



Quality and Sustainability Criteria in Purchase Decisions of Teenagers

H. Ostad-Ahmad-Ghorabi^{1*}, D.Collado Ruiz²

^{1*}Vienna University of Technology, Institute of Engineering Design, Austria

²Integration of Design & Environmental Assessment, Universidad, Politécnica de Valencia, Spain

Email: hesamedin@ostad.at

(Received Dec 2011; Published March 2012)

ABSTRACT

The raising sustainability awareness of consumers has brought the discourse about environmental impacts of products into public discourse. Industry has had to respond to this demand for sustainable products. Among the different customer groups, teenagers play a considerable role: Sustainability is particularly important for the younger generations. Children and teenagers of today are going to have to cope with the consequences of negligence of previous and current generations in protecting the environmental and social situation. It is thus important to understand how children and teenagers perceive the problem, and how they will act as consumers in the future. This paper discusses a project where teenagers were surveyed to find out about the importance of sustainability and quality aspects of products. Electronic entertainment products and clothing products were considered as it is assumed that teenagers mostly spend their pocket money for these two branches of products.

Key words: Eco-products, Quality criteria, Market survey, Teenagers

INTRODUCTION

As sustainability leaks into public discourse, considering the environment in the development of products is no longer a luxury for some. It has become a need for the many. Resource and energy efficiency, end-of-life regulations and consumer conscience have pushed the boundaries into a point in which products are held responsible for their impacts. This evolution has provoked not only the development of many tools, methodologies and approaches, but also the increase in consultancy and databases on environmental and social impacts. Communication of sustainability information may be Corporate Social Responsibility Reports (CSR) or Environmental Product Declarations (EPD), are becoming more and more a key success factor for industry. The raising sustainability awareness of customers is for sure an important drive here for. Among the different customer groups, teenagers play a considerable role: Sustainability is particularly important for the younger generations. Children and teenagers

of today are going to have to cope with the consequences of negligence of previous and current generations in protecting the environmental and social situation. Additionally, the next generation will have more training and information on the environmental impacts of their actions. It is important to understand how children and teenagers perceive the problem, and how they will act as consumers in the future. For such a reason, it seems relevant to get these young people involved. The project Sparkling Science, from the Austrian Federal Ministry of Science and Research and conducted by the Institute of Engineering Design of the Vienna University of Technology, constitutes an interesting framework to develop these ideas. With four cooperating schools products in the field of interest of teenagers were investigated in more detail after teaching pupils in the field of sustainability and Ecodesign. A publically accessible web-based platform was provided where sustainability criteria of products can be evaluated and a product profile can be stored. The platform was established under www.eco-product.at/youth. The platform provides

information and references concerning sustainability evaluation of products along with a communication forum to facilitate the exchange of product information. However, the main purpose of the platform is the possibility to introduce new products and evaluate them by giving answer to a set of pre-defined questions. These questions cover all life cycle phases of a product as well as the three pillars of sustainability: ecology, economics and social. The schools evaluated different electronic entertainment products and clothing products. It is assumed that teenagers mostly spend their pocket money for these two branches of products. Other desires as for housing, transport or vacation are usually provided by the parents. The questions provided on the platform are unbalanced towards environment: some 28 questions are provided for the environmental evaluation, whereas for economics 12 questions are given. For the social part there are only 9 questions available. Workshops conducted with the pupils showed that there was a demand for more questions in the other fields. Including more product quality-related criteria into the questions should give a more holistic approach.

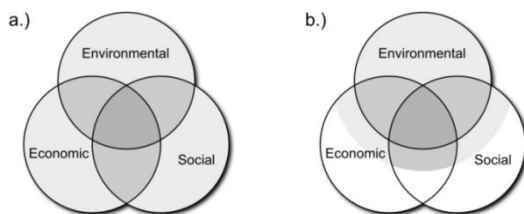


Figure 1 The three pillars of sustainability (a), and assumption of current coverage of eco-product platform (b)

Economic sustainability depends on having a product that meets the market needs. The field of quality management has long studied new product development with this frame of mind (ISO, 2005). A high-quality product could be understood as one that meets the demands of the market. If this is kept dynamically, economic sustainability can be attained.

This concept is actually present in many of the interpretations of quality, like durability or reliability. In particular, environmental sustainability and economic sustainability find a like in some of the criteria that define them: the environmental criteria (EC) and the quality criteria (QC). The overlap shown in Figure 1 forecasts the coupling of EC and QC. Sparkling science approved a project to gain insight into the way quality and sustainability concerns are understood by teenagers. A group of pupils was asked to reflect on the links between different sustainability criteria (SC) and QC, and to conduct an additional survey among other teenagers that were also willing to contribute. All the process was carried out with a through supervision from university staff.

STATE OF THE ART

Sustainability can be understood to be conceptually linked to quality, and most particularly economic sustainability. A sustainable product must ensure economic sustainability for the company, since it has to provide a competitive benefit.

Additionally, in order to excel in quality parameters, it is important to ensure sustainability criteria such as durability, sturdiness or reparability. Therefore, the two areas overlap strongly. Quality is a constant concern in the development process, and meeting the customer's requirements is the most relevant driving force in any design. Systematic integration of quality criteria has spawned many different methods and approaches. At company level, ISO 9000 has found many followers, including the management of product quality. One of the most widespread approaches is also Quality Function Deployment. Since its appearance in the sixties, it has evolved in a wide span of possibilities for expansion. Sustainability has also been a source of interest in the last decades. More and more Ecodesign methods, methodologies, and approaches have been seen to come and go. However, integration of this new factor is to be considered in integration with the rest of the criteria, if it is expected to be applied correctly.

Due to the popularity of systematic quality-oriented design techniques, it was foreseeable that researchers would try to combine this with sustainability criteria. Different methods such as those presented by (Cagno & Trucco, 2007), (Kobayashi, 2005), (Masui et al., 2003) or (Bovea & Wang, 2002) have tried to integrate environmental criteria and/or parameters into the QFD methodology or matrices, with different approaches. One of the first attempts (Bovea & Wang, 2002) proposed the generation of an environment-specific matrix in which LCA results were integrated, called green house in the Green-QFD methodology. This was then integrated with the more traditional matrices of demands and costs. Whilst effective for decision-making, integration only takes place at the latest stages. Masui et al. (2003) propose an approach by which additional Voice-of-the-Customer (VOC) demands are included to consider the whole value chain, as well as new engineering metrics. This is called QFD for environment or QFDE. This increases integration and assesses improvements in the most common levels in QFD, i.e. component, engineering metric and VOC levels. Cagno and Trucco (2007) follow these lines by proposing a structured Integrated Green and QFD, IGQFD. This approach is very similar to the previous, although the differences between the environmental objectives and quality functions are pointed out, as well as their relationship. Instead of assessing potential improvement ideas, they focus on a list of concepts. Kobayashi (2005) take a different approach by developing QFD-compatible environmental assessments. These assessments are independent, although customer requirements are also intended to include environmental concerns, i.e. environmental requirements desired by green consumers. His methodology is however more extends, and encompasses the product development process at several stages. Integration of sustainability criteria in all these methods is present to some extent. Nevertheless, in most cases environmental concerns are interpreted as the voice of the environmentally conscious customer (Kobayashi, 2005; Masui et al., 2003). Sustainability is assessed as a factor that is independent to quality, i.e., following different demands (Cagno & Trucco, 2007; Masui et

al., 2003) and being analyzed in a different way (Kobayashi, 2005),(Bovea & Wang, 2002). If there is some sort of coupling, it might provoke counter-balanced effects that end up giving priority to strategies that increase both quality and sustainability. In this paper, the relationship between quality and sustainability will be assessed, from the point of view of teenagers. This will potentially allow a deeper comparison, and additional integration, of both factors.

METHODOLOGY

To conduct the research, two product examples, a T-shirt and an iPod, were considered. The reason for having an entertainment electronic product and a clothing product is that they constitute representative product branches for which teenagers are mostly spending their money for. Other products such as school equipment, household electronics or else are usually provided by the parents; same appeals to expenses on travel and vacation, transport or housing. The research was structured in the following steps:

1-Definition of the relevant parameters for teenagers, i.e., SC and QC.

2-Survey of the importance of those parameters for teenagers. Survey of the relationships between SC and QC.

3-Analysis of the parameters individually.

4-Comparative analysis of the relationships.

There are numerous literatures available on SC interpreted from different points of view. For specific products, lists of particular criteria and recommendations are common, but general guidelines tend to be more likely oriented towards business or company assessment. Lists of criteria such as those published by the United Nations (Economic & Affairs, 2001), (DiSano, 2002) can serve as a guideline. However, they tend to include very specific and difficult to assess criteria. For that reason, the UN list was passed by the participating pupils and reduced to a set of 20 parameters that are understandable by people in that age range:

Abandonment of hazardous substances, Disposal of product, Energy consumption, Environmental legislations, Functionality, Information for use, Lifestyle, Lifetime of product, Materials, Packaging, Price, Protection of land, Protection of non renewable resources, Protection of the atmosphere, Protection of water resources, Reparability, Service, Maintenance, Social fairness, Transport, Waste and emissions. When it comes to QC, the situation is rather more complex. ISO 9000 (ISO, 2005) proposes to define criteria specifically for the product at hand, and only provides general guidelines. When a general approach is taken, it is not common to have lists that claim to be exhaustive or applicable to products in general. Furthermore, there is no widely accepted list of criteria. However, there are some basic concepts that can be taken as representative of product quality, and that were considered for the purpose of assessing QC (Garvin, 1984):

Aesthetics, Conformance, Durability, Features, Perceived Quality, Performance, Reliability, Serviceability.

These were given and explained to the teenagers to ensure that the correct meaning was considered, and they translated them

to German language to ensure that it would fit the vocabulary of the participants. In order to assess the role and importance of QC and SC a survey was carried out. Sixteen selected pupils aged between 18 and 20 years from the same school were asked to participate. The pupils knew the products by themselves as they either owned the same products or had a considerable knowledge and/or experience with them. The survey itself was divided into three parts: the first part was asking for the importance of SC, the second one the importance of QC. Both had to be rated with the values 1 for not important, 3 for important or 9 for very important. The third part of the survey comprised a matrix, linking QC and SC to be rated by the same scale, using the value of 0 for a non existing relation.

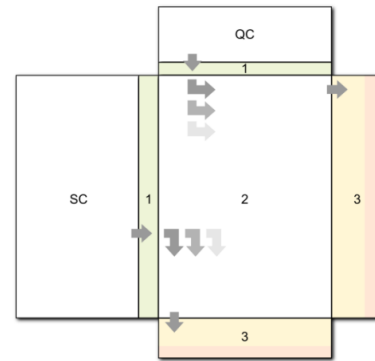


Figure 2 Structure of the matrix used to store and process the information

The first two parts of the survey already gave a first insight on the ranking of the criteria, based on the importance to teenagers. The mean of the values assigned to each criterion was calculated and used for the ranking. The same was done with the standard deviation to ensure that variability did not affect the conclusions. This was done for both, SC and QC by using tables with the structure shown in Figure 2. The two first surveys were used to assess the values in area 1, directly calculated from the sample. An interesting aspect to be researched here was whether the importance of QC calculated out of their relationship with SC (or vice versa) is linked to that directly assessed. The third part of the survey enabled to give answer to this question. The results of this part of the survey were recorded in area 2 of the matrix shown in Figure 2. The relative percentage of the scores of each SC to the total score was taken as a weighting factor when the interlink matrix was established. Matrix A as defined with index i for the m SC, index j for the n QC. The average value and standard deviation were cross-multiplied through the matrix of relationships (A). The calculated importance I' of each criterion follows equation (1).

$$I'_{sci} = \sum_{j \rightarrow n} A_{ij} \cdot I_j$$

$$I'_{QCj} = \sum_{i \rightarrow m} A_{ij} \cdot I_i$$
(1)

with *I* as the importance gathered from the surveys. These values were then divided by the total sum, to reflect their percentage. The results are included in area 3 of Figure 2.

RESULTS

The results of the surveys were compiled in the table shown in Figure 2. Four tables were generated in total, for mean and standard deviation, and for iPod and T-shirts. Table 1, shows one of these matrices, with the average assessments for T-shirts.

Table 1 one of the resulting tables: mean of the assessment for T-shirts

T-SHIRT	Importance mean	Performance							Derived importance	%	Difference	
		Performance	Features	Reliability	Perceived Quality	Aesthetics	Service	Durability				Conformance
Protection of land	7.27%	0.0	0.0	0.0	9.0	0.0	0.0	0.0	3.0	1.26	2.2%	-5.0%
Protection of the atmosphere	6.98%	1.0	0.0	0.0	3.0	0.0	1.0	0.0	1.0	0.64	1.1%	-5.8%
Social fairness	6.98%	1.0	0.0	0.0	9.0	0.0	0.0	0.0	9.0	1.89	3.4%	-3.6%
Price	6.54%	1.0	0.0	3.0	9.0	9.0	0.0	0.0	0.0	4.01	7.1%	0.6%
Lifetime of product	6.25%	0.5	0.0	3.0	3.0	0.0	0.0	0.0	0.0	0.39	0.7%	-5.6%
Protection of non renewable resources	6.25%	0.0	0.0	3.0	3.0	3.0	0.0	0.0	3.0	1.53	2.7%	-3.5%
Abandonment of hazardous substances	6.25%	3.0	0.0	9.0	9.0	0.0	0.0	9.0	0.0	4.21	7.5%	1.2%
Protection of water resources	5.52%	1.0	0.0	0.0	9.0	0.0	0.0	0.0	1.0	1.19	2.1%	-3.4%
Service, Maintenance	5.38%	9.0	3.0	3.0	9.0	0.0	9.0	9.0	0.0	5.25	9.3%	4.0%
Materials	5.23%	1.5	3.0	9.0	3.0	3.0	0.0	9.0	3.0	4.44	7.9%	2.7%
Functionality	5.09%	9.0	9.0	9.0	9.0	0.0	9.0	3.0	3.0	7.48	13.3%	8.2%
Environmental legislations	4.94%	0.0	0.0	0.0	9.0	0.0	0.0	9.0	0.0	1.78	3.2%	-1.8%
Reparability	4.65%	9.0	1.0	9.0	0.0	0.0	9.0	9.0	0.0	4.95	8.8%	4.2%
Disposal of product	4.36%	0.0	0.0	0.0	3.0	0.0	9.0	0.0	0.0	1.33	2.4%	-2.0%
Lifestyle	3.92%	3.0	9.0	3.0	9.0	9.0	0.0	9.0	0.0	5.67	10.1%	6.2%
Waste and emissions	3.92%	0.0	0.0	0.0	3.0	0.0	0.0	0.0	1.0	0.42	0.7%	-3.2%
Energy consumption	3.20%	1.5	0.0	1.5	3.0	0.0	1.0	3.0	1.0	1.43	2.5%	-0.7%
Information for use	2.76%	9.0	3.0	1.0	0.0	0.0	9.0	9.0	3.0	4.21	7.5%	4.7%
Transport	2.47%	0.0	0.0	1.0	0.0	0.0	0.0	0.0	3.0	0.41	0.7%	-1.7%
Packaging	2.03%	3.0	9.0	0.0	9.0	0.0	0.0	0.0	0.0	3.68	6.6%	4.5%
Derived importance		2.39	1.44	2.67	5.94	1.93	2.23	3.09	2.14			
%		11%	7%	12%	27%	9%	10%	14%	10%			
Difference		0%	-3%	-3%	16%	-7%	-1%	-3%	1%			

For the subjective assessments, the mean was considered an acceptable way to combine the opinions of all 16 participants. Nevertheless, for relationship assessments, this was thought to be insufficient. Some of the assessments revealed different understanding of concepts, as the results would be polarized. The most common understanding was then taken, i.e., the mode. Only in some cases, the two most popular scores – in case of a tie – were averaged. In general terms, there were a small number of criteria that showed a considerable variation in their importance. Figure 3 shows the different importance of QC, directly assessed by the participants and calculated through the relationships and the SC. It can be seen that for both products, SC are more strongly linked to perceived quality. The number of features, however, is very remotely associated with SC criteria and their importance.

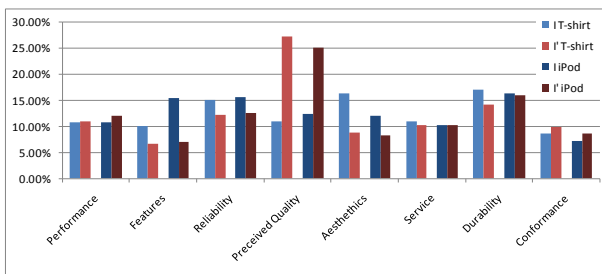


Figure 3 Direct and calculated importance for QC, both for T-Shirt and iPod

A similar assessment can be performed for SC, comparing their assessed importance and that calculated out of QC. This is shown in Figure 4. In these cases, the differences are higher, among other due to the high variety in the criteria. SC such as functionality, lifestyle, information for use and packaging are prominently linked to QC. Others such as service, materials and reparability follow closely, but depend more on the product. Criteria such as protection of land or atmosphere, social fairness or non renewable resources, lifetime of the product, waste and emissions or transport show very strong differences, in this case with very weak links to quality criteria. This seems to point out that some of these characteristics might be perceived as conflicting with other quality criteria, or at least not aligned with them.

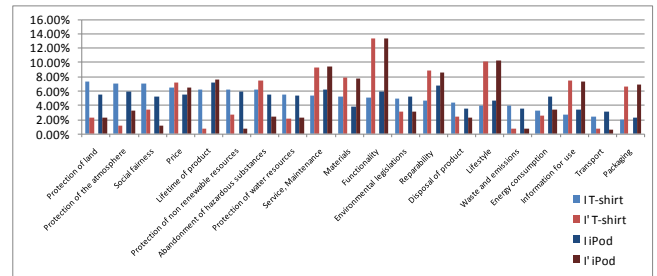


Figure 4 Direct and calculated importance for SC, both for T-Shirt and for iPod

Another interesting result is up to which point the assessments are aligned for such different products as iPods and T-shirts. Although some criteria differ, most of the assessments are similar, and in most cases, when $I > I'$ (or $I' < I$) for iPods, it also holds true for T-shirts.

CONCLUSIONS AND OUTLOOK

The results in the previous section point out some of the links between SC and QC. Out of the study of QC presented in Figure 3, the differences provide the greatest insight, since most of the parameters keep a similar level of importance. This justifies that, from the quality point of view, SC seem to cover most of the judgments of quality. If a product is assessed as sustainable, it can be presumed to be considered as of high quality as well. The only differences refer to perceived quality and number of features, with higher and lower calculated importance respectively. The reason for this could be that many of the SC is associated with company image and perception of a better product, more than with specific traits of the product itself. Perceived quality can be interpreted as the product's image, and is more closely related to these perceptive subjective parameters more than with performance indicators or technical specifications of the product itself. This is substantiated by the fact that the number of features receives much lower attention when considering I' . Having many features can be considered a sign of quality (even though arguably), but it is not perceived to reflect strongly on the SC. Additionally, it can be seen that this effect on the feature's importance is stronger for the iPod than for the T-shirt. Whilst this could be expectable – due to how abstract the concept of

“features of T-shirt” is – a similar effect is found for the T-shirt when it comes to aesthetics, as can be seen in Figure 3. The assessment of SC in Figure 4 also gives insight into the relation between SC and QC. There are much stronger differences, due to the higher amount of criteria and to the partial consideration of sustainability within QC. For example, SC such as protection of land or waste and emissions has no simple counterpart in the QC. However, others such as functionality or packaging have traditionally been strongly considered within quality literature. Other pragmatic sustainability criteria such as service, reparability and materials also have a relatively higher importance if QC is considered. It is also surprising how strong the lifestyle and the information for use are linked with QC. This strongly points out the link between sustainability and the user’s behavior. The user constitutes a relevant link between QC and SC. Some of the SC has different trends for T-shirt and for iPod. Such a case is the existence and depletion of hazardous substances, which is considered more strongly linked to QC for the T-shirt, but outstandingly less for the iPod. Teenagers are more sensitive to hazardous substances in T-shirts. These products are in content contact with the user, and are presumed to be neutral and healthy. The concept of having hazardous substances can be perceived as very bad quality. However, electronic products tend to be black boxed to the consumer’s eyes, thus making this a relatively minor issue for the iPod from the quality point of view. This is naturally not the case from the sustainability point of view. Another case of differing trends is that of the lifetime of the product. QC was very minor linked with the lifetime for the T-shirt, although it met –and went beyond – the importance when directly assessed for the iPod. This could be interpreted as a consequence of fashion and trendiness, which is linked to perceived quality and aesthetics (very importantly rated in Figure 3). One surprising perception is the relatively low importance of social fairness when considering the link with QC, particularly in the case of the iPod. This could be a consequence of the awareness that already exists in the clothing industry, in which cases of sweatshops and children labor have appeared in the media. Teenagers are bound to have heard about these issues, and this could affect the perceive image of the product. However, in the case of the iPod discussions in media are much less, and restricted to environmental issues.

REFERENCES

- Bovea, M., & Wang, B. (2002). *Integration of customer, cost and environmental requirements in product design: an application of green QFD*.
- Cagno, E., & Trucco, P. (2007). Integrated green and quality function deployment. *International Journal of Product Lifecycle Management*, 2(1), 64-83.
- DiSano, J. (2002). Indicators of Sustainable Development: Guidelines and Methodologies. *United Nations Department of Economic and Social Affairs, New York*.
- Economic, U. N. D. o., & Affairs, S. (2001). *Indicators of sustainable development: Guidelines and methodologies*: United Nations.
- Garvin, D. A. (1984). What Does “Product Quality” Really Mean? *MIT Sloan Management Review*, 26(1), 25-43.
- ISO, B. (2005). 9000: 2005 Quality management systems. Fundamentals and vocabulary. *British Standards Institution*.
- Kobayashi, H. (2005). Strategic evolution of eco-products: a product life cycle planning methodology. *Research in Engineering Design*, 16(1), 1-16.
- Masui, K., Sakao, T., Kobayashi, M., & Inaba, A. (2003). Applying quality function deployment to environmentally conscious design. *International Journal of Quality & Reliability Management*, 20(1), 90-106.

All in all, it can be seen that QC and SC are strongly linked with each other, and with the exception of some traits, they would spawn similar conclusions. Criteria such as increased functionality or a high number of features are perceived as contributing more to quality than they do to sustainability – which is in part logical unless they substitute other products – and the very impact-related SC are not profoundly included in QC unless additional criteria are considered. Possibly adding QC such as “environmental impact” and/or “social impact” could solve this divergence. This experiment gives a first insight in this relationship and the possible links that can be studied. Nevertheless, some of these conclusions could be the consequence of more than one effect. For example, although it has been tried to be avoided, some of the criteria (within QC or SC) could be linked with each other, thus introducing coupling effects. Furthermore, the lists could possibly be increased (e.g., as proposed, by adding “environmental impact” to QC) to cover additional areas (either of sustainability or of quality). The eco-product for youth platform should therefore be expanded, as was presented in the introduction, to include these considerations. Items such as lifestyle or functionality should be expanded into more questions, to reflect the importance that this has on quality. Also, service and reparability should be somehow extended, since they not only have a strong link with quality, but are also very relevant from the point of view of increasing resource efficiency. Another interesting effect to be studied is the perception of a bigger sample of the population, including different ages and social situations. Cultural context is also very influencing on the results, so the comparison of different countries is also within outlook from this study. In future research, similar surveys shall be carried out in different locations of the world both physically and online – which is a source of difficulty, but also of interesting differences in perception – to dramatically expand the number of cases in order to make the conclusions sturdy enough for policy-making or specific market strategies.

ACKNOWLEDGMENT

The project discussed in this paper has been funded by the Austrian Federal Ministry of Science and Research in the scope of the Sparkling Science research program.