Completeness of Development Projects Assisted by QFD: a Case Study

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Abstract. To assess the completeness of a Business Development Project (BDP) is not a simple task. The usage of some design method such as QFD eases but does not solve completely the problem, because the information displayed in the QFD matrices is highly dependent of the experience and intuition of the design team. This paper presents a case study of a BDP, where the completeness of the project was assessed through a slightly modified view of QFD: instead of looking at the market requirements themselves, it is proposed to find out the ways the requirements are accomplished. This procedure made possible the identification of the not covered portion of the market requirements and guided the project revision.

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

1 Introduction

The strategy management process has been recommended by many authors e.g. Porter [9], Lobato [8] and Shapiro [10], to guide organizations toward a desired position.

A small educational enterprise in Brazil set-up its business development project to achieve this goal. Araujo and Trabasso [1] describe the initial planning phase of this project where the quality function deployment (QFD) was used to assist the deployment of the project requirements into a determined set of action plans which were further deployed into the organizational business processes.

The analysis done by the authors has endorsed the hypothesis that the QFD methodology can assist the deployment of company strategic objectives and eases the planning stage of a Business Development Project (BDP). The quality of the BDP, measured by its completeness, for instance was not within the scope of that analysis. This paper addresses this very aspect and proposes slightly changes on QFD methodology in order to assess the completeness of business development projects.

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The text is organized as follows: initially, it is presented the BDP applied by the case study enterprise; then, completeness of business development project is analyzed and a literature review is presented. Next, the proposed procedure to analyze the project completeness is described. Finally, the conclusions concerning the specific case study and the modifications suggested in the QFD are presented and discussed.

2 Business Development Projects Assisted by QFD

The business development project presented by Araujo and Trabasso [1] has been running since 2005 at an educational enterprise in Brazil, which operates since 1983, has 85 employees and around 500 students. The quest for excellence is a tradition of that enterprise and received special push when the Brazilian National Quality Award (PNQ) [5] was selected as the guideline for its business improvement.

Once the PNQ requirements were identified as strategic objectives for the business development project, the planning phase has been derived through the QFD methodology. Because QFD is a tool suitable for product development, some adjustments were made to QFD in order to apply it in the business environment. Essentially, the adjustments were made on the inputs and outputs of the QFD matrices, as shown in Table 1, and on the requirements weights that were replaced by the PNQ [5] score values.

Table 1. QFD matrices comparison between product and business development

QFD Matrix	Product development		Business development	
	Input	Output	Input	Output
1	Customer needs	System requirements	Stakeholder needs	Model requirements
2	System requirements	Characteristics of parts	Model requirements	Action plans
3	Characteristics of parts	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 enterprise that could be correlated to any PNQ requirement. These were grouped into a set of 12 action plans and an initial QFD matrix with their relations with the PNQ requirements was drawn, as shown in Figure 1.

			Action Plans												
			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	Customer Satisfaction	General Administration	Enterprise Resources Planning	ISO9001:2000	Child care	Human Resources Excellence	Students with Special Needs	Social Responsibility	Making the Student a Citizen	External Communication	Balanced Scorecard (BSC)	PNQ Point Value
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
															1000
		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.

The QFD matrix shown in Figure 1 depicts how the action plans support the PNQ requirements. The action plans are rated according to its relative importance; the more important plans can be recursively deployed toward the company structure up to their critical tasks that would support the plan execution.

Although the QFD matrix shows the relationship between all PNQ requirements and the selected set of action plans, the recognition of the full coverage of the requirements is not easily assessed. For instance, observing Figure 1, it is possible to infer that the requirement “Vendor Outcome” is weakly associated to the set of action plans, due to only three weak relations were found, whereas the causes of this poor relationship intensity are not directly presented.

On the other hand, it was identified three strong relations for the requirement “Value Creation and Support Processes”; however the associated action plans could be correlated leading to an overestimation of the overall relationship intensity.

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

3 Literature review: QFD flaws

A literature review reveals that many authors have analyzed how the QFD methodology and the design team aspects can affect the results of the QFD matrices. The main finds were classified and presented in this section.

3.1 Relations are arbitrary and subjectively determined.

Kim *et al* [7] 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 [2] 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 grant an intrinsic uncertainty to the QFD methodology.

3.2 Engineering characteristics could be insufficient to cover up the requirements.

Fehlmann [4]; Kim *et al.* [7]; Shin and Kim [11]; Chen and Chen [2] observed that the selected engineering characteristics could be dependent to the others (multi-co-linearity) i.e. they could enlighten the same portion of the requirements, leading to an over or underestimation 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 [3]; Kim *et al.* [7] and Franceschini and Rupil [6] proposed directives to analyze the intensity of the relations between the requirements and the engineering characteristics; however these procedures are not able to clearly assess the sufficiency of the engineering characteristics to fully support the requirement accomplishment.

3.4 Relations do not address how a requirement is accomplished.

Even though the relations inferred in the QFD matrices can be associated to a measure of effectiveness (MOE), as recommended by Cohen [3], they are not specific or reference how a requirement is achieved or verified. Chen and Chen [2] corroborate this statement: "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 Project

In order to overcome the QFD limitations stated above and consequently, assess the completeness of the business development project, it is proposed an alternative procedure to identify the relations between the action plans and the PNQ requirements. This procedure modifies slightly the way of viewing the QFD relations: instead of looking at the market requirements themselves, it is proposed to find out the ways the requirements are verified i.e. through the PNQ assessment criteria.

The PNQ assessment criteria are used to measure the actual enterprise performance. The assessment procedure evaluates the PNQ requirements classified as "approach and process" on seven distinct areas: adequacy, proactive, refinement, innovation, dissemination, continuity and integration; and those, classified as "result", according to their relevancy, actual result and tendency.

In the case study, the relationship between the action plans and the PNQ assessment criteria has been determined in two steps: (1) identification of the most relevant action plan for all the performance areas of the requirement under analysis, see example on Table 2; (2) establishment of the relationship intensity based upon a heuristic rule presented on

Table **3**.

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
Proactive	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 ("approach and process") and action plans.

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

Naturally, many possible alternatives could be used instead of the heuristic rule presented, e.g. the usage of different weights for each performance area or the association of more than one action plans to a single performance area. These rules could lead to slightly differences of the relation intensity.

Even though some uncertainty is expected in the relation intensity, some interesting results were gathered when the procedure was applied to the case study.

The new QFD planning matrix shown in Figure 2 has substantial differences as compared to the first draft presented in Figure 1:

- The superposition among the action plans was reduced as only one plan was labeled 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", added in Figure 2, highlights this information.
- The priority order of the action plans was modified, as a consequence.

			Action Plans												
			3	2	NR	1	7	5	9	12	11	4	8	10	6	
		Legend: Relationship Intensity ● - Strong (Value = 9) ⊙ - Average (Value = 3) ○ - Weak (Value = 1)	General Administration	Customer Satisfaction	Not Related	Pedagogic Excellence	Human Resources Excellence	ISO9001:2000	Social Responsibility	Balanced Scorecard (BSC)	External Communication	Enterprise Resources Planning	Students with Special Needs	Making the Student a Citizen	Child care	PNQ Point Value
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
																1000
		Action Plan Absolute Importance	1650	970	920	810	810	710	610	360	220	150	110	0	0	
		Action Plan Relative Importance	23%	13%	13%	11%	11%	10%	8%	5%	3%	2%	2%	0%	0%	

Figure 2. QFD planning matrix: relations determined with PNQ assessment criteria

The outcome of this analysis has compelled the project team to review the business development project and a new set of action plans was determined. Some plans had their scopes enlarged, new were added and non relevant were merged into more significant plans e.g. "Child care" and "Making the student a citizen"

were merged into "Pedagogic Excellence". Figure 3 shows the final result yielded from the steps just described.

			Action Plans											
			3	1	2	7	9	12	13	5	11	4	NR	
		Legend: Relationship Intensity ● - Strong (Value = 9) ⊙ - Average (Value = 3) ○ - Weak (Value = 1)	General Administration	Pedagogic Excellence	Customer Satisfaction	Human Resources Excellence	Social Responsibility	Balanced Scorecard (BSC)	Corporate Governance	ISO9001:2000	External Communication	Enterprise Resources Planning	Not Related	PNQ Point Value
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
														1000
		Action Plan Absolute Importance	1530	1000	840	770	690	630	590	470	220	170	0	
		Action Plan Relative Importance	22%	14%	12%	11%	10%	9%	9%	7%	3%	2%	0%	

Figure 3. QFD planning matrix: relations determined with PNQ assessment criteria.

5 Conclusions

Although the QFD methodology might be worth using to draw the planning phase of business development projects, the completeness of the derived plan is not easily confirmed, because:

- The QFD methodology calls for relations which are arbitrary and subjectively determined;
- engineering characteristics could be insufficient to cover the requirements and even might support the same portion of the requirement;
- the absence of a formal criterion to identify the intensity of the relations between requirements and engineering characteristics makes difficult the requirement coverage analysis;

- the relations do not address how a particular requirement is accomplished.

In the case study presented, the completeness of the business development project derived primarily from QFD has been analyzed with the help of a procedure that, instead of looking at the market requirements themselves, it finds out the manner the requirements are accomplished: for the case study, this manner is the PNQ assessment criteria. The well defined scope of the PNQ assessment criteria and the choice of only one action plan to each single PNQ assessment criterion lead to a revised QFD planning matrix which has 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 has triggered a project review which resulted a comprehensive coverage of the PNQ requirements.

Even though the case study discussed herein is from the business sector, the problems identified and the proposed solutions are not exclusive of this environment. New studies shall be performed to find out whether the results of this paper could be extended to the product development environment and how the QFD methodology could be improved to incorporate more objective evaluations.

6 References

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