production approval. However at this stage, the tooling for the product is complete and there is not the budget to provide engineering changes at this point. In this case, the prototype is used to only to verify the specifications, as compared to a prototype that is used to reevaluate the concept development, where new changes may be made for a new prototype.

The following methods provide additional tools that have been used in product development processes.

The user-oriented product development process uses human factors and ergonomics to develop the design of the product (Kaulio, 1998). The primary characteristics of this process include providing an analysis of the problem or opportunity suggested by customers as a starting point to create a set of user requirements. Similar to the QFD approach, the user requirements are transformed into quantifiable engineering requirements. At this point in the process, prototypes are tested by users and modified by designers.

This specification process in user-oriented product development typically requires the combination of high volume sales with low production costs. This method has been applied to areas such as designing work and military clothing, hand tools, public systems, and public transports (Kaulio, 1998). These examples either have very large research and development budgets, or the cost of prototyping is relatively low. To manufacture different prototypes of a hammer, for example, is much cheaper than to manufacture a computer controlled device. However, public systems are very expensive. The difference being that public systems have a larger budget for product development as compared to a manufacturing a computer controlled device or a DJ device that National Industries designs. The life expectancy of public systems is measured in decades as compared to a computer based product, such as DJ equipment, which may be obsolete by the time it comes to market.

Concept testing is similar to the user-oriented product development process in that customers are used in the concept stage. However, concept testing uses more of an integrated approach for prototyping and specification phases. In concept testing, focus groups may be created to come together, and asked to react to stimulating drawings, models, and non functioning prototypes. The major component missing from this process is engineering and manufacturing constraints. This method does not provide communications channels between different functions of the firm. Concept testing provides direct customer feedback to the area of the company that is performing the process. With the DJ market being such a volatile one with highly competitive firms fighting for market share, the engineering and design forces must work together concurrently.

Beta testing is a back end testing procedure frequently used in software engineering (Kaulio, 1998). Beta testing specification capabilities are completely in a back end approach where designers provide the original specifications, engineers produce design specifications and technical requirements, and manufacturing will implement the proposed product from the chain. At this point, customers evaluate the product and propose changes after all of the design has occurred.

Beta testing is very useful for the electronic portion of DJ product development such that software written or audio preferences can be altered by programming changes. In other words, beta testing is very useful for fine tuning a product, rather than designing the product. It is very similar to a guess and check method, which would increase the time to market, unless the first product is good enough to pass the checks.

Consumer idealized design can be described as a process for having customers involved in the actual design of new to market goods or services (Kaulio, 1998).

This process involves focus groups similar to concept testing. In this case, the focus group session begins with a blank sheet of paper and the members of the focus group develop the product as compared to a focus group evaluating the product. A design is formed, technical requirements are formed, and validation for the decisions is documented. The specification phase of the consumer idealized process includes 100% of the focus group's decisions and does not take into account the engineering or technical requirements to make that happen. For simple products, such as hand tools, the technical requirements to make these focus group recommendations are not a critical factor in the development. However, for complex products, such as computer software, like what National needs in the DJ industry, focus groups might develop products which are not feasible to produce under the cost constraints. There is no prototyping phase with this process.

Generally, focus groups will provide an excellent voice of the customer (VOC) if the sampling for the focus group fairly represents the customer market. However, customers always want a feature loaded product at a featureless price point. This presents a contradiction in focus groups developing products. If the focus group does not weight the features that they are specifying, then the designers and engineers do not have enough information to accurately rate these features when features need to be removed for costing reasons. There are methods to obtain cost-benefit trade-offs in new products, however, this can be difficult to validate for new technologies which are not easily understandable by average users because they have not been previously introduced into the market.

The lead user method is very similar to the consumer idealized design method except that users are selected for a focus group based on their specific needs that are ahead of the product technology curve (Kaulio, 1998). The customers in a focus group for the lead user method are selected because they are users who face the needs of the market months or years before the majority of customers in that market. This method has similar relationships to the specification phases, concept development phases, and prototyping phases as the consumer idealized design method. The major difference is the selection of users. One advantage of this method over the consumer idealized design method is that the information is a forecast into the future. The disadvantage is the risk involved. Many products are designed with the intentions of reaching the masses with only penetrating a small section of the market. The reason for this risk is that the select focus group members do not necessarily represent what the entire customer base will want or need int the future. There is a higher product risk involved with the lead user method because of the uncertainty in the ability of the focus group to accurately predict trends in the disc jockey market...

Participatory ergonomics uses customers in the design phase to actively work as designers (Kaulio, 1998). This method is primarily used in workspace design and has not been reported as a method that has been used with the design of mass market products (Kaulio, 1998).

Rajala and Savolainen applied the IDEF0 technique (Integration Definition language 0 for modeling function) to the QFD model. As shown in Figure 3, IDEF0 sets up a model of the business process and transforms it into a simulation model form (Rajala and Savolainen, 1996). Figure 4 shows how this model has been used in a specific business example with inputs, outputs, constraints, and resources expended (Rajala and Savolainen, 1996).

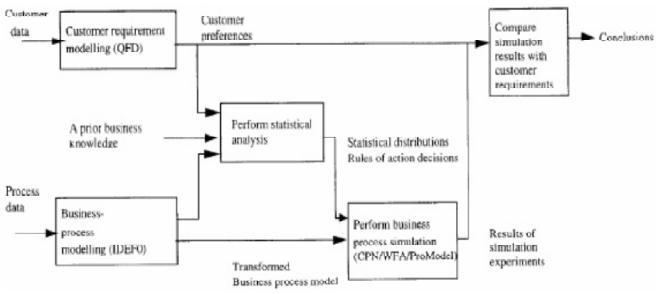

Figure 3: IDEF0 Example (Rajala and Savolainen, 1996)

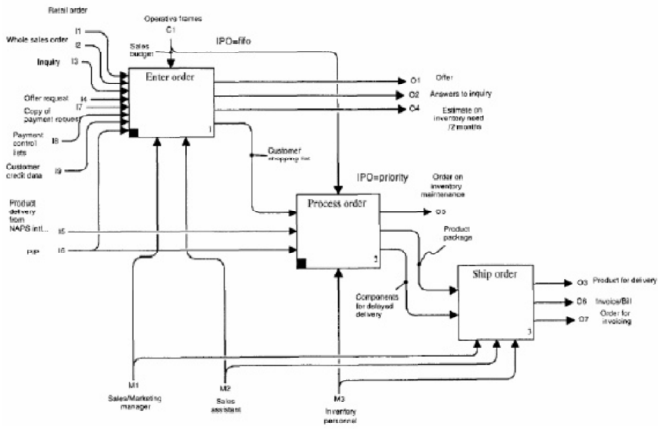

Figure 4: IDEF0 Example (Rajala and Savolainen, 1996)

The specification phases with IDEF0 are very useful for setting up the relationships in an easy to use graphical representation.

The concept development phase is unclear with IDEF0. Prototyping may occur at the conclusion of the IDEF0 process.

IMPLEMENTATION

Project Definition

As mentioned in the methodology, QFD is an overall concept that translates customer requirements into the appropriate technical attributes which can then be designed and engineered (Chan and Wu, 2001). This method will be used in the traditional sense to provide the translation. In addition, it will be customized to account for different customer segments and variable costs and times to production due to OEM relationships.

Objectives, their variables, and their subjective constraints are provided in the project definition. The objective was set from upper management and confirmed during the first QFD meeting with the team.

Objectives

With the release of a competitor product that provides opportunity advantages to a current existing National product line, the project's objective is to provide a feature set for the new product.

The feature set must provide direct competition to competitors by optimizing the features needed by the target customers, providing excitement

features, and to meet a price point set by sales and marketing management. This new product must provide National with the competitive advantage, within appropriate production costs to meet sales price points.

The objective function is to maximize overall product quality by selecting the feature set subject to the constraints.

Variables

Variables for the project include all of the possible customers which the project will be marketed towards, all of the feasible technical attributes, as well as data defining, specifying, and relating these variables.

Constraints

Explicit constraints for this project include the total production cycle time and the total cost of the product. The man hours available is a constraint, however it is not included in this QFD model.

National provided support for this QFD approach from top level management down. Management supported this initial project as a pilot to introduce the concept of quality into their product development process. National has not set a constraint on the time allocated to develop the feature sets. However, for future projects at National, historical data on QFD development and manufacturing deadlines will add the additional constraint of the time allowed for research on the variables to improve the accuracy of the data set for variables.

Once the project is defined, the process can be developed to meet the demands of the specific project.

Process

The process to implement QFD at National to meet project objectives includes:

1. Forming the cross functional QFD team.
2. Selecting the user interface to communicate with the team including software selection.
3. Developing the house of quality.
4. Developing a model to output the quality with fixed variables.
5. Maximizing the quality by changing variables within the constraints.

These steps in the process are further illustrated and start with forming the cross functional QFD team.

FORMING THE CROSS FUNCTIONAL TEAM

The initial activity to start the QFD process once the project definition is completed is to form a cross functional team which will gather people representing different functions of the organization (Karlsson, 1996). For National, this includes representation from sales, marketing, engineering, product development, and design. The QFD leader is also included in this group to direct the team.

Including expertise from different functional areas has been shown to contribute to the decision making process in QFD projects (Cristiano *et al.*, 2001). Various literature sources have stated that this is one of the most critical elements to successful QFD projects.

The National QFD team consisted of seven members from the engineering, marketing, sales, management, and product development divisions of National:

- QFD Facilitator: (Project Manager).
- Upper Level Management. (Senior V.P. of Sales and Marketing).
- Product Development (Experienced Product Developer).
- Sales (National Sales Manager).
- Marketing/Advertising (Senior V.P. of Sales and Marketing).
- Industrial Design (Industrial Designer; Industrial Design Manager).
- Engineering (Director of Engineering and Product Development).

The team size has proven to be appropriate considering the size of National. In a study performed in 1986, 66% of Japanese QFD teams reported to be ten people or less (Cristiano *et al.*, 2001). This information validates that there is no reason to suspect that seven member team is not an appropriate size.

The QFD facilitator is responsible for the QFD process generation and the management and direction of the team.

The Senior Vice President of Sales and Marketing has a dual role representing National's Marketing/Advertising department as well as providing the leadership and support for the QFD project from upper level management. Strong positive relationships between upper level management support and QFD success have been concluded in various surveys with QFD success rates (Cristiano *et al.*, 2001).

Product development's expertise to the cross functional team brings historical data on the National historical products, information on competitive products, as well as expertise from the DJ market. National's product developer is also a mobile DJ with over 20 years experience which is helpful for defining and describing variables in the QFD model as well as providing customer insight to the product.

The sales division is represented by National's national sales manager with over 20 years experience in selling products to dealers as well as communication channels between the finished products and the customers. Sales is a vital role to the QFD matrix development because many features have a technical nature that needs to be marketable, such that the sales department can successfully produce sales and procure the products in a timely manner. National's national sales manager also travels to dealers and trade shows which provide valuable expertise in QFD process discussions.

Two team members are from the industrial design department. One member is a National industrial designer. The other member is the manager of the industrial design department. The designer is responsible for providing the form for the product once the quality function deployment process provides the feature set. The industrial design manager is responsible for providing general expertise in regards to the voice of the customer and how customer requirements relate to technical attributes.

In planning for this project, National plans to use an OEM for much of the engineering work to be completed. However, National does employ in house engineers for certain components. The engineering function is represented by the director of engineering and product development. This member's expertise is in costing and feasibility of the technical attributes suggested and listed in the HOQ.

Once the team has been formed, the project manager is responsible for selecting an appropriate user interface for the QFD development process and searching and selecting possible software packages capable to meet the demands of this project.

DEVELOPING THE HOUSE OF QUALITY

The What's, How's, and Relationships Between

The house of quality (HOQ) was developed during the first QFD team meeting. Once the team was selected and confirmed, the team was formally introduced to the QFD process and was provided with a schedule of the process with milestones and an itinerary for the first meeting. The itinerary for the first meeting included:

1. Provide an introduction to QFD.
2. Confirm the project definition.
3. Rank the importance of the three customers to the project.
4. Define and rate each customer requirement against each of the three customers for the product.
5. Create a weighted voice of the customer for the product.
6. Rank competitive products to the voice of the three customers.
7. Define the technical attributes (TAs).
8. Provide relationships between the technical attributes and the weighted customer requirements which in turn provides rankings and weightings of the TAs listed based on the data entered.

All members of the team were present at the start of the meeting. Only the product developer, the engineer, the industrial designer, and the QFD facilitator participated in steps 7 and 8.

VOICE OF THE CUSTOMER

In the specific market for the product used with the QFD process, there are three different customers

that National would like to market their products to. Two of the customers have similar characteristics and the third represents a small portion of the market and has unique demands for the product which differ from the other two types of customers. To develop the list of customer requirements from the VOC, the product developer and the industrial design team listed all of the top requirements. The industrial designer worked on a psychoanalysis profile of the three types of customers that would be using the product prior to the initial team QFD meeting. This analysis was used to clarify the VOCs such that the team can best compare them with the relationships with the three different customers, the relationships between the competitive products, and the list of TAs.

Technical Attributes

To create a list of technical attributes, the product developer consulted with other team members before the first meeting to create an extensive list of all possible technical attributes which would be considered in this QFD project. Many of the technical attributes created were interrelated. All of the relationships have been noted in comments in meeting minutes. Some of the technical attributes were found to be basic features referring Kano's model .These technical attributes are assumed to exist in the project, and were removed from the QFD selection model. The associated resources required to develop and manufacture these assumed basic features have been deducted from the available resource constant in the model. The goal of the QFD exercise is to determine which technical attributes will be included and what resources (if applicable) should be spent investing into the corresponding TA to maximize the overall quality of the product within the constraints listed.

Conclusions

This paper presented a methodology, discussed the implementation and deployment of the methodology, and calculated optimum results using genetic algorithm software for the feature set of a new product currently being developed at National Industries in the disc jockey market using a modified version of the traditional QFD process. The QFD process has been modified by including multiple customers for the product with respective ratings, providing an enhanced competitive analysis which includes the ratings for the VOC's relative importance to the product, the interrelationship between TAs, and the method of communication between the cross functional team.

As mentioned, the QFD process has been identified as a tool to aid in the product development. The QFD process has improved the method of product development at National by reducing the lead time to a finalized feature set, reducing costs in engineering changes by implementing quality into the product, and developing the relationship between features and customer requirements to aid in a paradigm shift decisions.

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