ASSESSING THE QUALITY OF PRODUCT DESIGN FROM THE DESIGNER'S POINT OF VIEW

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Abstract. *This paper presents a case in which a methodology combining SERVQUAL and the critical incident technique (CIT) has been used in order to assess the designer's point of view as regards the quality of the product design process. It is pointed out that the environment in which the research was carried out provides a unique opportunity for selecting a very representative population of designers. Then the research questionnaire is described and it is explained how it was submitted to selected individuals. Following, the identified critical incidents are listed and classified according to SERVQUAL dimensions, in order to give the reader a comprehensive view of the designers´ opinions relating to both relevant and irrelevant aspects involved in design quality assessment. Finally, the important concept of* ***effectiveness factor*** *is introduced and its relationship with satisfaction items and SERVQUAL dimensions is established.*

Keywords*: Product design, Quality, Critical Incident Technique, SERVQUAL.*

1. Introduction

The need and importance for adequate management – including the evaluation of the quality and effectiveness – of the product design process has already been widely established by several authors, both in academic environments and at the importance interface between universities and manufacturing companies, as one can verify e.g. in Acosta (2004); Barroco and Kaminski (2003); Alves and Trabasso (2003), Sozo, Forcellini and Ogliari (2003); Martini, Cruz and Trabasso (2003); Acosta, Araujo and Trabasso (2002); and Silva (2001).

With this paper the authors, based on their respective professional experiences as design engineers, consultants and professors involved with quality and product design matters, hope to add a contribution to a better understanding of what is significant to the continual improvement of the design process by adopting a specific approach focused on the design professional, or simply 'the designer'.

Being designers themselves, the authors chose this particular approach in order to take into consideration two relevant aspects of design realization and evaluation. On the one hand, unlike clients and other interested parties, quality standards such as ISO 9001 (ISO, 2000b) do not require that the designers' point of view be formally taken into account when evaluating the quality and effectiveness of the product design process. On the other hand, the designer is certainly a central actor of the socio-technical network of product realization. Therefore, when listening to what designers have to say one, in addition to gathering meaningful information, avoids an important evaluation drawback: the lack of formal measures of satisfaction with the appraisal process at the designer level of the organization.

The authors would like to acknowledge, however, that the whole work of listening to what designers have to say and then turning observations into evaluation factors will involve more than one phase. The first phase is presented herein and further phases will be dealt with in future papers.

2. The product design process

2.1. The concept of product design

Before getting down to the survey proper, it is interesting to make some considerations about what is actually meant by product design. Caminada Netto and Kaminski (2005) thoroughly discuss the fact that "design and project, although related, are not conceptually identical". They also point out that "nowadays both terms are loosely employed even in

technical and scientific environments", and that "in the Portuguese language spoken in Brazil this fact is made worse by confusions created when translating from English texts".

The slight but meaningful differences between the concepts of design and project have been made clear in the 2000 version of the 9000 series of ISO international standards which embody the state-of-the-art consensus on quality matters of representatives from some 150 countries, and are shown in Fig. 1.

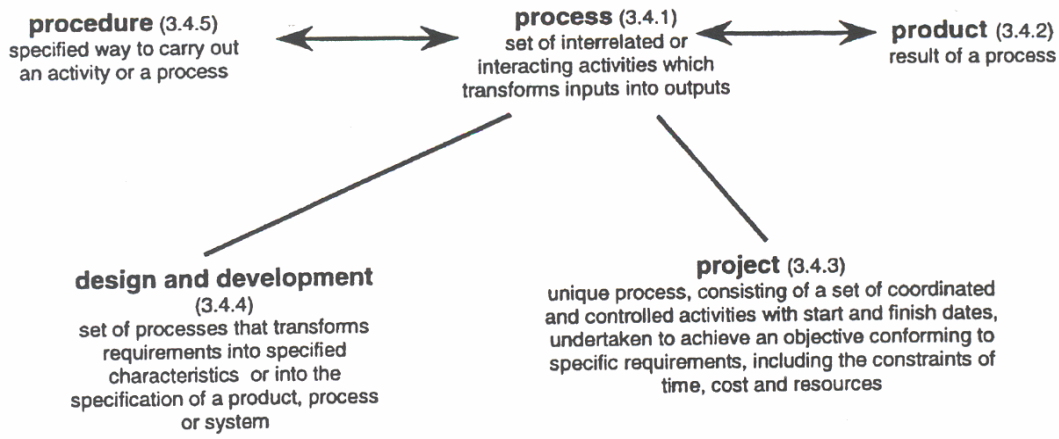

Figure 1 – Concepts relating to process and product (ISO, 2000a).

As can also be seen in Fig. 1, both the concepts of design and development and of project are related to that of process through a generic type relation, where "subordinate concepts within the hierarchy inherit all the characteristics of the superordinate concept and contain descriptions of these characteristics which distinguish them from the superordinate (parent) and coordinate (sibling) concepts" (ISO, 2000a).

Caminada Netto and Kaminski (2005) conclude their reasoning by saying that "although there may be many similarities between the concepts under consideration, the authors believe that the differences, however small, play an important role when attempting to come up with a methodology for assessing the efficiency of design and development processes as opposed to project processes."

2.2. Design as product

In 1991 the *Ad Hoc* Task Force assigned by ISO Technical Committee 176 to prepare an strategic plan for the architecture, numbering and implementation of the 9000 series of ISO international standards – appeared four years earlier in 1987 – published their report that was to become known as *Vison 2000* (Marquardt et al., 1991), where it was stressed that establishing adequate product categories had been considered to be a critical aspect within their attributions. Table 1 shows the four generic categories of product then established as they are now defined in standard ISO 9000:2000 (ISO, 2000a).

Table 1 – Product generic categories.

GENERIC CATEGORY	PRODUCT DEFINITION
Hardware	Hardware is generally tangible and its amount is a countable **characteristic**.
Software	Software consists of information and is generally intangible and can be in the form of approaches, transactions or **procedures**.
Processed materials	Processed materials are generally tangible and their amount is a continuous characteristic.
Services	Service is the result of at least one activity necessarily performed at the interface between the supplier and customer and is generally intangible.

It is important to remark that there is seldom a "pure" product. That is, products are normally composed of a mix of product categories. And so is product design. Although containing a high amount of software, and sometimes varying amounts of other categories, design is basically a service supplied to either internal or external customers. Therefore, the authors believe that the evaluation of the effectiveness of product design can be approached by employing service quality methodologies.

3. The survey

3.1. Methodology selection

As a first step in structuring a survey designed to learn what designers have to say about the evaluation of product design processes, it was necessary to select an adequate methodology. It was therefore considered important to examine the best existing practices. After having done that, the authors decided to use a combination of two well-known methodologies: the Critical Incident Technique (Flanagan, 1954; Hayes, 1998) and SERVQUAL (Parasuraman, Zeithaml and Berry, 1985). As pointed out by Caminada Netto et al. (2003), "*the combination of these two methodologies provides a better means for directing the desired information when carrying out the research. While the Critical Incident technique investigates the clients' points of interest, SERVQUAL allocates them according to definite categories and together they allow the optimization of the survey work*".

According to the Critical Incident Technique (CIT), a brief questionnaire was drawn up where in its first half respondents were asked to identify up to 10 specific examples of aspects (critical incidents) that they considered important to the effectiveness of the product design process. In the second half the questionnaire requested up to 10 unimportant aspects. Table 2 shows the questionnaire's general outline.

Table 2. Questionnaire form.

PRODUCT DESIGN AND DEVELOPMENT PROCESS EFFECTIVENESS

OBJECTIVE: Dear colleague, the purpose of this survey is to identify factors that allow organizations to measure their ability to continually improve the product design and development process. **Your contribution - as a specialist - is very important** so that we can obtain results which may be valuable to all who work in this area today and will work in the future.

GUIDANCE: Please don't rush. Take your time and fill in the questionnaire. We ask you to list below from five to ten examples of technical, human and economical aspects that are respectively important and unimportant when measuring the effectiveness of the product design and development process.

We ask that examples reflect **your perception** in a specific and unique way. For instance: - Designers' motivation is marginal. Or: - Never exceed planned costs. Or: - Team cohesion is vital.

Thank you very much for your cooperation!!!

IMPORTANT ASPECTS
1. .....
2. .....
3. .....
.
.
.
10. .....

UNIMPORTANT ASPECTS
1. .....
2. .....
3. .....
.
.
.
10. .....

Parasuraman, Zeithaml and Berry (1985), as a result of initially interviewing twelve focus groups in three different regions of the United States and four distinct service sectors, and then carrying out a quantitative survey in order to learn how customers assessed five service sectors, which included the original four, arrived in a first phase to the ten

service quality dimensions shown and described in Table 3. These ten dimensions were later consolidated into five dimensions only. As previously mentioned, such dimensions may provide a sound basis for the classification of answers – obtained according to the Critical Incident Technique through the questionnaire of Table 2 – into adequate categories.

Table 3. description of SERVQUAL service quality dimensions.

DIMENSION	DESCRIPTION
Tangibles	Appearance of physical facilities, equipment, personnel, printed and visual materials.
Reliability	Ability to perform promised service dependably and accurately.
Responsiveness	Willingness to help customers to provide prompt service
Competence	Possession of required skill and knowledge to perform service.
Courtesy	Politeness, respect, consideration and friendliness of contact personnel.
Credibility	Trustworthiness, believability, honesty of the service provider.
Security	Freedom from danger, risk, or doubt.
Access	Approachability and ease of contact.
Communication	Listening to customers and acknowledging their comments; Keeping customers informed in a language they can understand.
Understanding the Customer	Making the effort to know customers and their needs.

3.2. Population selection and sample size

The second step consisted of identifying who should be interviewed. It was necessary to have people directly involved with product design. But how to select and then reach them, this is the first question which presents itself to any researcher.

The adopted solution was to use a readily accessible population, both representative and also encompassing a considerably greater number of organizations than it would have been possible to reach with a few visits. In fact, the economy of effort and time represented by this option was enough to recommend its adoption.

The population chosen was made up of students directly involved with product design in two further education courses – Product Management and Engineering and Quality Engineering – both offered by the Continuing Education Program (PECE, 2005) at the Engineering College of the University of São Paulo. That is, professionals directly involved with product design from different sectors of activity; acting professionally in their respective organizations; and dedicated to intellectual improvement on the occasion of the survey, therefore susceptible to the appeal of an academic work. As a matter of fact, the authors believe that the environment in which the survey was carried out provides a unique opportunity for selecting a very representative population of designers and therefore represents a significant contribution to the contemplated identification of aspects or critical incidents.

It was then necessary to determine sample size. Considering that one was dealing with a very homogeneous population (all of them work with design), sample size was not considered critical. Anyway, Hayes (1998) recommends that when carrying out such individual interviews the number of interviewees should vary between 10 and 20 people.

3.3. Critical incident identification and classification

In accordance with what was previously discussed about population and sample size, questionnaires were submitted by one of the authors to 20 of his students randomly selected while attending disciplines EP-004 “The Client’s Voice in Product Design” and EQ-001 “Quality Management Systems – ISO 9000” in 2004.

After examining answers in detail, critical incidents were classified in categories or **satisfaction items** (Hayes, 1988) and related to SERVQUAL dimensions as shown in Table 3.

It is very important to note that the identification of adequate satisfaction items constitutes a critical phase in departing from the broad SERVQUAL approach for service quality and focusing on the particular field of design quality. Once more this was done here taking into consideration the designer’s point of view and the authors’ experience as designers.

Once suitable satisfaction items had been chosen after painstaking discussions between the authors and comparisons with other service cases, the critical incidents provided by respondents were classified accordingly. Illustrative

examples of how critical incidents were classified are shown in Table 4. However, although respondents provided what they consider to be both important and unimportant aspects, only important aspects have been listed as examples.

Table 3. Satisfaction items versus SERVQUAL dimensions.

	SERVQUAL DIMENSIONS	
SATISFACTION ITEM	CONSOLIDATED	ORIGINAL
Documents **Resources**	Tangibles	Tangibles
Fundamentals **Realization** **Results**	Reliability	Reliability
Plans **Budget**	Responsiveness	Responsiveness
Competence **Experience** **Information**	Assurance	Competence Courtesy Credibility Security
Communication **Motivation**	Empathy	Access Communication Understanding the customer

Table 4. Examples of critical incidents classification.

CRITICAL INCIDENTS	SATISFACTION ITEM
Comprehensive documentation is very important. Group decisions cannot be lost. Etc.	**Documents**
Compatible human and technical resources. Concept validation in labs. Etc.	**Resources**
Identification of all potential risks. Focus on clients is fundamental. Etc.	**Fundamentals**
Leadership through example. Involvement of all the organization's departments. Etc.	**Realization**
Competitive selling price Up to date design Etc.	**Results**
Challenging but attainable goals. Meet schedule. Etc.	**Plans**
Information is essential Easy access to technology Etc.	**Information**
Individual and team motivation. Team involvement in new developments. Etc.	**Motivation**

4. Effectiveness factors

The final move in this preliminary or preparation step – leading to a deeper survey in the future – consisted of introducing a new concept that could relate critical incidents to the effectiveness of the product design process. In order to do so it was necessary to take into consideration, in addition to the main aspect of effectiveness evaluation, the need for concision in any questionnaire. Therefore, the following six **effectiveness factors** were introduced:

1. Design preparation;
2. Organizational environment;
3. Information and knowledge;
4. Technical personnel;
5. Design realization;
6. Product success.

Figure 2 shows the evaluation chain linking each effectiveness factor to the corresponding critical incidents through satisfaction items.

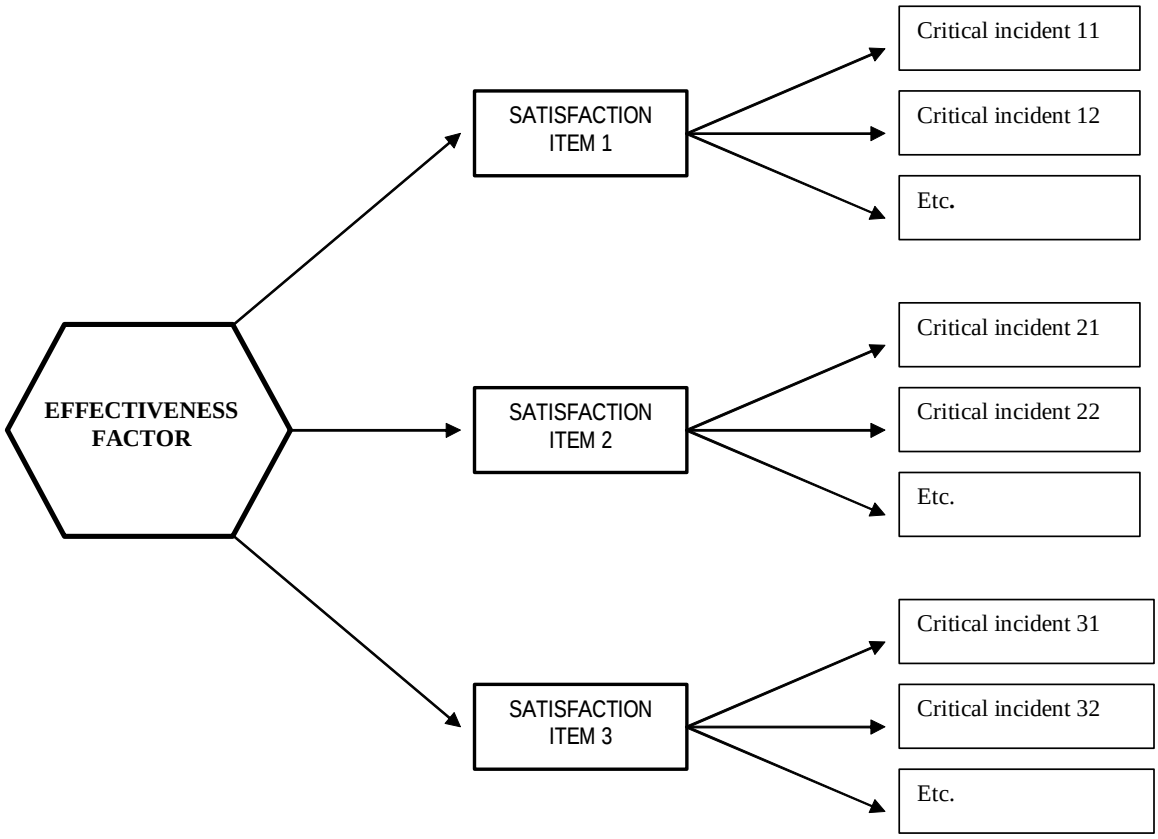

Figure 2 – Critical incidents, satisfaction items and effectiveness factors.

Once having realized how SERVQUAL dimensions, satisfaction items and effectiveness factors closely interrelate, one can see that the latter constitute adequate building blocks for structuring an in-depth survey questionnaire. Therefore, ***effectiveness factors*** constitute an important concept that allows one to link the opinion of a designer – a central actor of the socio-technical network of product realization – to the formal activities of efficiency evaluation in the implementation of an organization's Quality Management System.

5. Concluding remarks

The authors hope to have made clear that this paper deals with an exploratory survey, which constitutes a first phase in assessing the designer's opinion as regards the evaluation of the effectiveness of the product design process. This phase employed a combination, which once more proved very useful in surveys of this kind, of CIT and SERVQUAL approaches as follows:

1. A questionnaire was drawn up;
2. A unique and very representative population was selected;
3. Critical incidents were collected;
4. Satisfaction items were identified; and

5. Critical incidents were classified according to satisfaction items.

In addition, adequate ***effectiveness factors*** were introduced and related to both critical incidents and previously identified satisfaction items.

A second phase is already being carried out in order to go from ***effectiveness factors*** to practical measures of process evaluation. When this second phase is completed it is hoped that enough information will have been gathered in order to allow the authors to eventually come up with a 'friendly' method of evaluating the process of product design, and one which may actually be found useful by designers and design organizations alike.

6. Acknowledgements

The authors wish to express their deep gratitude to all of their students who willingly and often enthusiastically contributed their answers.

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8. Responsibility notice

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