Vilnius University

Faculty of Mathematics and Informatics

Master's Degree Program of Software Engineering

Course 1, Group 1

Quality Function Deployment (QFD) Analysis of Internet Voting System

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1. Introduction

Product (internet voting system) will be developed for the purchase in the marketplace (*i.e. Envato market*). This document contains Quality Function Deployment (QFD) of the product ("Internet Voting System") to evaluate product's market fit and to ensure that after its release, it will have higher overall ranking compared to other similar products in the same marketplace, and on the internet in general.

QFD Analysis **do not** separate requirements to functional and non-functional, so they here are listed in the same list, differently than in requirement specification.

We define product buyer here as a standard marketplace customer, that is mostly to be expected to be a developer or CTO of buying organization that has to set up internet voting for some kind of local government, and has skills about the need of all four perspectives – market analytics perspective, user's perspective, system analytics perspective & basic software system engineer perspective.

2. Quality function deployment (QFD) purpose, build steps & structure

Quality function deployment (QFD) analysis, with this "house of quality" model (see Figure 1) and its relationship matrix is here to evaluate product's market fit and to ensure that the product ("Internet Voting System"), after its release, will have higher overall ranking compared to other similar products in the same marketplace (in this case – "Envato Market"), and on the internet in general (including other marketplaces, as well as independent websites of individual sellers, whose products are easily discoverable by search – in 80% of searches via "Google" made by potential buyers, only the first 4-5 Google result pages are checked, which is equal to up to 35 results, as of today, when Google search produces 7 results per page.

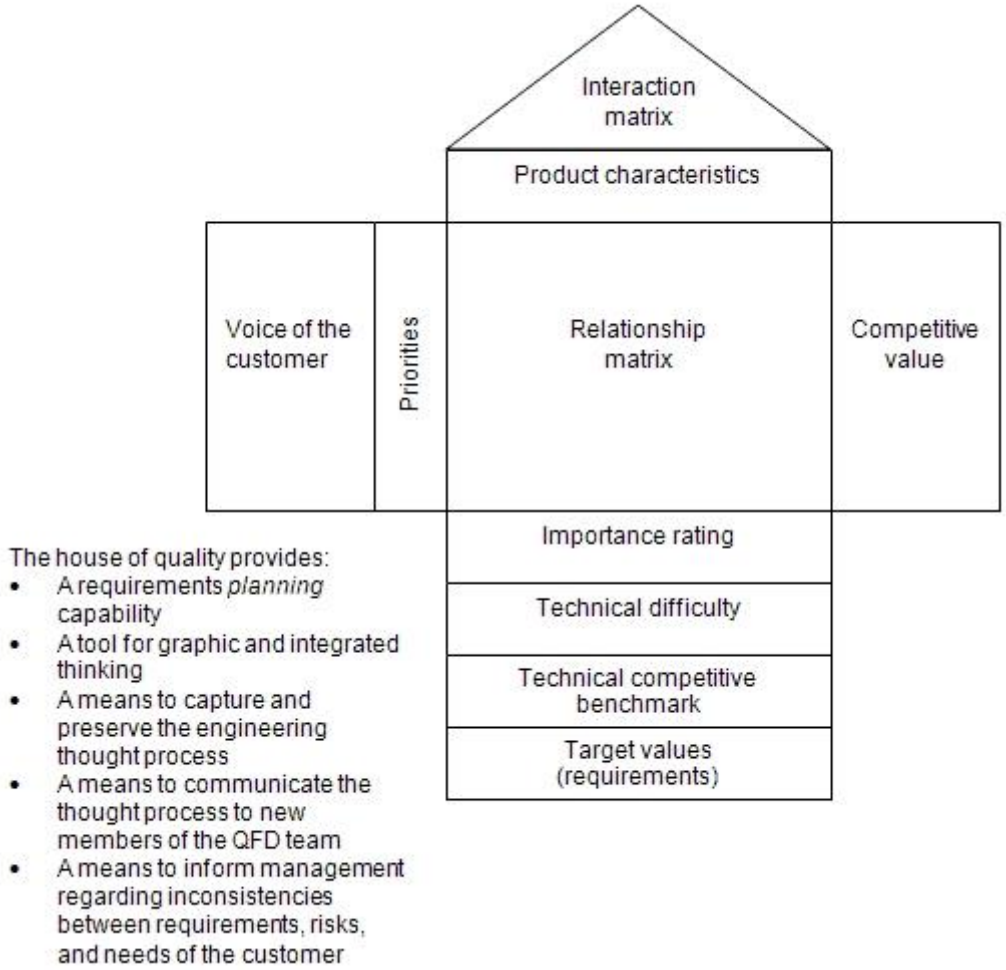


Figure 1. House of quality template and benefits

The old-school QFD method, described in ASQ organization[1] was based on waterfall method on product quality investigation via bunch of different matrices, differently to nowadays, where agile development process dominates, and majority of systems are made for the market are made small to moderate size, and created as quickly and easily & insertable parts ("plug-ins") to the engine (*i.e. WordPress Content Management System (CMS)*). So for those scenario's it is more popular to use simplified version of QFD, defined by University of Cambridge.

As world's top university institute – Institute for Manufacturing at University of Cambridge – research says[2], the main purpose of QFD method is used to identify critical customer attributes and to create a specific link between customer attributes and design parameters. For a company, that is building a product

[1] "What is Quality Function Deployment (QFD)" in ASQ organization page: https://asq.org/quality-resources/qfd-quality-function-deployment

[2] Institute for Manufacturing at University of Cambridge research about Quality Function Deployment (QFD): https://www.ifm.eng.cam.ac.uk/research/dstools/quality-function-deployment/

to the market, it helps to get better understanding about overall standings of their upcoming product compared to other similar products in the same marketplace or even across the whole internet.

Matrices are used to organize information to help marketers and design engineers answer three primary questions:

1. What attributes are critical to our buyers (customers)?
2. What product features (design parameters) are important in driving those buyer attributes?
3. What should the product feature (design parameter) targets be for the new product (new design)?

Example simplified-QFD here would be the following (see Figure 2):

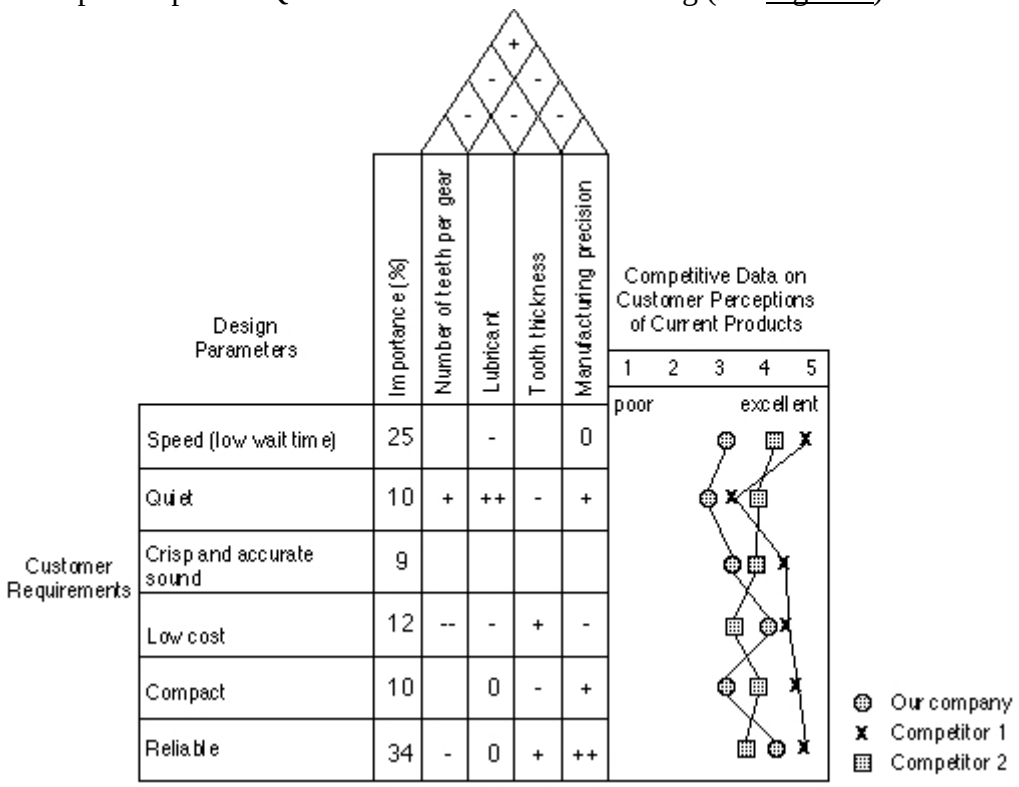


Figure 2. Example simplified-QFD

2.1. Build steps of simplified-QFD

1. The organizing framework for the QFD process is a planning tool called the "house of quality" (simplified example above). Working as a team, design engineers and marketers first establish critical customer attributes for the product. These attributes become the rows of the central matrix of the house of quality. The team may group attributes into broader categories in order to simplify planning and analysis.
    a. After establishing attributes, the team now establishes weightings that represent the relative importance of each attribute from the customers' perspective. The complete set of weightings adds up to 100%.
2. The second step is to establish the critical design parameters that drive system performance (in measurable terms and directly linked to customer attributes).
3. The third step is to fill in the body of the central matrix. Each cell represents a potential link between a design parameter and a customer attribute. This "relationship matrix" indicates both the direction and strength of the relationship.
4. The fourth step focuses on customer perceptions of the company's existing product as compared to its competitors. This may give insight into market problems and opportunities. The fifth and last piece of analysis is the interaction or relationship between design parameters. In the cells of the "roof" matrix is indicated the strength and direction of the interrelationships among design parameters.

2.2. Simplified-QFD structure

There is three QFD tables in this document, each is for different product's quality level:

1. Basic product's quality (expected requirements *i.e. support government-issued ID, voter undisclosability of secret vote*),
2. Required product's quality (normal requirements, *i.e. allow to cast a vote*),
3. Premium product's quality (exclusive requirements, *i.e. statistics of voters' activity per city, area*).

The horizontal rows are buyer's requirements (in other words – "*What has to be built*"), and vertical columns are the product's features (in other words – "*How will that be build*").

The values of the fields based on the strength of relationship between buyer's requirement and product's feature in those five levels:

1. "++" - strongly related (strictly positive)
2. "+" – related (positive)
3. "0" or blank – not related (neutral)
4. "-" – conflicting (negative)
5. "--" – highly conflicting (strictly negative)

3. Product's quality function deployment (QFD) analysis

3.1. Basic product's quality (expected requirements)

This table consists of system features, that are not described anywhere, but they are expected to be as granted, as if not, the buyer of the system will thing that the creator of the system has no domain knowledge about the technology and business (or legal process) field, for which he is building the system.

This table does not have priority column, as these requirements are expected as granted (all are top priority). This table also does not have the competitive data column, as all competitors and our company must-have all these features.

Table 1. Basic product's quality QFD analysis

Buyer's requirement (V) *(What has to be built)* \ **Product's feature (>)** *(How will that be build)*:	API to add access to Centre of citizens registry	Multi-write support of data	Data encryption of secret voting via trusted algorithm (i.e. SHA2-512)	Use wide internet lines with well internet connections	Support to vote via USB-key (non-mobile devices)
Useful for government voting	++		+	+	+
System not loses the voting data		++		+	
Voter undisclosability of secret vote			++		+
Voter can vote from abroad			+	+	++
Unit value (how much – acceptance criteria)	5000 USD	2 write slots at the same time	30+ years unrecoverability grant	Recommends 1 GBps connected-data-center server	+ Mobile carrier network access requirement status (is not required)

3.2. Required product's quality (normal requirements)

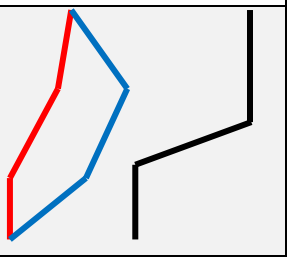
This table consist of features that is a must-to-have for the system, so that typical (mostly-expected) buyer of the system won't reject the purchase. These features, and fit for those requirements has to be defined in both places:

1. Main product description page on marketplace (in this case – Envato Market).
2. In the product documentation.

Differently to Simplified-QFD model, where the "Importance" column is used, and its total value in percent has to be 100%, for this "required system quality" table we use "Priority rating" column instead with values from 0 (lowest, not important) to 5 (highest, very important).

The priority values are gathered via comments from potential buyers (companies), or / and via main buyers, by which basic needs the standard product version is build. Basic needs here means, that the product feature list does not include niche features (like country-specific bank payment method integration), and instead the system just have detailed API and instructions how to add these niche features via clearly documented and defined system extension points.

Table 2. Required product's quality QFD analysis

Buyer's requirement (V) *(What has to be built)* \ **Product's feature (>)** *(How will that be build)*:	Buyer`s priority (LO-HI: 0 to 5)	Vote action from A to Z via 5 steps	Data shredding via clusters	Use one-way hashing algorithm	Support voidance of vote by administrator	Competitive Data on Buyer Perceptions of Current Products
						1 2 3 4 5 *Poor* *Excellent*
Fast voting process (less than 10 mins)	4	++	+			
Can run elections for whole city / state (up to 10M people)	5		++			
Can Re-Vote	1			+		
Paper voting can still be done	5				++	
Unit value (how much – acceptance criteria)		1-5 min	500,000 voters x cluster x N	+ (Sha2-512 or similar)	+ (Void)	Black line – our company Red line – competitor #1 (VeryConnect) Blue line – competitor #2 (eBallot)

*5 steps (pages) are – login page, election selection page, candidate selection page, vote verification screen, vote confirmation page

3.3. Premium product's quality (exclusive requirements)

The features of the system defined in this table is not required by the buyer to make purchase, but they are nice-to-have, and may be the selling point, in case if the buyer is compared several similar systems on same or different marketplaces.

This table also has priority field, as same as in "Required product quality" table, because we can compare these exclusive features existence in competitor products, as well as we can interview our potential buyers about their happiness level of getting one on more of these exclusive features added and how would that this impact their choice of purchase compared to other similar product, that does not have those exclusive features.

Table 3. Premium product's quality QFD analysis

Buyer's requirement (V) *(What has to be built)* \ **Product's feature (>)** ***(****How will that be build)*:	Buyer`s priority (LO-HI: 0 to 5)	Display statistics of voters activity per city, area	Candidates, elections and voting data export	Competitive data on Buyer Perceptions of Current Products 1 2 3 4 5 *Poor* *Excellent*
Voting analysis	4	++	+	
Can save data to PC	3	+	++	
Unit value (how much – acceptance criteria)		Area, city, state, ZIP code (Geo-groups)	+ (via PHPMyAdmin)	Black line – our company Red line – competitor #1 (VeryConnect) Blue line – competitor #2 (eBallot)

4. Findings

After the QFD analysis it is clear, that, if done well, with at least couple of exclusive features, the product is likely to be able to outcompete similar product on the marketplace and on the internet in general.