
Completeness of Development Projects Assisted by QFD: a Case Study

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Abstract. The completeness of development projects assisted by QFD is not easily assessed due to the information displayed in the QFD matrices are highly dependent of the experience and intuition of the design team. This article presents a case study of a business development project, where the completeness was assessed when the focus of the QFD relationships was moved from the client requirement itself to how the requirement shall be verified. This procedure made possible the identification of the not covered portion of the client requirement and compelled the project scope review.

Keywords. Quality function deployment (QFD), completeness, business development.

1 Introduction

The competitive strategic management process has been recommended by many authors e.g. Porter [10], Lobato [9] and Shapiro [11], to guide the organization evolution toward a desired future position and to overcome the threats and obstacles usually found during its business development process.

Pursuing this objective, a small educational organization in Brazil set-up its business development project, Araujo and Trabasso [2] describe the initial planning phase of this project where the quality function deployment (QFD) method was used to assist the deployment of the requirements into a determined set of action plans and subsequently into the organizational business processes.

However, that study only validated the hypothesis that QFD can assist the deployment of company strategic objectives and make easy the initial planning of the business development process; the results gathered from the modifications suggested in the QFD methodology to assess the project scope completeness were not presented.

This article aims to present these finds; the proposed changes on the QFD method and to discuss the completeness of development projects assisted by QFD.

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The text was organized in order to firstly review the main steps and results of the business development process applied to the studied organization; secondly the completeness of the project scope is analyzed and a literature review is presented. Item 4 presents the procedure implemented to analyze the development project completeness; its consequences in the relations between requirements and action plans in the QFD matrices and the results obtained. Finally conclusions concerning the specific case study and the modification suggested in the QFD methodology are presented.

2 Business Development Assisted by QFD

The business development project presented by Araujo and Trabasso [2] has been running since 2005 at a kindergarten to elementary education school, based in São José dos Campos, Brazil, operating since 1983, currently with 85 employees and about 500 students. However; its quest for excellence was initiated two years before, when the Brazilian National Quality Award (PNQ) [6] was selected as a guideline for its business improvement.

The use of PNQ as a proxy of the enterprise strategic planning objectives was an interesting find gathered by the usage of the theory of inventive problem solving (TRIZ) introduced by Altshuller [1]. TRIZ was applied in the case study to solve the dilemma in general observed in small companies when the funds are not sufficient to support all the essential operational and strategic tasks.

Once the objectives were determined the next step would be the usage of QFD to deploy the PNQ requirements into the action plans that were selected to conduct the development process. However the QFD methodology is native of the product development environment, so some adjusts shall be incorporated to bring the QFD more effective to the business development background. Essentially the changes were performed on the inputs and outputs of the QFD matrices, as shown in Table 1, and on the requirements importance weights that were replaced by the quality award requirement point values i.e. the PNQ [6] requirement point values.

Table 1. QFD matrices comparison between product and business development

QFD Matrix	Product development		Business development	
	Input	Output	Input	Output
1	Customers needs	System requirements	Stakeholders needs	Model requirements
2	System requirements	Parts characteristics	Model requirements	Action plans
3	Parts characteristics	Production processes	Action plans	Business processes
4	Production processes	Manufacturing operations	Business processes	Critical tasks

The action plans were identified after an extensively internal survey to find out the actions, programs and efforts performed by the organization that could contribute to any PNQ requirement. Amazingly, it has been found 72 different efforts with several levels of control, implementation progress and complexity.

These efforts were grouped into a set of 12 action plans and the initial QFD matrix with the relations between the PNQ requirements and action plans was generated, see Figure 1.

			Action Plans												PNQ Point Value		
			1	2	3	4	5	6	7	8	9	10	11	12			
Legend: Relationship Intensity ● - Strong (Value = 9) ○ - Average (Value = 3) ○ - Weak (Value = 1)			Pedagogic Excellence													40	
			Customer Satisfaction			●											
			General Administration			●										30	
			Enterprise Resources Planning														30
			ISO9001 / 2000													30	
			Child care														30
			Human Resources Excellence							○						30	
			Students with Special Needs														30
			Social Responsibility										○			30	
			Making the Student a Citizen														
			External Communication													30	
			Balanced Scorecard (BSC)														
PNQ Requirements	Leadership	Senior Leadership															40
		Continuous Improvement Culture	●	○	○	○		●		○	○	○	○				40
		Organization Performance Review	○		●			○	○			○	○		●		30
	Strategic Planning	Strategy Development		○	●					○		○					30
		Strategy Deployment	●	●				○		○		○	○	○	●		30
	Customer	Customer and Market Knowledge	●	●	○			○		○		○		●			30
		Customer relationship and satisfaction	○	●	○		○		○				●	●			30
	Social Responsibility	Social responsibility		○	○					●	●	○	○				30
		Ethics and governance	○		○				○	●	●	○	○				30
	Measure and Knowledge Management	Information Knowledge Management				○	○					○			○		20
		Benchmarking information Management	○			○						○		●			20
		Intangible assets management	○						●						○		20
	Human Resources	Work Systems					○		●								30
		Employee Learning and Motivation	○				○	○	○	○						○	30
		Employee Well-Being and Satisfaction					○		○	○	●						30
	Process Management	Value Creation and Support Processes	●	○		●	○	○		○							50
		Vendor Processes	○			○	●							○			30
		Economic and Financial Processes				●	○						○				30
	Results	Customer-Focused Outcomes	○	●	○			○		○				○	○	○	100
		Economic and Financial Outcomes	○	●	○	○		○		○			○	○	○		100
		Human Resource Outcomes			○				●	○						○	60
		Vendor Outcomes				○									○	○	30
		Social Responsibility Outcomes	○		○			○	○	○	●	○	○	○	○	○	60
Processes Outcomes		●			●	●			○		○	○		○		100	
																100	
Action Plan Absolute Importance			3500	2550	2370	2100	2040	1560	1510	1500	1450	1360	1250	1240			
Action Plan Relative Importance			16%	11%	11%	9%	9%	7%	7%	7%	6%	6%	6%	6%			

Figure 1. Initial QFD planning matrix.

This first result of the business development project shows how the action plans support the requirements of the PNQ and can be used to guide these requirements through the company structure by a second and third deployment levels, where the action plans shall be related to the internal business processes and recursively these process to their critical tasks.

Although the QFD matrix shows the relationship between all PNQ requirements and the selected action plans, the recognition of the full coverage of the requirements is not an easy task. For instance, observing Figure 1, it is possible to detect that the requirement “Vendor Outcome” is weakly associated to the set of action plans, due to only three weak relations were found; on the other hand, it was identified at least three strong relations for the requirement “Value Creation and Support Processes”; however there is no guarantee that these relations are not explaining the same portion of the requirement.

From the organization point of view, the completeness of the business development project i.e. a plan that addresses every portion of the PNQ requirement, is a worthy outcome to evaluate the actual effort required to complete the improvement process.

3 Literature Review: Completeness of Development Plans assisted by QFD

A literature review revealed that many authors have studied how the QFD methodology or the design team aspects can affect the QFD matrices results or difficult the data analysis. The main finds were classified and presented in this chapter.

3.1 Relations are arbitrary and subjectively determined.

Kim *et al* [8] report that “The limitations of the current QFD practices mainly come from the fact that a HOQ (House of Quality) requires subjective, interrelated and complicated information”, additionally Chen and Chen [3] state that the design teams should use its own experience, knowledge and intuition to determine the engineering characteristics that would support the client requirement. These observations confer an intrinsic uncertain to the QFD method.

3.2 Engineering characteristics could be insufficient to cover the requirements.

Fehlmann [5]; Kim *et al.* [8]; Shin and Kim [12]; Chen and Chen [3] observed that the selected engineering characteristics could be dependent with the others (multi-co-linearity) i.e. they could explain the same portion of the requirements leading to an overestimation of the requirement coverage.

3.3 Absence of formal criteria to identify the intensity of the relation between requirements and the engineering characteristics.

Some authors e.g. Cohen [4]; Kim *et al.* [8] and Franceschini and Rupil [7] proposed directions to analyze the intensity of the relations between the requirements and the engineering characteristics; however these procedures are not able to clearly assess the intensity or the sufficiency of the engineering characteristics to fully support the requirement accomplishment.

3.4 Relations do not address how the requirement is accomplished.

Even though the relations inferred in the QFD matrices construction can be associated to a measure of effectiveness (MOE), as recommended by Cohen [4], they are nor specific or do not reference how the requirement will be achieved or verified. Chen and Chen [3] corroborate this statement when analyzing the focus of the QFD prioritizing procedure: “Wasserman formulated the QFD planning process as a linear programming model that select the mix of design features which resulted in the highest level of customer satisfaction. The model focused on prioritizing the allocation of resources among design features, rather than determining the target levels of engineering characteristics”.

4 Improving the Business Development Plan

In order to accomplish the completeness of the planning for the business development project, and guided by the finds of the literature review, it was proposed an alternative procedure to identify the relations between the action plans and the PNQ requirements, where the focus of the relationship was moved from the requirement itself to how the requirement will be verified i.e. the PNQ assessment criteria.

The PNQ assessment criteria are the instruments used to measure the actual organization status toward the excellence model described in the PNQ requirements and are based on the judgment of how the organization is performing the adequacy, proactively, refinement, innovation, dissemination, continuity and integration of the requirements classified as “approach and process” or relevancy, actual result and tendency of those ones classified as “result”.

In the example presented, the relationship between the action plans and the PNQ assessment criteria was determined, for each requirement; firstly by the identification of the most relevant action plan for any of the single criterion applied to the requirement under analysis, see example on Table 2; secondly a heuristic rule, presented on Table 3, was used to infer the relationship intensity.

Table 2. PNQ assessment criteria and relevant action plans and for the requirement: “Information Knowledge Management”.

PNQ assessment criteria	Relevant Action Plan
Adequacy	Not related
Proactively	General Administration
Refinement	Balanced Scorecard
Innovation	Not related
Dissemination	Balanced Scorecard
Continuity	General Administration
Integration	Not related

Table 3. Heuristic rule used to determine the relationship intensity between PNQ requirements and action plans.

Intensity of the relationship	Symbol	Value
Strong	●	Four or more criteria associated to the action plan.
Average	⊙	Two or three criteria associated to the action plan.
Weak	○	One criterion associated to the action plan.
Inexistent		No criteria associated to the action plan.

The chosen of the more appropriate heuristic rule was not included in the scope of this article. However; many possible alternatives can be used e.g. introduction of different weights for each criterion or the association of more than one action plan to a single criterion; these alternatives could lead to slightly differences in the estimated relation intensity.

Even though some uncertain is expected in the estimated relation intensity, some interesting results were gathered when the proposed procedure was applied to the case study. The new QFD planning matrix shown in Figure 2 has substantial differences in comparison with the first table presented in Figure 1:

- Superposition among the action plans was reduced due to only one plan can be chosen as relevant to each PNQ assessment criterion.
- Some action plans were not identified as relevant to any of the PNQ requirements.
- It was possible to identify the portion of the PNQ assessment criteria that was not covered by the selected set of action plans. The column “Not related”, in Figure 2, represents this lack of relation.
- Consequently the action plans prioritized order was modified.

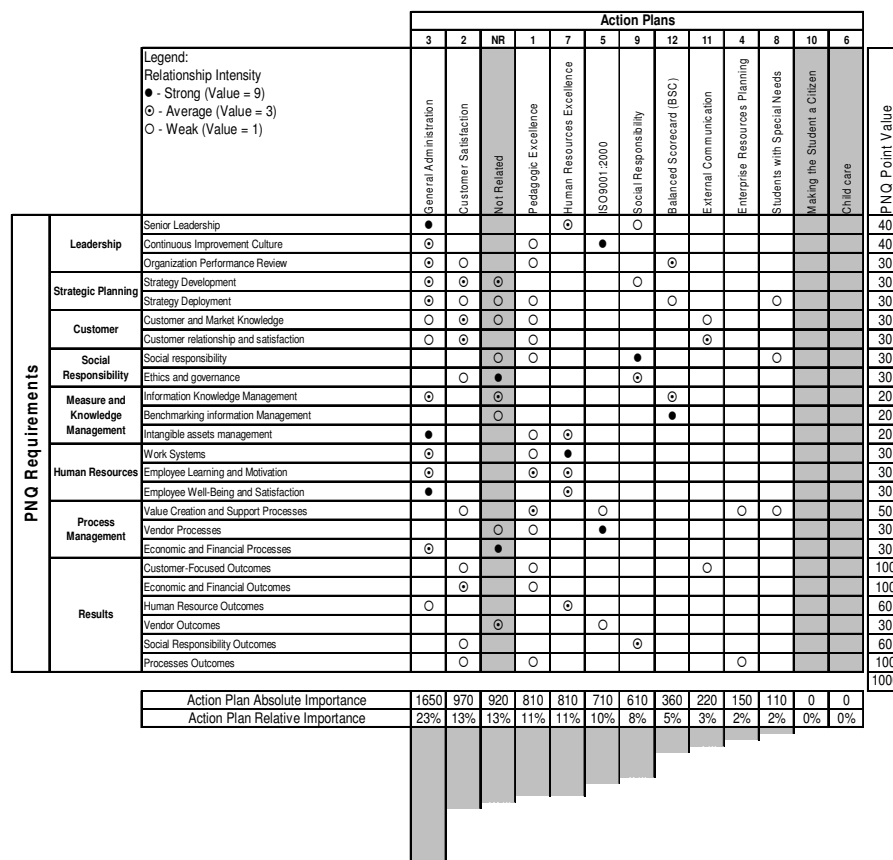


Figure 2. QFD planning matrix: relationships determined with PNQ assessment criteria; not related items present.

This result compelled the project team to eliminate the lack of relation between the planned actions and the PNQ requirement. So the project was reviewed and a new set of action plans was determined, where some plans had their scopes enlarged, new plans were added and non relevant plans were merged into more significant ones e.g. “Child care” and “Making the Student a Citizen” action plans were merged into “Pedagogic Excellence”. Finally a third QFD matrix was appraised and the results were presented in Figure 3.

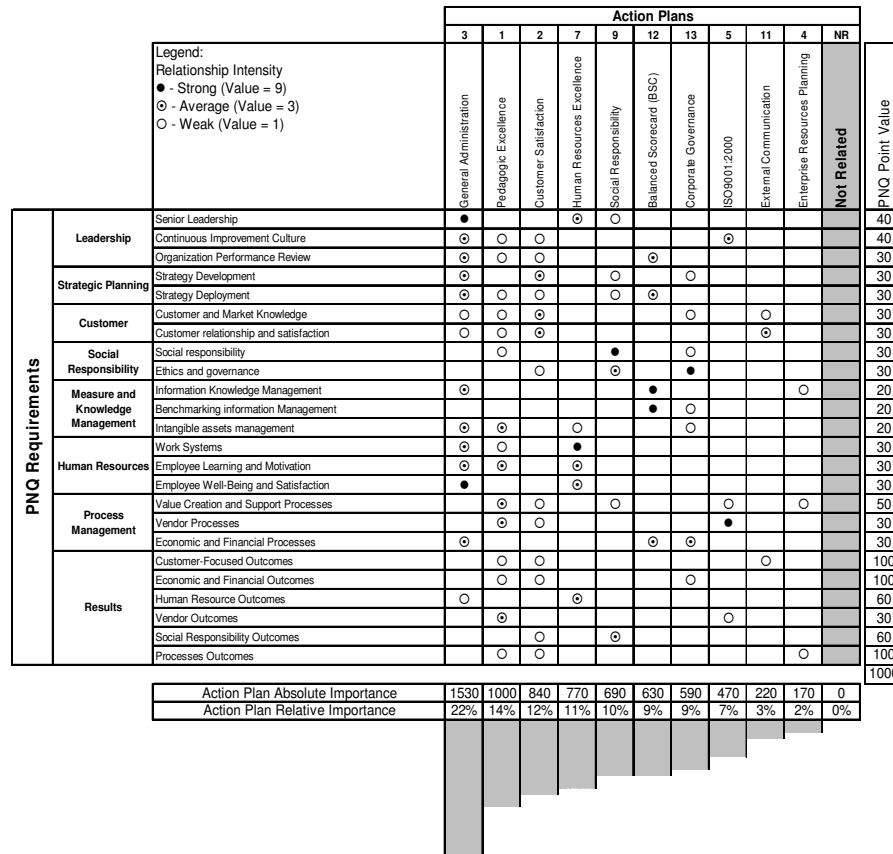


Figure 3. QFD planning matrix: relationships determined with PNQ assessment criteria; not related items eliminated.

5 Conclusion

Although QFD is a worthy tool to assist the planning phase of business development projects, the completeness of the plan is not easily verified and achieved, due to:

- Relations are arbitrary and subjectively determined in the QFD process, conferring an intrinsic uncertain.
- Engineering characteristics could be insufficient to cover the requirements and could explain the same portion of the requirement.
- The absence of a formal criterion to identify the intensity of the relation between requirements and all the engineering characteristics, difficult the analysis of the requirement coverage.
- Relations do not address how the requirement is accomplished.

In the case study presented, where the PNQ requirements were defined as the bases for the organization quest for excellence, the completeness of the business development plan was analyzed moving the focus of the QFD relationships from the PNQ requirement itself to how the requirement shall be verified i.e. the PNQ assessment criteria. The well defined scope of the PNQ assessment criteria allied with the procedure applied; where only one action plan was related to each single PNQ assessment criterion; lead to a new QFD planning matrix with some significant gains:

- The Superposition among the action plans was reduced.
- The portion of the PNQ assessment criteria that was not covered by the action plans was easily identified.
- The assignment of the “not related” items guides the project scope review toward the full coverage of the PNQ requirements.

Even though the case studied had the business development as its background, the problems identified and the proposed solutions can be applied to the QFD original environment: the product development process. New studies shall be performed to find out how the QFD methodology can be improved to congregate features to move or associate the relationship process to the final product verification requirements aiming to determine a clear and finite evaluation scope capable to assist the assignment of not covered requirements and to address how the client requirement was actually achieved.

6 References

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