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Provider Selection Using QFD Technique: A Customers Product's Case Study.

Harshvardhan P. Ghongade

Research Scholar, Department of Mechanical Engineering,
North East Frontier Technical University, (India)
&
Asst. Prof., Department of Mechanical Engineering,
Shatabdi Institute of Engineering & Research, (India)

ABSTRACT

Purpose –In the past few years the role of buying in global competition effectiveness has been progressively increasing in significance. On the contrary, the part of packaging continues to increase in reputation because of its dual function in Shipping and advertising. The persistence of this paper is to engagementof the Quality Function Deployment (QFD) methodology to analyze the common purchasing problem of provider selection for toothpaste packaging. Thus, an method well known in quality management is amended for use in the entirely new environment of provider selection in purchasing.

Design/Methodology/Approach

This paper investigates by stipulating the properties necessary for appropriate packaging. It then examines the type(s) of packaging essential to satisfy these properties. Finally, it moves to the selection of a provider having the necessary properties to provide the packaging. This analysis is performed with a QFD construction.

Findings

The Quality Function Deployment (QFD) process directed to a quick identification of those providers most capable of providing the product characteristics that met the corporate total value goal at the time of study.

Practical Implications

This paper presents a structured management approach to cope with the common drawback of provider choice. In doing thus, it provides associate approach which will be generalized to resolve many varieties of call issues endeavor operations and supply chain managers.

Originality/Value

The paper presents a management approach to the very important area ofprovider selection. In doing so, it employs a technique well known in the product design area, but notused in the area of provider selection, that of Quality Function Deployment (QFD). It extends beyondthe dyad in that it brings to bear a powerful technique from the Quality Management discipline to aproblem in another discipline, Purchasing.

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Keywords:*Purchasing Techniques, ProviderEvaluation, Marketing,Packaging, Quality Function Deployment, Supply Chain Management, ProviderSelection, Production Process.*

I. INTRODUCTION

During the past quarter of a century, there has been an increasing awareness of the vitalrole played by purchasing in enabling a company to be competitive. One of the mostimportant aspects of purchasing is provider selection. A continuing challenge of providerselection is that of qualifying innovative providers that can deliver products of quality,cost and on time (Ramadan and Schmits, 2006). Along with the increased importance ofpurchasing there has developed an increasing consciousness of the importance ofpackaging in increased sales and market share. Many universities, which formerly hadno courses in packaging, now offer degrees with a major in packaging. Consequently, packaging, along with purchasing, also has become a vitally important aspect of competitiveness. This conjunction between the importance of packaging and purchasing has also led to an operational interface between the two. The qualification process utilizes quality function deployment (QFD), a process well known in the area of product design, development, and improvement. QFD is a structured, disciplined process which has been widely used for converting qualitative factors or features into quantitative production requirements. It has been well known and widely used in quality product design. However, it has not been widely used in other applications requiring structured decisions, including such applications as provider qualification (Ansari and Modarress, 1994). This case study is important for demonstrating how the QFD technique may be employed to solve the difficult and frequent decision of provider selection. Further, the paper demonstrates how the AFD method might be employed to other areas requiring structured decisions. As this case is developed, the personal care products division of the XYZ Corporation has been challenged to lower its expenditure on toothpaste production by 5 percent. Having examined the cost structure of the ABC Toothpaste brand, purchasing management has determined that the carton spend pool has the best opportunity to deliver these savings due to its track record for having an attractively large spend, an amount of $18M a year, and a competitive supply base. Competition is strong due to the broad technology platform that allows many providers to be considered. Also, since business is robust, longer production runs will allow the providers to gain better economies of scale. There is a great deal of SKU proliferation, since each of their major customers (Wal-Mart, Costco, Kroger, etc.) want something unique, which necessitates that providers build flexibility into their production processes. The result of all of this is emphasized importance upon the role of packaging, and upon the role of purchasing in product packaging development. Thus, the paper is interdisciplinary in its approach. In this paper, we propose a three-phase QFD framework to assist supply managers in communicating stakeholder expectations when selecting a packaging provider. We illustrate the usefulness and limitations of this approach using a case study from a large consumer products company. This paper contributes to the literature in that it employs a well-known process, QFD, in an application where it has not been used before.

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II. LITERATURE REVIEW

Bossert (1991) noted that QFD is a tightly structured methodology used for integrated product development, and also in product improvements, which are often found necessary when a product begins to lose market share to competing products. This methodology is an integral part of total quality management (TQM) and was originated by Akao (1997) in the mid-1960s (1997). Dr Akao, along with Dr Shigeru Mizuno, wrote the very first book on QFD. QFD is defined by its originator as:

[...] a methodology that converts user demands into substitute quality characteristics (quality characteristics), determines the design quality of the finished good, and systematically deploys this quality into component quality, individual part quality and process elements and their relationships (Akao, 1997).

QFD may also help multi-functional teams identify and prioritize customer requirements and relate these needs to corresponding product or service characteristics (Krieg, 2004; Kaufmann et al., 2009). The so-called house of quality (HoQ) is an extension of basic QFD. HoQ is a series of matrices that relate initial customer requirements to the manufacturing operations that must be employed to satisfy those requirements. A typical HoQ sequence is shown in Figure 1.

QFD has been a central feature in implementing TQM projects (Summers, 2005). Over the years, QFD has attracted attention from a wide range of progressive industrial organizations in the US including Ford Motor Company, General Motors, Rockwell International, AT&T, DEC, Hewlett-Packard, and Polaroid (Schubert, 1989). Although most of the reported applications have been in the area of product development and improvement, QFD also has been successfully applied as a strategic planning tool for service improvement projects (Maddux et al., 1991). As a matter of fact, QFD is such a generalized approach that it can be used in applications well outside the traditional ones in integrated product development. It is so flexible that it can be modified to provide a flexible, integrated planning framework to facilitate planning in areas such as planning process improvement projects (Benjamin et al., 1996), planning for technology transfer on information technology projects (Khawaja and Benjamin, 1996), business planning in small companies (Ferrell and Ferrell, 1994), and manufacturing strategic planning (Crowe and Cheng, 1996). The HoQ approach may be adapted to any number of phases. Benjamin et al. (1998) have even modified the QFD approach for use in academic course planning. This adaptation is shown in Figure 2.

QFD has been used in many contexts. However, it has had limited application in supplier selection. Other methodologies proposed for the analysis of procurement decisions include modeling (Choi and Kim, 2008; Lam and Tang, 2006; Narasimhan et al., 2006; Weber et al., 2000); reverse request for proposal (Stright and Candio, 2000); analytical network processes (Ozden, 2006); and data envelopment analysis (Al-Faraj, 2006).

III. CASE STUDY FROM INDUSTRY

In the case study from the consumer product company described in this paper, we analyze a modified two-phase QFD process used to facilitate effective communication

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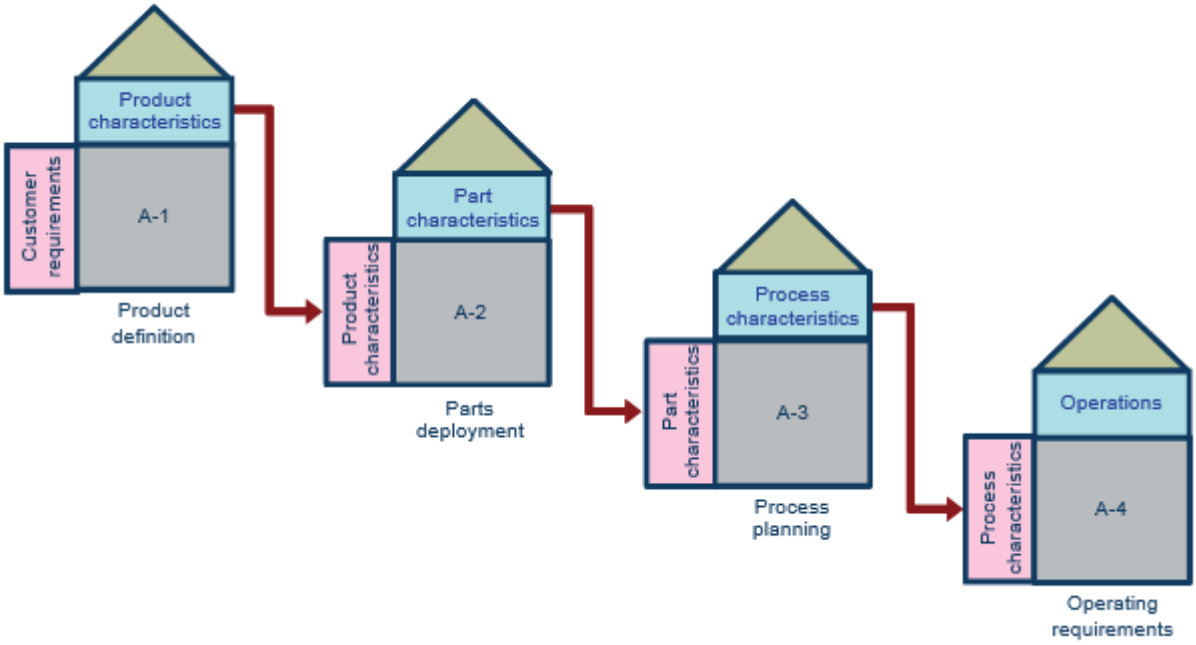

Figure 1: House of Quality

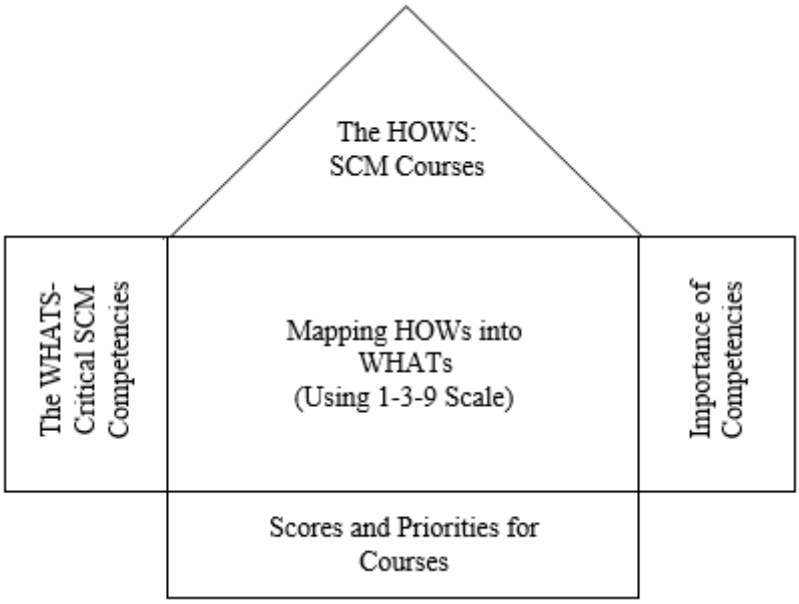

Figure 2: Single-Phase HoQ for Curriculum Development

Source: Benjamin *et al.* (1998)

among stakeholders during the selection of a packaging provider. This approach can assist supply management professionals by facilitating quick identification and prioritizing of the packaging provider that would deliver critical product packaging characteristics.

The case study was conducted at XYZ Corporation, one of the leading consumer products companies in the world engaged in the manufacturing of a variety of products, such as toiletries and cosmetics, small appliances,

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consumer durables, consumer electronics, and other household items. The company structure includes a division dedicated to the managing corporate direct and indirect spend. The division, henceforth referred to as Purchasing, manages over $60 billion (US) in spend for the corporation each year.

In the past, carton buyers have achieved savings in a variety of ways: through negotiations, change in provider, or by streamlining material specifications. In termsof specifications, many experts have explored the value of various printing technologies and their impact on packaging costs. There are identifiable advantages for utilizing each technology. Historically, various combinations of material/logistics prices,yearly savings, contract periods, printing technology, as well as tooling cost, all have been considerations in technologyselection.

For two-three years board mills have been caught between rising energy, waste paper and operating costs, and the inability to increase prices due to supply overcapacity. There has been massive industry restructuring over the past 18 months in North America and Western Europe. On recycled board, three topcompanies ProviderA,ProviderC,andProviderDrepresent75percentofthemarketvs55percent a year ago. Capacity utilization is now close to 100 percent. As a result, the industry has recently been able to implement sharp price increases in an attempt to recover increases in costs and lost margins. Board prices are now at historically high prices, following years of sluggishness. Going forward, further industry rationalization (reduction in capacity through closure or other consolidation) is expected in North America and Western Europe. Large capacityincreases in China, are dedicatedfor the moment to domestic growth. Within the next year, 5-10 percent further price pressure is expected on carton board across the industry.

Conversion is the process of transforming the board into a finished carton. A large portion of the industry is backward integrated into board mills to facilitate conversion. The industry has seen an unprecedented level of mergers, acquisitions and private equity buy outs over the past year, affecting XYZ Corporation's largest providers.Due to increased production costs, companies are restructuring, idling or shutting down underperforming capacity impacting the availability of supply in the marketplace. As converters are subjected to the record high board prices, increased feedstock prices must be passed on to customers. This, in turn, exerts cost pressure on the customer firmstoreducecostsinordertoremaincompetitive.

IV. METHODOLOGY

A small team from the company, comprised of employees from purchasing, engineering, manufacturing, and marketing, was charged with the responsibility of developing competitive packaging while reducing costs. It was decided to employ QFD, an approach successfully used by many the past two decades to translate design requirementsintoameansofsatisfyingthoserequirements.Aftersomeinitialresearch to determine how the QFD process is usually employed, the team decided to adopt a five-step procedure with a two-phased approach (two HoQs) to provide a rapid, structured, integrated approach to selecting a packaging provider. A diagram for this two-phased approach is shown in Figure3.

The five step approach adopted by the team was as follows:

Step 1. Use of an *Ishikawa* (fishbone) diagram to determine the cartonage properties necessary for the application. This involved answering the questions

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of"what,""where,""when,""why,"and"how."Thesequestionswere,ofcourse, directedatanalyzingandidentifyingtheecessarycartonageproperties.

Step 2. Translation of the cartonage properties obtained from Step 1 into those provider characteristics necessary to satisfying those propertiesthrough

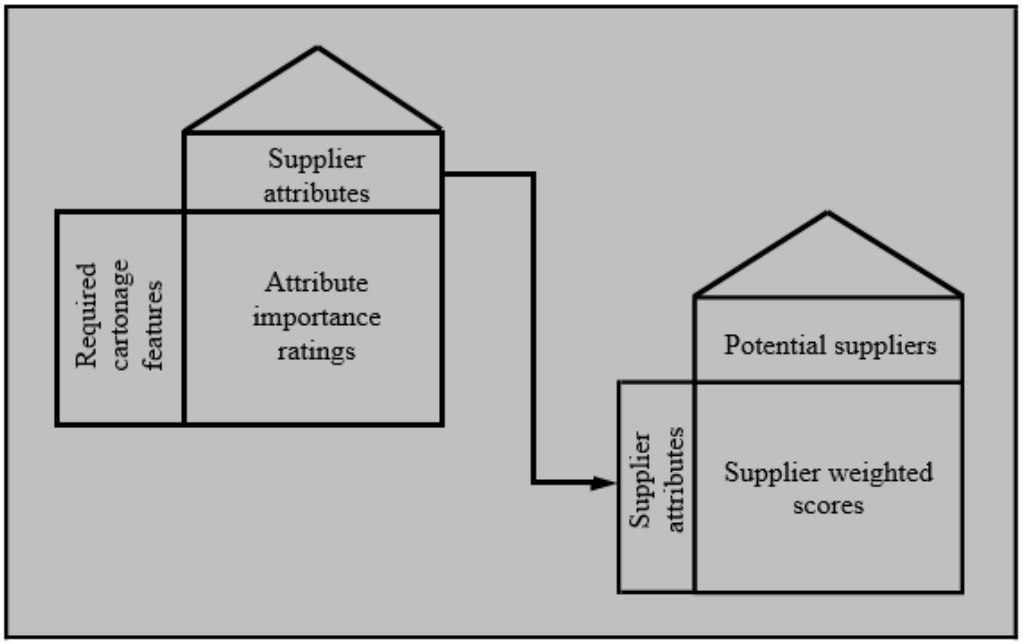

Figure 2: Two-phase HoQ Provider

the first HoQ. In this step, cartonage properties were assigned a rating as to the importance of each relative to the others. Further, each of the provider characteristics was rated as to its effect upon each of the cartonage properties.

Step 3. Building on the work of Benjamin *et al.* (1998), a two-phase HoQ was adopted as the model for provider selection. Consequently, a second HoQ was constructed to translate provider characteristics from Step 2 into the most qualified provider. In this step provider characteristics were arrayed against those top providers thought capable of satisfying the characteristics. From this it was possible to prioritize each of the provider characteristics as to its overall importance in providerselection.

Step 4. Using the second HoQ from Step 2, and based upon information developedabouteachpossibleprovider,eachwasratedastohowwellitsatisfied the necessarycharacteristic.

Step 5. The rating for the importance of each provider characteristic was then multiplied by the rating for each provider as to how well it satisfied that characteristic, and a score was obtained for each provider. These scores were then added for each provider to obtain an overall score as to how well each potential provider satisfied the necessary characteristics. The winning provider wasthenselectedashavingthegreatestcombinedscore.

Based upon the foregoing, the team began execution of the five step process. Completion of the first step resulted in the *Ishikawa* diagram shown in Figure 4.

The process using the *Ishikawa* diagram yielded the five cartonage design features as follows:

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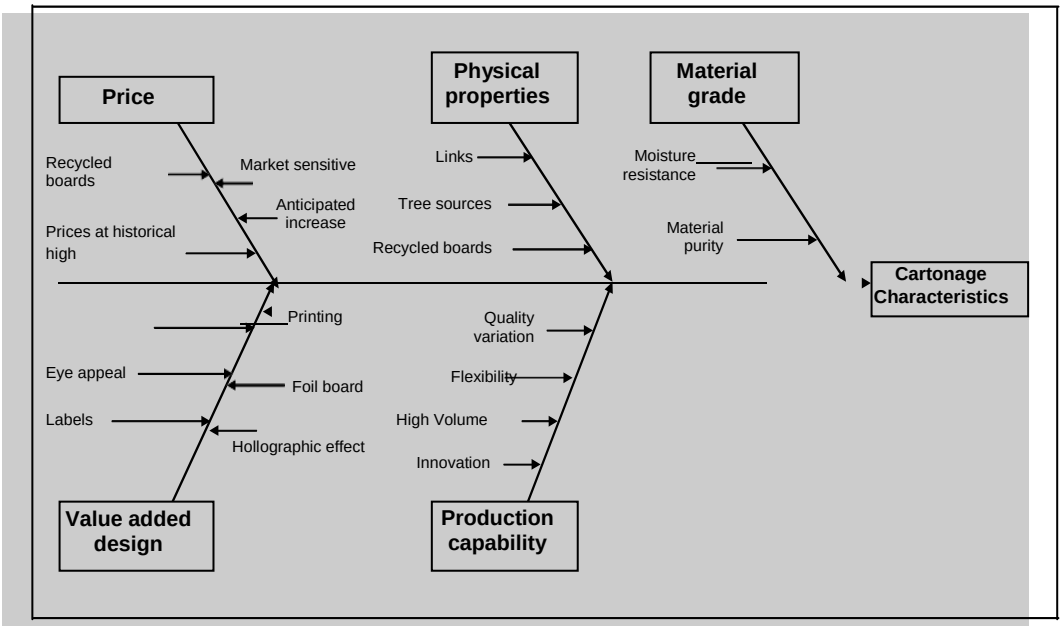
1. adesignthataddsvaluetothecontainer;
2. stiffness of container boardmaterial;
3. moisture resistance of containerboard;
4. contaminant free container board;and
5. price sensitivity of containerboard.



Next, the team analyzed the attributes believed to be most necessary for providers in order for them to satisfy the cartonage features obtained from the *Ishikawa* process. These features were then arrayed in the first HoQ against the provider attributes thought necessary to satisfy the features. Next, each feature was assigned a rating in the range of 1 thru 9, depending upon the relative importance of each feature to the others: 9 being the most important, and 1 the least. Following the feature ratings, each provider attribute was rated as to its influence on each cartonage feature. The rating scale for this was shownin Table I.

Each provider attribute rating was then multiplied by each cartonage feature importance rating. The products from these multiplications reflected the importanceof each provider attribute in satisfying required cartonage features. Finally, the products foreachproviderattributewereaddeddowntheirrespectivecolumnsandnormalizedto obtain an overall relative importance for each provider attribute in satisfying required cartonage features. The results of these operations are shown in Table II, the first provider selection HoQ.

Using the results from the first HoQ for provider attributes, the second HoQ was developed. In this HoQ, the provider attributes were arrayed, along with their importance ratings, against the providers found from background development to have been capable of satisfying the attributes. Each potential provider was then rated on a scalefrom0to100astohowwellitsatisfiedagivenattribute.Theseratingswerethen multiplied by the provider attribute ratings to obtain a set of weighted factor ratingsfor each provider. These weighted factor

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ratings for each potential provider were then totaled to obtain a total score indicating how well each provider satisfied all of the provider attributes. That provider with the greatest overall score was then selected to satisfy the carton age requirements for the XYZ Corporation. The results of the second HoQ analysis are shown in Table III.

V. RESULTS

As noted above, the second HoQ shown in Table II rates each of the four qualified providers against the provider attribute factors. The valuation factors were then utilized to analyze the four providers selected to compete for the contract. The providers were note das A(incumbent), B(a new entrant), C(a minority business entrant), and D (a former incumbent). Each provider demonstrated unique strengths and weaknesses associated with the nature of their business. Provider A received the highest score of

101.0 out of a possible 153, after receiving the highest scores in four of the seven critical value factors. Provider D came in second place with 85.0 points. Providers C and B came in third and fourth, respectively, with scores of 71.0 and 57.0. Table II summarizes the results of the HoQ for the potential packaging providers.

Rating	Strength of Relationship
9	Most
3	Moderate
1	Weak

Design features required	Quality		Sustainability		Innovation		Icumbency		Responsiveness		Green initiatives		Weights	Total
Value added design	□	40	□	40	•	72	Δ	8	Δ	8	–	–	8	168
Production capability	•	63	Δ	7	□	35	•	63	□	35	Δ	7	7	210
Material grade	□	30	□	30	Δ	6	–	–	□	30	–	–	6	96
Physical properties	•	72	Δ	8	□	40	–	–	□	40	□	40	8	200
Price	•	81	•	81	•	81	□	45	•	81	•	81	9	450
Score		286		166		234		116		194		128		1,124
Percentage influence		25		15		21		10		17		11		100

Symbol	*Relationship*	*Weight*
•	Strong	9
□	Medium	5
Δ	Weak	1

Table II. First providerselectionHoQ

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The "whats": critical competencies for packaging suppliers	The "hows": competing suppliers								
	Supplier A		Supplier B		Supplier C		Supplier D		
	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Weights
Quality	9	45.0	1	5.0	3	15.0	9	45.0	5.0
Sustainability	9	22.5	1	2.5	3	7.5	9	22.5	2.5
Innovation	3	4.5	9	13.5	3	4.5	1	1.5	1.5
Incumbency	3	7.5	1	2.5	1	2.5	1	2.5	2.5
Responsiveness	1	3.5	9	31.5	9	31.5	1	3.5	3.5
Green initiatives	9	9.0	1	1.0	1	1.0	1	1.0	1.0
Absolute score	101.0		57.0		71.0		85.0		153
Relative score (%)	66.0		37.2		46.4		55.5		100
Rank	1		4		3		2		

Notes: Rating scale: 1 – weak, 3 – medium, 9 – strong; weights: 1 – low, 3 – medium, 5 – high

TableIII. QFD chart – provider selection for toothpaste packaging

VI. CONCLUSION

The QFD process led to a rapid identification of those providers most capable of providing the product characteristics at the time of study. The rankings enabled the rapid development of provider selection, which then could be readily communicated to the numerous stakeholders for feedback. Cross-functional teams were able to make contributionsinallstepsofthedevelopment.QFDhasproventobeaneffectivetoolin managing product/service development in the manufacturing industry, in software development, and in service industries. It can provide a powerful framework for enhancing effective communication, defining clear and accurate tasks, and achieving effective resource utilization. This makes the technique attractive for adoption as a planning tool to enhance any group decision-making process. In the case study described, the structured QFD process facilitated effective communication among all stakeholders, potential providers, marketing, design, engineering development, manufacturing,productionandpurchasingefforts(AnsariandModarress,1994).

The case study illustrates the flexibility of the QFD framework in providing a robust methodology for achieving effective communication among the stakeholders during the design and development of new toothpaste packaging. Although a more complex, multi-phased, QFD process is often necessary to achieve a sound understanding of the interrelationships among the variables in a particular application, the two-phase approach described in this paper proved adequate for our purposes of understanding the interrelationships in translating cartonage properties in a provider capable of providing the required cartonage. It further demonstrates the capability of QFD in providing good answers in a timely manner, and serving as a sound tool for communication with stake holders.

A short coming of QFD in this, or for that manner any application, is that it relies upon a subjective evaluation of the factors under consideration. Thus, the numerical ratings upon which the method relies can be only quasi-objective. That is to say that the eventual selection (s)express only the preferences of the group performing the selection process, and not necessarily what might be the best selection(s). This situation might be consider ably improved by using QFD in conjunction with an experimental method such as Taguchi's. Also, QFD contains no

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mechanism for determining whether group selections have been made consistently. Using QFD in conjunction with analytical

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