Topic 3: Requirements Management

Learning Outcomes

Upon successful completion of this topic you will be able to:

- discuss the importance of defining customer needs at the onset of a programme
- develop a generic check list of ‘customer’ requirements
- identify the ‘Voice of the Customer’
- define the stages typically associated with the House of Quality (QFD)
- benchmark customer wants against competitive products
- correlate customer wants against engineering specifications
- develop a QFD matrix
- evaluate a given QFD matrix.

Introduction to the Topic

At the onset of the development process it is important to identify what the product must do to meet the customer’s expectations and, while this may seem easy to achieve, it often presents a major stumbling block for many design programmes.

Global competition has forced organizations to identify niche markets in which products are designed to meet the particular requirements of discerning customers, where engineering and marketing personnel approach customers for input at the design stages, where specifications are defined by the wants of the customer and where the specifications that are ‘Critical to Quality’ receive special engineering care throughout the product development process.
Session 3.1 Introduction to Requirements Management

The outline of a generic development cycle illustrated in the previous section shows two broad categories of customers that must be satisfied – the internal customer and the external customer.

Effective business planning, sales/marketing strategies, resource allocation and manufacturing considerations form the main demands of the internal customers (i.e. those within the organization who are responsible for creating the product), while Legal/Government regulations, buyers/end users and competitors form the bulk of external customers.

Realizing that timing is critical to the success of the final product, too often organizations are falsely lured into making quick assessments of the customer’s expectations of a product in an effort to get the programme under way. Aggravated by poor communication between the marketing and manufacturing divisions, uncertainty often results in the specifications for a new product to be based on previous programmes. Unfortunately however, the customer’s demands are constantly changing and the conditions that may have rendered products to be successful in the past, may become outdated by the time the new product reaches the marketplace. Further, the initial specifications may fail to address all the “downstream” implications on the manufacturing processes with the associated difficulties this might create.

In order to help address at least the main programme requirements, some organizations choose to apply a broad checklist approach to check that most of the fundamental parameters are identified. An example of a list of ‘Universal Considerations’ may be:

1. **Production Costs** – including direct labour and material costs and indirect overheads including logistics, equipment, facilities etc
2. **Timing** – this significantly impact upon the ROI
3. **Risk** – identify and assess the potential risks associated with the project
4. **Flexibility** – the ability to incorporate the new product within existing facilities
5. **Quality** – the ability to meet specifications and control processes
6. **Efficiency** – assessment of the utilization of equipment and resources
7. Environment – impact of products/processes on the manufacturing processes

In this way both the obvious direct costs as well as the less obvious indirect costs can be highlighted early in the program in an effort to minimize any downstream surprises or the shifting of problems from one division to another throughout the PD cycle.

Over more recent times, increased global competition and a more discerning customer have forced companies to target niche segments of the marketplace and the associated need to rigorously address the requirements of these customers. Care is taken to identify the customers for each niche market segment and then develop product to specifications that are derived from the eternal customer - rather than relying only on the experience of internal customer (marketing, product planning etc).

This has been successfully achieved by introducing the ‘Voice of the Customer’ in the initial marketing stages of the PD cycle particularly through a technique which is now universally known as Quality Function Deployment (QFD).

Session 3.2: Introducing the ‘Voice of the Customer’

Typically marketing, product planning and engineering have determined what customers want through past experience and warranty/service complaints. At best new engineering and performance specifications are derived from past data, but more often than not, performance requirements revert back to previous specifications or those that are easier to manufacture.

On the other hand the main feature of ‘Customer Driven Product Development’ is for the customer to be more directly involved in defining the product’s requirements at the earliest stages of the PD cycle. The customer’s wants are specified through the use of surveys, focus groups, customer assessments of similar competitive products etc. In this way the customer’s wants are defined specifically and are documented accordingly. But importantly, they can then be readily translated into relevant manufacturing targets and specifications.

One important ingredient for the success of this approach is for marketing and engineering personnel to work closely together during their early evaluations with the customer.
Various ranking methods can be applied to highlight the few very important features that need extra engineering effort, from the many less important features that need only standard engineering effort.

A process called Quality Function Deployment (QFD) was developed in Japan in the 1960s to formalize these activities and serve as a repository for the retention of this information for ongoing programs.

**Session 3.3: ‘Customer Driven Product Development’ and QFD**

QFD is a planning tool for translating the quality needs demanded by the customer into appropriate company targets (specifications).

Developed to formalize the application of the ‘Voice of the Customer’ in the PD process, QFD was first successfully applied in Japan at the Kobe shipyards and was later applied extensively by Toyota. Since then it has been recognized as an important strategy for managing customer requirements worldwide.

Some have suggested that the term ‘Customer Driven Product Development’ is a more suitable title, nevertheless the main feature of the QFD is to give the voice of the customer prominence and to direct the development of performance specifications from fuzzy marketing directives into specific engineering imperatives that will render the success of the products in the marketplace.

Also known as the ‘House of Quality’ the generic structure of QFD for the Product Planning (Phase I) is as shown in Fig 3.1.
Several fundamental steps are typically applied in the Product Planning QFD matrix, namely:

1. Capture the wants/needs/demands of the customer
2. Generate a customer importance ranking
3. Conduct customer competitive assessment (benchmark)
4. Translate customer wants into performance requirements – hows
5. Conduct and analyse the relationship matrix
6. Develop and analyse the correlation (trade-off) matrix
7. Conduct an engineering assessment (benchmark)
8. Calculate the overall importance rankings.

At this stage it is important to remember that the primary purpose of the QFD technique is to identify the vital few characteristics that are...
critical to quality and which require special engineering effort for successful resolution in the final product. Although there are only several basic steps required to successfully complete this technique, each can be relatively complex, making the overall process quite time consuming.

It is very important to keep the aim of the exercise in perspective, and practitioners need to be mindful of time limitations and not get too carried away with the process of filling out the matrix simply for the sake of it.

A similar process can also be applied to cover the other main stages of the PD cycle as:

- Phase I: Product Planning
- Phase II: Design Development
- Phase III: Process and Manufacturing Planning
- Phase IV: Production Control

**Session 3.4: Defining Customer “Wants” and Customer Competitive Benchmarking**

An essential ingredient of the QFD technique is to ask the customers what they would want and record these in the customer’s actual words. In the past this work was typically allocated to the marketing division and was met by market research, surveys, clinics, focus groups etc. But the QFD process mandates the involvement of the PD team (and particularly the manufacturing sector) during this process.

As well as satisfying the external customer in this way, the PD team must formalize the internal customer requirements in a similar way.

In many cases comments by the customer may be very broad and difficult to specify at a primary level. Here the PD team may need to synthesize these to a more definitive secondary level or even a tertiary level; i.e. to a level that can be clearly defined.

At this stage it may also be convenient for the customer to rank the ‘wants’ in importance using a simple ranking system (e.g. a numbering from 1 - 10). At the same time it may also be important for the customer to compare the companies’ current products against the competitor’s products for each of the customer wants previously identified.
This information enables the PDT to identify what features of the product need to be improved to remain competitive.

It is the first step in developing a quality planning table that can be used to identify what areas need to be improved, target values and how much improvement is required over a period of time.

Similarly PDTs can clearly identify marketing opportunities that will make the product stand out from the competition.

Session 3.5: Defining the ‘Hows’ - Substitute Quality Characteristics (SQC’s)

Each customer wants/needs/demands must be translated into engineering ‘hows’. The relevant question here is, ‘how will the product meet the customer demands?’

Typically these engineering ‘hows’ form the basis of technical specifications that impact directly upon one or more of the customer ‘wants’. They represent the engineering characteristics that ‘substitute’ for the ‘quality’ demands of the customer. Sometimes described as Substitute Quality Characteristics, the SQC’s are used to identify how the organization will meet the customer demands.

In order to be effective the SQC’s need to be:

- concept free (not specific to any one design or process)
- testable (can each be tested and evaluated?)
- measurable and controllable (preferably using variable data)
- addressed at a total system level.

At this stage it may be expedient to identify the optimal target values (including units) for each SQC, as well as an engineering competitive assessment to assess how well competitive products compare for each SQC.
Session 3.6: Developing a ‘Relationship’ and ‘Correlation’ Matrix

The relationship between the customer’s wants and SQC’s can be evaluated in a matrix format. Allocating some form of weighted measure (e.g. strong, medium, weak) can give a broad indication of the strength of each SQC on the particular customer want. In this way the relative impact of each SQC can be identified for the whole product. Finally, the scores for each SQC can be calculated to give an overall importance rating or a relative scale as a percentage.

And while the importance ranking provides a good indicator of those SQC’s that are more important than others, there are a number of other issues that may over-ride the importance ranking; e.g. the interaction between different SQC’s.

Featured as the roof of the QFD matrix, the ‘Trade-off Matrix’ is effective at providing a better understanding of the potential trade-offs that need to be made at a product specification level.

Conflicts often arise between different SQC’s. For example a negative effects might be realized when the increased performance of one SQC hinders the performance of another. Here a trade-off might need to be made at an engineering level at the early design stages. Conversely a positive effect may result and in some cases there is no net effect between different SQC’s. Simple symbols are used to identify the strong/weak positive and negative interaction on the roof of the QFD matrix.
Session 3.7: Completing the ‘House of Quality’

Depending upon the product or service being evaluated, the basic QFD matrix can be expanded to include many other important features of the product, namely:

- technical and regulatory requirements
- target values and directions for improvement
- warranty/recall costs and repair times
- service history and complaints
- technically important features
- degree of organizational difficulty
- pre-planning matrix.

When appropriately used, these issues can have significant impact on the selection of customer wants which need to be addressed in the new PD process. To provide a measurement of importance these features can be ‘weighted’ to provide a quantitative comparison of values. In themselves the numbers should not be seen as absolute; i.e. they have no meaning in themselves, but are comparators used to prioritize appropriate actions.
Session 3.8: Analysing a QFD Matrix

It is important to remember that the main purpose of QFD is to identify the significant few characteristics that are Critical to Quality for tracking throughout the PD cycle and for the application of special engineering effort. In other words the QFD process is used to help address those product characteristics that are important, new and traditionally difficult to meet.

Care should be taken to interpret and analyse the meaning of the interactions and conflicts that the overall matrix implies. Often the inferences offered are more relevant than the numeric size of numbers generated in the importance rankings.

A well executed QFD analysis will contain a significant amount of information. It is important that the matrix be analysed by the PDT in totality. Some guidelines are:

- blank or weak rows
- blank or weak columns
- conflict between competitive assessments
- sales points
- opportunities to “imitate”
- determine planned quality
- resolve negative interactions
- finalize target values
- determine what company measures (SQC’s) need to be deployed to the next phase.

The meaning of these criteria must be carefully evaluated by the team and assessed for appropriate consideration in light of the overall QFD standing. In light of this, the QFD matrix should be seen as a focal point for further discussion by the PD team for the resolution of topics that may need to be clarified and potential difficulties that might require special engineering effort.
Activity 3 A

Requirements Management

Reading:
- Please refer to the bibliography at the start of the programme and read the articles referring to QFD. In particular please read the paper by John Hauser & Don Clausing, 1988, *Harvard Business Review* Volume 66, Issue 3, *The House of Quality*. ⁹

Website:
- Visit and review website [http://www.npd-solutions.com/qfdsteps.htm](http://www.npd-solutions.com/qfdsteps.htm) and be prepared to discuss the concept of QFD, how it is used and how it integrates into the overall Product Development process.

Activity:
In Activity 1A you were advised to purchase a 4-ring binder in which to keep your lecture notes and handouts. Assuming that you purchased a new binder:
- what features influenced your selection of one brand of binder in preference to another? Jot them down
- develop a questionnaire that you might use to assess the ‘demanded’ customer wants for a binder from the marketplace
- conduct a survey and develop a QFD matrix for the binder
- explain which features are Critical to Quality (CTQ).

Discussion:
- Participate in groupwork during lectures and online discussions.

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⁹ You can access this article directly by clicking on the link which will take you to RMIT library’s ejournal subscription service. You will need your student number to log on to access this service. After clicking on the link, click on ‘EBSCOhost Business Source Premier’ to see an abstract of the paper, then click on ‘pdf Full Text’ at the top of the abstract to read the full article.
Summary and Outcome Checklist

This Topic introduced you to requirements management. Tick the box for each statement with which you agree:

- I can discuss the importance of defining customer needs at the onset of a programme.
- I can develop a generic check list of ‘customer’ requirements.
- I can identify the ‘Voice of the Customer’.
- I can define the stages typically associated with the House of Quality (QFD).
- I can develop a ‘relationship’ matrix.
- I can benchmark customer wants against competitive products.
- I can correlate customer wants against engineering specifications.
- I can develop a QFD matrix.
- I am able to evaluate a given QFD matrix.

Assessment

Assessment for this Topic will be included in Assignment 1.