WORKING PAPER, CONCLUDE PROJECT

ANALYSIS OF THE ENVIRONMENTAL CRITERIA IMPACTING A PRODUCT'S DEMAND USING THE DOUBLE-CODING METHOD

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Abstract

The business models of companies are starting to shift towards a new version that includes the environmental dimensions. Being "green" or "eco-friendly" is no longer a choice but a duty that may also be used as a leverage. The present paper studies the effect of environmental criteria on a product's demand from a Business-to-Business point of view. Firstly, a literature review is conducted in order to frame the subject. The next step is to categorize the environmental criteria preselected and drawn from the bibliographical research. Furthermore, it must be emphasised that the current study is conducted from a second coder angle of view following the double-coding method which is used in qualitative analyses. The results obtained facilitate the decision-making for the stakeholders since it defines more precisely the priorities.

Keywords

Product's environmental performance, Product's environmental criteria, Product's demand, Product's environmental attributes, double-coding, decision-making.

Introduction

The environment has been perceived as an ornament used by companies to embellish and modernize their image. Nowadays, the planet cannot afford the luxury of choice. Thus, protecting the environment is a must and every party is concerned since it is a global issue. Industries, being an active part of every society, can champion this cause by enhancing the environmental performance of its products and hence, its supply chain. However, this task is not simple since it shakes the foundation of the supply chain modelling adopted.

In fact, environmental awareness brought about change in customers' behaviour in a Business-to-Business context which directly impacts the demand. Yet, the demand is still used as an exogenous parameter instead of it being an indigenous one and hence, does not vary in the simulation model usually developed in the literature.

The problematic mentioned above is at the core of the project "CONCLUDE: CONception des Chaînes Logistiques avec une Demande sensible à la performance Environnementale" financed by ANR, which aims globally at taking into consideration a demand sensitive to environmental performance in supply chain modelling. As for the present scientific paper, it follows the same approach and orientation since the ultimate goal is to deliver a rigorous categorization of the environmental criteria influencing a product's environmental quality using a qualitative analysis which, in turn, is based on double-coding method.

Materials and Methods

The methodology proposed here include**s** both a **literature review** and a qualitative **data** analysis. **The first part shows a literature review development.** The concepts which has been identified as relevant for the rest of the research process are defined fully respecting the plurality and differences of points of view. This step is crucial since it allows the coder to keep a critical eye while analysing the environmental criteria in the next step**.**

Qualitative analysis using the double coding method

The objective of the qualitative analysis is to develop a categorization of criteria influencing the environmental performance of a product. It is addressed according to two different phases which are the first coder and the second coder analyses. The first step is already tackled since the present research paper is developed from the second coder's angle of view. As a result, an inventory of environmental criteria as well as a study about the different methods of categorization are previously established.

The second phase of the categorization of the environmental criteria relies on the use of the double coding method. The principle is to code the same material and data by two researchers so as to discuss the similarities and most importantly their difficulties and difference of point of view. These disagreements and dissonance, according to (Miles & Huberman, 1984), mean that the definition is to be more in-depth developed or amended. The time spent on double-coding is no wastage since it allows researchers to reach a common vision of the categorisation of the data. This method not only helps getting a clear idea on the issue tackled but also provides a good reliability check.

Double-coding can be divided into two steps: intra-coding and inter-coding according to (Miles & Huberman, 1984). The first treatment is to be conducted by the coder alone in order to ensure the consistency of his own work by reviewing his results regularly. As for the second treatment, the two results obtained by the two coders are confronted so as to come up ideally with a common resolution that does not negate the rich character of each contribution.

Furthermore, there is room for innovation and creativity in research; different techniques and methods can be used so as to enrich the results as stated by (Westbrook, 1994), "*During the analysis of data, certain techniques can strengthen the resultant claims. Sometimes other sources can be used to confirm inferences from data. These may include past successes, contextual experiences, established theories, and representative interpreters."*

Results

Definition of the main concepts:

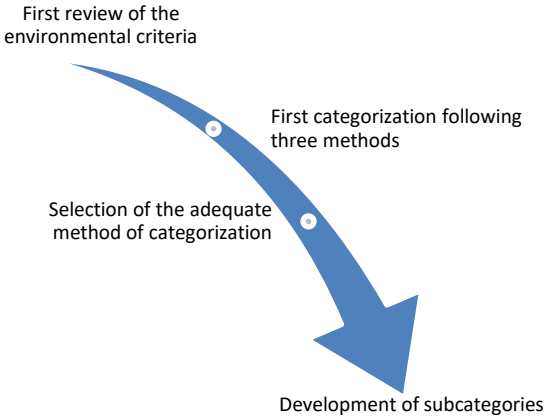
Product's environmental quality definition

Speaking of a product's environmental quality may not be the adequate means to develop the concept of a product's environmental attributes. Still, it is a good start to explore more thoroughly this issue. Scientific references do not match; if (Gupta & Palsule-Desai, 2011) and (Mantovani & Vergari, 2017) focused more the product's aspects related to the optimization of its impact on the environment, (Nouira, 2013) and (Brécard, 2014) leaned towards the consequences of the product on the ecosystem such as its carbon emission.

Product environmental attributes

Product's environmental attributes refer to its high environmental quality according to (Deltas, Khanna, & Ramirez, 2004) which can be divided into vertical attributes (greenness and intrinsic quality for instance) and horizontal attributes (style, design and convenience). For example, a product that harms the environment cannot hold environmental attributes which is a perception similar to (Soylu & Dumville, 2011) and (Yenipazarli & Vakharia, 2017), but different from other scientists' opinions. (Alwitt & Pitts, 1996) have stated that environmentally related product attributes do not necessarily reflect the benefits of a product environmental wise since they are related to positive and negative impact.

Intra-coding results:



The first phase of the treatment is mainly related to going over the 300 environmental criteria previously identified by (Palacios-argüello, *et al.* 2018). The objective is to eliminate redundancy and classify each criterion in the appropriate category. The categorization is performed using three different methods:

I. Categorization towards products or organizational practices

Being able to decipher between a criterion oriented towards products or organizational practices can be rather hazy especially in certain cases. For instance, "Using biodegradable raw materials" can be classified as a product-oriented criterion since it is directly related to the product's components but also as an organizational practice that can be generalized for the whole organization and industry. The solution in this case is to assign the criterion into the two categories.

II. Categorization into quantitative and qualitative criteria

As the previous type of categorization, same can be said. Considering a criterion as a quantitative one can be

confirmed if a numerical indicator is involved and can express accurately and faithfully the criterion in question. As formulated by (Jabbour & Jabbour, 2009), the quantitative criteria may be numerically evaluated in monetary value for instance. As for the qualitative criteria, they are mostly related to the organisation's practices such as the competencies environmentally wise, supplier green image…etc. Still, it is a debatable and a very subjective categorization that depends strongly on the coder's angle of view.

III. Categorization according to the product's life cycle

This type of categorization, suggested by (Palacios-argüello, *et al.* 2018), goes through the whole product's lifecycle, from raw materials' supply to the disposal. Besides, the classification is not only vertical following the different phases of the life cycle (supply, manufacturing, distribution, use and disposal) but also horizontal in a transversal way which concerns the globality of the supply chain and product's life cycle.

For the last two types of categorization, the constraint is linked to the unicity of the assignment. Being able to classify a criterion into one single category needs to be ensured. Otherwise, if the criterion fits into two or more categories, it needs to be split into several parts. To summarize, three tasks are to be done: detect the redundancy, categorize the remaining criteria and finally identify the ones which need to be split.

In the second phase, all the redundant elements are eliminated. As for the criteria needed to be split, the task is proceeded while maintaining the same reference to the author. The objective at this stage is to come up with subcategories for each category. The focus here is on the categorization oriented towards the product's lifecycle. In fact, this method of classification is able to deliver a more consensual result comparing to the two other methods which are more subjective and hence, susceptible to create many divergences in the step of confrontation with other points of view.

Furthermore, after going over the criteria, other similarities emerged. It is essential to detect and eliminate these repetitive criteria which might not be as blatant as the other elements already identified since it was more likely expressed in different words but still, the meaning is highly similar. It is recommended to keep a traceability of the different treatments proceeded on the data which is useful in case a step backward is required. Moreover, the subcategories previously identified are reviewed.

After fitting the criteria into both categories and subcategories, the next step is to summarize the results obtained in order to compare it with the first classification which leads to the "confrontation" or, in other words, the inter-coding.

IV. Categorization according to each coder

Categories

The categories used by the two coders are the same:

- Supply
- Manufacturing
- Distribution
- Use
- Disposal
- Transversal

Subcategories

Regarding the subcategories, the first coder established 18 subcategories and the second coder established 20 subcategories.

- Supply category: 6 (1st Coder) vs 5 (2nd Coder)
- Manufacturing: both coder established two subcategories but different.
- Distribution: 4 (1st Coder) vs 3 (2nd Coder)
- Use: 2 (1st Coder) vs 3 (2nd Coder)
- Disposal: 1 (1st Coder) vs 2 (2nd Coder)
- Transversal: 3 (1st Coder) vs 5 (2nd Coder)

Table 1 details the subcategories proposed by each coder.

Table 1. Subcategories comparison between the coders.

Categories	Subcategories Coder 1	Subcategories Coder 2
Supply	Raw materials characteristics	Choice of materials and product's composition
	Product components	
	Product design	Design/Conception phase
	Purchasing practices	Procurement/Purchase management practices
	Packaging	Product's packaging practices
	Purchasing practices - suppliers	Suppliers relationship management
Manufacturing	Manufacturing management practices	Manufacturing management practices
	Manufacturing technologies	Manufacturing process
Distribution	Sales and marketing practices	Distribution methods and practices
	Warehouse decisions	Flow optimization
	Transport practices	Logistics' fleet
	Distribution technologies	
Use	Product use charasteristics	Product's characteristics during use
	Customer management practices	Consumer's involvement in the enhancement of the product's environmental quality
		Product's green image
Disposal	Reverse management practices	Waste disposal
		Reverse logistics practices
Transversal	Emission	Emission assessment
	SC actors environmental practices	Guideline of environmental practices
		Final product's intrinsic quality
	Ressources efficiency	Resource use
		Use of clean technology

Criteria

Each criterion is then assigned to the appropriate category and subcategory. The first coder established 300 environmental criteria and the second coder established 265 environmental criteria.

The results of the intra-coding for the first coder are shown in Table 2.

Table 2. Criteria established by the first coder.

Categories	Subcategories	Environmental criteria	Rate	Category rate
Supply	Raw materials characteristics	11	3,7%	27%
	Product components	24	8,0%	
	Product design	1	0,3%	
	Purchasing practices	22	7,3%	
	Packaging	12	4,0%	
	Purchasing practices - suppliers	11	3,7%	
Manufacturing	Manufacturing management practices	30	10,0%	12%
	Manufacturing technologies	6	2,0%	
Distribution	Sales and marketing practices	2	0,7%	18%
	Warehouse decisions	9	3,0%	
	Transport practices	36	12,0%	
	Distribution technologies	6	2,0%	
Use	Product use charasteristics	8	2,7%	6%
	Customer management practices	9	3,0%	
Disposal	Reverse management practices	32	10,7%	11%
Tra	Emission	21	7,0%	27 %
	SC actors environmental practices	41	13,7%	
	Ressources efficiency	19	6,3%	
	Total	300	100%	100%

The results of the intra-coding for the second coder are shown in Table 3.

Table 3. Criteria established by the second coder.

Categories	Subcategories	Environmental criteria	Rate	Category rate
Supply	Choice of materials and product's composition	22	8%	22%
	Design/Conception phase	6	2%	
	Procurement/Purchase management practices	9	3%	
	Product's packaging practices	11	4%	
	Suppliers relationship management	10	4%	
Manufacturing	Manufacturing management practices	18	7%	11%
	Manufacturing process	10	4%	
Distribution	Distribution methods and practices	32	12%	21%
	Flow optimization	19	7%	
	Logistics' fleet	4	2%	
Use	Product's characteristics during use	11	4%	6%
	Consumer's involvement in the enhancement of the product's	2	1%	

	environmental quality			
	Product's green image	4	2%	
Disposal	Waste disposal	12	5%	12%
	Reverse logistics practices	20	8%	
Transversal	Emission assessment	4	2%	28%
	Guideline of environmental practices	38	14%	
	Final product's intrinsic quality	15	6%	
	Resource use	12	5%	
	Use of clean technology	6	2%	
Total		265	100%	100%

Discussion

In qualitative analysis, there is always a risk of subjectivity which is often interpreted as lack of rigour. The question to be asked is: Is the final goal of qualitative research the exactitude and conformity or that "cobbling-together" intrinsic characteristic (which is not necessarily pejorative)?

The answers vary, and double-coding is one of them. Although the principle has already been explained, it is interesting to grasp its utility beyond the result obtained. In fact, the original purpose is to depollute the material of its predefined theoretical mold. However, while proceeding so, there is high risk of circularity which means that the ultimate result of the double-coding only confirms -in most of cases- the theoretical framework which implies that the coder is still confined in the mold of theory that restricts any potential "discovery" or hidden little facts. As formulated by (Valéry, 1960), "Small unexplained facts always contain grounds for upsetting all explanations of "big" facts."

Nevertheless, allowing theory to frame partially the material can be beneficial since it provides limits to subjectivity. In fact, if we give free reign to the coders, divergences are going to be numerous, hence, a complexity in the final analysis. In this case, the different types of categorization are given by theory and it is up to each coder to choose the most adequate method and assign the different criteria into the appropriate category. Besides, developing sub-categories is a personal choice too.

The result of the intra-coding is subject to the inter-coding which refers to the confrontation step with the results of the first and the second coder. The type of categorization adopted is the same. Thus, it is possible to conduct a quantitative analysis based on the percentage rate of each category.

The results show similar proportion for each category and its rank with slight differences nonetheless. Qualitative wise, each coder developed its own classification in terms of subcategories. However, there are similarities in some cases but with different formulation, other subcategories are either split or grouped.

In fact, for each category unit, the subcategories scan the whole spectrum but with differences in numbers and titles. The distribution category expresses accurately the differences noticed. The first coder integrated the sales and marketing practices as subcategory whereas the second coder placed it in the use category and included it in the product's green image subcategory because its effect is noticed in the purchase trends of the users.

For the rest, the distribution methods can be divided into technology adopted, warehouse and transport practices as it

is the case for the first coder or seen from another perspective which is related to flow management and logistics fleet as it is the case for this present study.

Conclusion

The results presented in this paper are interesting since it deals with two different aspects. Firstly, the double coding method used is quite interesting and can be adopted in other qualitative analyses related to different projects. Secondly, being able to provide an inventory of categorized environmental criteria impacting the demand is helpful for the organizations aiming at developing their green image since it facilitates the prioritization of the actions.

Furthermore, the number of criteria that have been taken into account by the coders are different: the first coder classified 300 criteria and the second coder 265. This difference can be explained by the difference of treatment regarding the elimination of redundancy and classification of each criterion in the appropriate category.

Nevertheless, regarding the results of the categorization developed by the coders, we can conclude that there are very similar. For the supply's category rate both coders categorized the criteria almost in the same percentage, between 22% and 27%. For the manufacturing category the range was between the 11% and 12%. For the distribution category it was between 18% and 21%. For the use category, both coders obtained the same rate 6%. For disposal category, it was between 11% and 12%. Finally for the transversal category, it was between 27% and 28%.

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