Reflections on Systems Engineering (SE) - Quality Function Deployment (QFD)

Berquó, Jolan Eduardo – Electronic Eng. (ITA)
Aerospace Product Certifier (DCTA/IFI)
Government Representative for Quality Assurance – RGQ (DCTA/IFI)
Post-graduated in Reliability Engineering and System Safety Engineering (ITA)
Specialization in Systems Engineering and Analysis (Italy)
jberquo@dcabr.org.br

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As promised in IYK 65, we will present in this IYK the excellent tool for capturing customer requirements, in the first activity of the first phase of the life cycle of a system (Conceptual Phase), that is, the identification of customer needs. We are speaking about the Quality Function Deployment - QFD. As always, it's just a familiarization, but enough, we believe, to awaken in the reader an interest for a further study.

In fact, what we are going to do in this IYK is to complement the subject of IYK 65, (Requirements). We cannot forget that we are still in the Conceptual Phase of the life cycle of a system, i.e, we are still defining requirements.

In this opportunity, we will show how to translate customer needs or requirements into engineering technical specifications, which will be configured into functional requirements that will then generate performance requirements.

QFD is one of the possible tools that can do this translation. It is a methodology highly praised by professionals who use it. It is in fact a process that significantly improves the ability to capture, prioritize, and evaluate customer requirements using a team approach.

Once agreed with the customer, these technical specifications are then transformed into functional requirements and, hence, into top-level performance requirements, that is, aircraft level. This is the same mechanism for defining performance requirements as addressed in IYK 65.

The basis of QFD is the construction of at least four matrices, the first known as House of Quality (HOQ). The HOQ refers to the requirements or needs of the customer, thus falling into the conceptual phase of the system life cycle. It is shown in Fig. 1. This first array refers to the aircraft as a whole. Examine this matrix well and then follow the meaning of each of your "rooms".

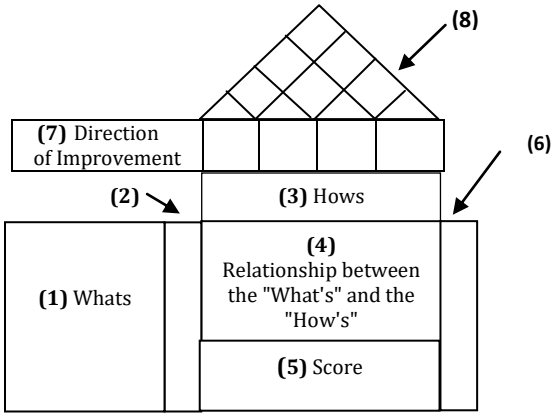

Fig. 1 - The House of Quality (HOQ) – Aircraft Level

(1)**"Whats"** - These "Whats" in the first matrix (HOQ) are customer's needs, but in their language (voice), comparing with the characteristics of aircraft of the same class and already in operation at that moment. Let us consider, for our example, the following needs:

- Longer aircraft range;
- More passengers;
- Higher cruising altitude;
- Higher speed;
- Increased operational availability; and
- Greater dispatchability.

(2)RELATIVE IMPORTANCE OF THE "WHATs". It could be a scale of 1, 2, 3, 4 and 5, from least important (1) to most important (5), but according to the customer. As examples we cite:

- Longer range of aircraft: 5;
- More passengers; 5;
- Highest cruising altitude: 3;
- Higher speed: 5;
- Greater operational availability: 4; and
- Greater dispatchability: 5.

(3)"HOWs" are the technical specifications presented by the company, in the translation or transfer of customer needs to the "Voice of Engineering". Consider, as an example, the following "How's":

- Auxiliary fuel tanks;
- Vortex generators;
- Wider wings;
- Higher aspect Ratio;
- Cell dimensions;
- Reliability; and
- Maintainability.

(4) **RELATIONSHIP BETWEEN THE "HOWs" AND THE "WHAT"**, showing the importance of a particular "How" in the understanding of the company to meet each "What" of the customer. Let us use the following logarithmic score as an example:

- Weak relationship: 1;
- Widdle relationship: 3; and
- Strong relationship: 9.

If there is no relationship of a "How" with a "What", a "zero" is signaled, or nothing is marked, with "zero" being the score. This relationship is identified by the company, but then discussed with the customer in a workshop.

(5) SCORE - Once the score of each "How" for each "What" has been established by means of the values 0, 1, 3 and 9, these values are multiplied by the respective weights of "What's" (1, 2, 3, 4 or 5) and adding these products to each "How". To this product is added the so-called filtering value, that is, a numerical value corresponding to schedule or cost risk. The cost would be, for example, denoted by a scale, such as: (5) cost less than that of the competitor; (1) cost approximately equal to that of the competitor; and (-1) cost greater than that of the competitor. It is a relative scale for that moment (Conceptual Project).

(6) COMPETITIVE EVALUATION - Consists of analyzing how are the "Whats" as compared to those of our main competitor. If we are better or almost equal, we leave them as they are; if we are worse, we must improve them. This is done using the following symbology:

- We are better: **+**
- We are equal: **=**
- We are worse: **-**

(7) IMPROVEMENT DIRECTION - Based on the Competitive Assessment, it indicates whether or not we should improve a specification ("How") of our current project, relative to the competitor's. This can be done by symbology: Improvement Direction.

Direção de Melhoria	↑	↑	↓	↑	↑	↑	▫

The up arrow means “to improve the How", i.e., the respective specification. The down arrow, “ to reduce the specification” ; and the rectangle, "leave as it is."

(8) RELATIONSHIP BETWEEN THE "HOWs" - *This is* the "roof" of the HOQ. It is the relationship between a "How" and another "How", showing how the variation of a "How" affects the variation of another "How". One possible symbology might be as follows:

(+) - Positive;
(0) - Neutral (or nothing is inserted); and
(-) - Negative.

The matrix 1 (HOQ) is then shown in Fig.

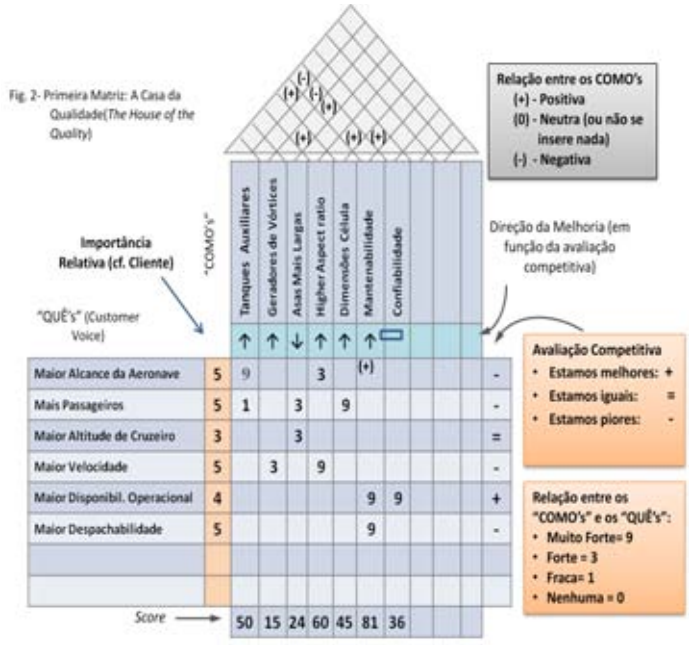

Fig. 1 – Matriz 1 (HOQ) - Nível Avião

Completed the aircraft level matrix, we pass to the matrix 2 (systems level), with the same format, except that the "Hows" of the aircraft level matrix become the "Whats"of the matrix 2; but only the most important "Hows" since it does not make sense to pass a "How" with competitive evaluation "We are equal (=)" to the next matrix.

Fig. 2 gives an idea of this chaining.

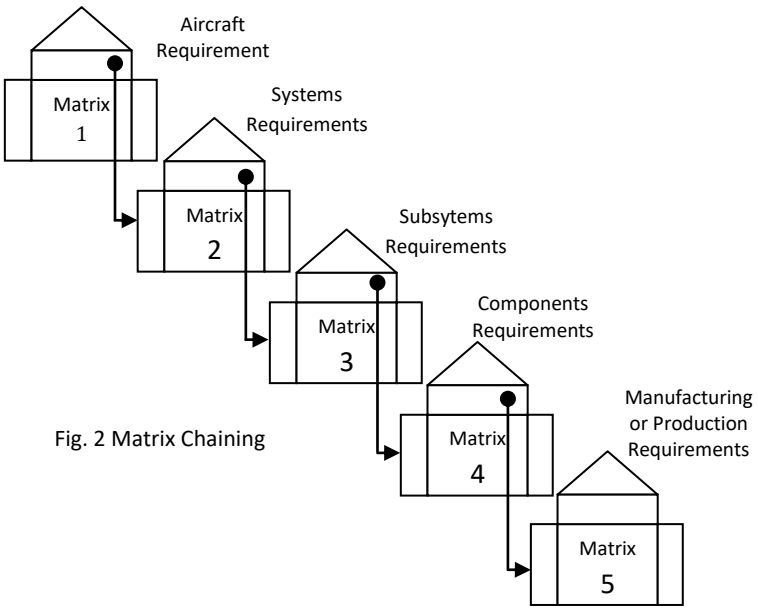

Fig. 2 Matrix Chaining

The process can also be applied to the logistic technical support requirements and infrastructure support requirements for the operation.

Well, dear reader, we are ending up here. The purpose was to give an idea (familiarization) of the QFD method, with an example for an aircraft. We strongly recomend to you the references presented bellow.

Until the next IYK.

References

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