Draft#1 - Quality Function Deployment (QFD)
Expressed as "House of Quality (HOQ)"
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Quality Function Deployment (QFD) is a detailed, multi-step planning method for delivering product, services, and processes to customers, both external and internal to an organization. It is a way to *translate* between the various customer languages expressing demands (Voice of the Customer), and the organization's languages (Voice of the Designer, Developer, Business Analyst, Manufacturer, . . .) expressing solutions that satisfy those demands.

Where Used

QFD can be used within any endeavour that requires structured planning for anything!

Product/Service Development

This is the standard use in finding out what customers want in the way of a new products or services. Customers describe the feature set they want, and the designers try to come up with a product or service that matches that set.

Business Process Engineering (Lean Sigma Initiatives)

Examining the flow of various process through the organization (or between organizations) so as to identify value, identify the value stream, and in general, eliminate waste, and smooth out the value stream flow. QFD can be used to identify customer "pull" options.

Accounting and Accounting Software

Find out from the potential users what they want and expect to see, and if the chosen package or development project will meet those expectations.

Insurance, Financial Planning

Do a QFD to find out the client's goals and constraints and then tailor a policy set to match that.

Marketing

This function interpenetrates all of the efforts of an organization to make its services available to customers. In this context, marketing is planning and so QFD can play a crucial role.

QuickStart QFD Instructions

Here is a simplified QFD matrix of customer wants that is translated into designer priorities. This matrix, when elaborated with a number of other matrix analyses, is usually called the "House of Quality". So, I will start slowly here and just concentrate on two of the linked matrices comprising the House. The customer needs and their rankings that I show here is one of those matrices, while the technical options and their interactions with the customer needs is the second matrix. (See table on page 3).

Planning to Develop a Fountain Pen using QFD

1. Gather customer needs, wants, demands, and desires for this product (and its associated service such as instructions, packaging, . . .) . List these down the left side of a table. Note that these can be pretty general, such as "easy to use", "relatively cheap", "won't break", "understandable instructions" and so on.

2. Rate each of them on a scale of 1-5, this establishes preferences.

- "5" is a 'must have', can't live without, 'showstopper'

- "4" is very important

- "3' is highly desirable

- "2" nice to have

- "1" include if easy (but beware of introducing additional complexity that must be later maintained and enhanced!)

3. Across the top of the table place write the options, from the organization's technical/ business perspective, that will satisfy these customer needs. This is the language of the organization. Early on, this is usually very general or very specific, depending on the experience of the organization in this area.

- Now at the intersection of each row and column, place a value measuring the "degree of satisfaction" of that design feature, on that customer's need. I use this degree of satisfaction perspective since it matches the realization that every choice is "fuzzy" and the task is to pin the 'fuzz' down within a workable interval. Other authors use the work "impact" to indicate how the need is addressed by the design feature. I have also used the term "cover". Again, use a 1-5 scale (with a possible negative number to indicate feature conflicts) as above with the following meanings. Later analyses can use more sophisticated rating and ranking techniques such as Tomas Saaty's *Analytic Hierarchy Process (AHP).*

- "5" totally satisfies the customers need

- "4" mostly satisfies the need

- "3" somewhat satisfies the need

- "2" a small part of the need is satisfies

- "1" a very small part of the need is satisfies

- "0" or blank means no satisfaction or relevance at all

- Note: Negative numbers are possible if one feature negatively impacts another (in the gardening world, stronger weed killers usually decrease safety and increase environmental damage).

In the table below I have filled out a QFD matrix using myself as the 'customer' as well as the "designer"(not usually a good plan!) For example, in the row "handsome" and the column "contoured barrel", I have placed a '2' since I am thinking that the shape of the barrel will contribute to the handsomeness of the pen (I really like nice fountain pens, but mostly to do with the nib design and ease of writing).

Calculating the Design Rankings

Once I have the matrix of 'degree of satisfaction' values I want to rate the design features so as to concentrate on those that do the most satisfying.

- For each design column cell, multiple the degree of satisfaction with the customers preference ranking.For example, for the 'nib design' column intersected with the 'easy clean row', there is a satisfaction of '4' . Multiple this with the customer preference of "3" to yield 12.

- Add up all the column values and place in the bottom of the table. This yield a '77' for the colum in question.

- You can look at these numbers and get a 'first cut' idea of what design areas to concentrate on.

- *Iterate, increment, and deliver*: Go back and do this matrix again with more input and more analyses.

TABLE 1. Fountain Pen - Simplified QFD

Customer-Needs, Desires, Wants, Demands	Customer Preference Rating	screw -type ink filler valve	modular design	hardened plastic	contoured barrel	nib design	inter-change-able nib
handsome	2	0	0	1	2	4	4
unbreak-able	4	0		5	1	2	2
easy clean	3	3	4	0	0	4	4
fits my writing angle	5	0	0	0	4	5	4
fits my hand	4	0	0	2	4	0	0
easy fill	3	3	4	0	2	4	4
nib choice style	4	0	0	0	2	4	4
Design Rating = Σ rating x preference		18	24	29	56	77	72

Exercise A1

Using the blank table below, cook up a QFD for planning a product such as a pencil, coffee mug, company logo, Master's Thesis, Textbook, or anything else you can think of that can be done in the alloted time.

TABLE 2. Simplified QFD for _____

Customer-Needs, Desires, Wants, Demands	Customer Preference Rating						
Design Rating = Σ rating x preference							

Roots of QFD

QFD is part of a tradition that includes Voice of the Customer, Total Quality Management (TQM), Business Process Re-engineering (BPR), and Lean 6-Sigma. The Toyota manufacturing company has pioneered these tools and today's Lean Manufacturing initiatives are a reflection of what the Japanese have learned and implemented. In a note of bitter irony, the ideas of lean manufacturing were actually begun in the United States, and so acknowledged by the Toyota engineers, but were forgotten/ignored during the heyday of U.S. dominance after world war II. People like Edward Deming proposed these ideas to U.S. industry in the 1950's but only the Japanese listened and the rest, is history!

The QFD systems enables a development team to capture a customer's demand/wants/desires, in an organized way, and relate those to the features of proposed goods, services, or processes. This approach started in Japan in the late 1960s and reached the U.S. in the mid 1980s.

A major emphasis of QFD is the use of conceptual tools, ways to think about data, ideas and their interactions. In this area, QFD is something of a polyglot, incorporating anything that helps! In this tutorial you will read about the major approach of QFD, where the ideas of "What" the customer wants is linked up with "How" the organization is going to satisfy that want.

The Overall Framework of the Method, House of Quality (HOQ)

The procedure is to construct one or more matrices that inter-relate producer and consumer mutual expectations. Due to its visual appearance, the diagram below, guiding the QFD process, is called the "House of Quality" (HOQ).
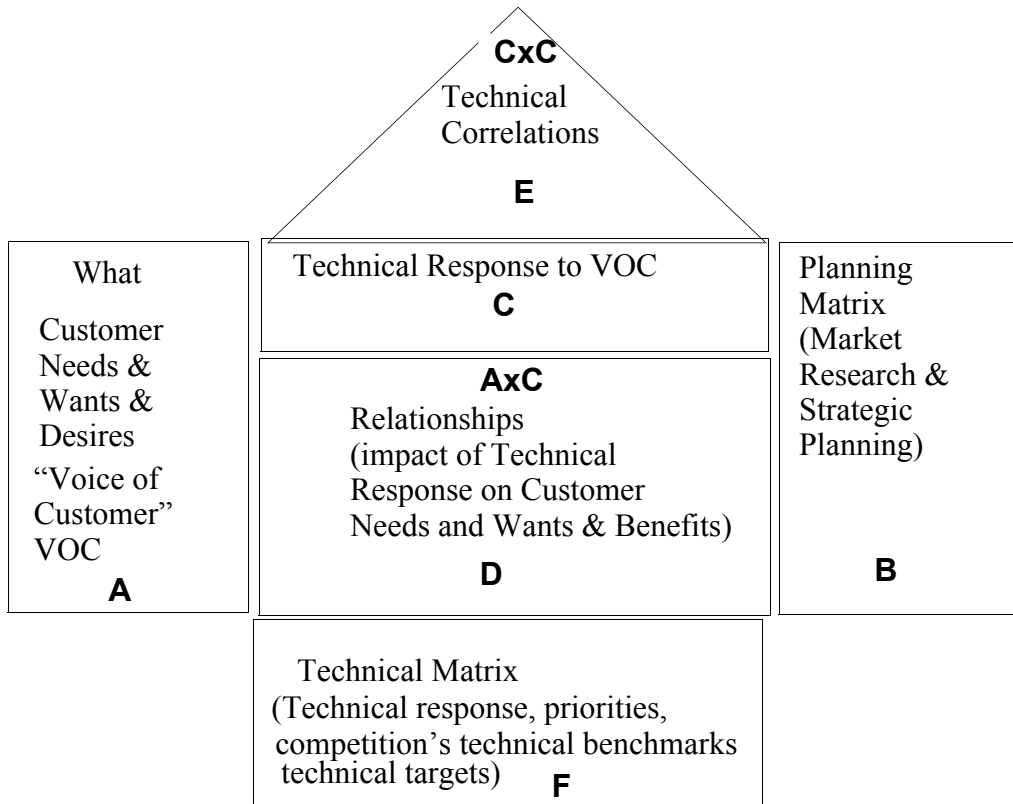
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                              CxC
                           Technical
                           Correlations
                               E

    What              Technical Response to VOC        Planning
                                 C                     Matrix
    Customer                                           (Market
    Needs &                    AxC                     Research &
    Wants &              Relationships                 Strategic
    Desires              (impact of Technical          Planning)
                         Response on Customer
    "Voice of            Needs and Wants & Benefits)
    Customer"                    D
    VOC                                                        B
           A
                   Technical Matrix
                   (Technical response, priorities,
                    competition's technical benchmarks
                    technical targets)     F
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FIGURE 1. House of Quality (HOQ) adapted from "Quality Function Deployment"

Discussion of HOQ Components

Section A

This is a structured list of customer demands, wants and desires. Marketing plays a big part here and the list can be organized in the helpful form of a tree diagram. This is a hierarchy of demands/wants/needs organized into levels. These demands are usually derived form the customer's actual words by means of interviews or other interactions. The actual customer responses are then analyzed using some sort of context analysis such as an Affinity Diagram and or the Analytic Hierarchy Process that then results in a hierarchy diagram.

Section B

This contains the marketing data concerning the importance of those wants and desires of Section A. This is often called the "Planning Matrix". The purpose of this section is figure out the order of importance of customer input and results in a 'rank -ordering' of the customers input. This section also holds data as to how well the organization is doing relative to the competition. Strategic goals are stated here for the anticipated product or service.

Section C

This is the organization's (internal) technical response consisting of the description of the anticipated features of the product/service that will match up with the customers input of

Section A. These are usually in the form of 'requirements' and consist of entries such as solution independent measurements or metrics, product/service requirements, product/services capabilities or characteristics. This is the Voice of the Developer (VOD) and they call this section the "Product Requirements" or the "Design Requirements". These responses can be called "Customer Requirements" or "Technical Specifications" plus many others.

Section D

This holds the relationship, and its strength, between the product/service and the customer demand/needs/desires. This matrix cell holds a 'degree' or 'level' of importance of the product/service's impact on the customer's want at the intersection of the column of Section C with Section A. In a slightly more formal way, I could characterize these entries in the matrix as weighted cross products of A and C, that is A x C. So, if the demands were {a1,a2,a3} and the C responses were {c1,c2}, then Section D would consist of the 6 cells together with their degree of impact {{a1 c1,w1}, {a1 c2 - w2}, {a2 c1,w3}, {a2 c2,w4}, {a3 c1,w5}, {a3 c2,w6}}

Section E

This shows the inter-relationships between the technical components laid out in section C. These are the inter-correlations between the technical proposed response features. This is half of the matrix consisting of the weighted cross product of E x E.

Section F

This holds the technical priorities based on customer needs/desires and the technical /customer relationships. This section also holds information on competitors technical performance.
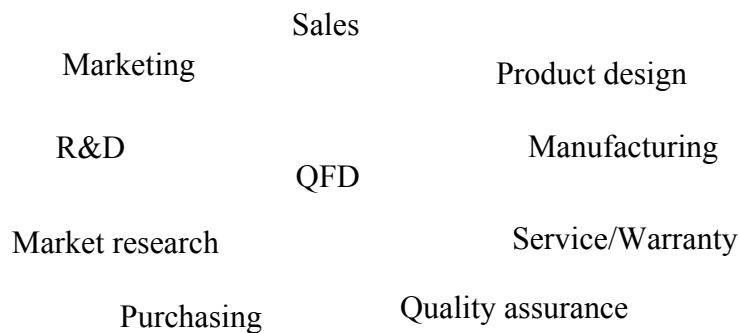
Sales

Marketing

Product design

R&D

QFD

Manufacturing

Market research

Service/Warranty

Purchasing

Quality assurance

FIGURE 2. Central Role Played by QFD as an Integrating Procedure

QFD as a Sequence of Translations

1. Translate Customer Demands, wants, needs, desires --> Voice of Product/Service designers. This says that designers of products and services ought to design in accordance with what the customer actually wants.

2. Translate Voice of Product/Service designers --> Voice of (Business/Manufacturing) Process Planners. Once a product/service is designed, can it really be manufactured/ser-

viced? This is the stage where the process planners work to see how the product can be manufactured or the service be planned out. This is still at an abstract 'paper' level and before a product is actually made or a service is implemented. However, prototypes of product or services are commonly prepared at this stage.

3. Translate Voice of (Business/Manufacturing) Process Designer --> (Business/Manufacturing) Implementors. Once a process is planned out, what real world variations will occur and how will they be accommodated?

4. Translate Voice of Business/Manufacturing process implementors --> Voice of Quality, test, critical part/service characteristics

1. VOC --> VOD (Plan the product/service)

2. VOD --> VOP (Design the product/service)

3. VOP --> VOI (Design the process that will create the product/service)

4. VOI --> VOQ (Establish controls, quality, text & inspection methods applied to the product/process within the process framework)

Kano's Model

Customers respond to different kinds of features of a product or service. Kano points out that these features can be classified into three categories.

- Dissatisfiers

- Satisfiers

- Delighters

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