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Criteria for The Management of Product Development in Small and Medium-Sized Clothing Enterprises

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***Abstract*— The aim of this research was to identify and analyses the level of importance that is given to product development management criteria in small and medium-sized clothing enterprises, and in what order those criteria should be implemented by such companies. The methodology of this research was performed by means of identifying product development management criteria in relation to the clothing industry, which were located in the relevant literature, in multiple-case studies, and also recommended by specialists in the field. A multi-criteria analysis was performed of the ranking in which companies should implement these criteria. The criteria that received the highest overall classification and ranking relative to each other were recommended by specialists and they were the criteria of 'integration' and 'value' in the management of product development in small and medium-sized clothing businesses.**

***Index Terms* — Clothing, Product development, Management criteria.**

I. INTRODUCTION

The classification of clothing products is determined by the product's life cycle, which is divided into long, medium and short-term. Long-term products are basic and are called style products. Medium-term products have progressive sales performance and can be classed as fashion products. Fashion products have a gradual increase in sales; they remain on the market for a given period and their sales decline slowly, usually lasting for a season. The trends for this type of product establish what will be the most important elements (colors, fabrics, types of clothing and accessories) for the autumn/ winter or spring/summer seasons. Short-term products are characterized as faddish products; they are quickly adopted by the market, reach their peak in terms of sales, and then quickly decline. This type of product does not last for a long time in the market and tends to attract a limited number of customers [1,2].

Companies that produce clothing goods deal with products that characteristically have a medium or short commercial life cycle. Such companies need to produce their goods quickly, flexibly and with great distinction. These companies generally produce items that are classified as consumer goods; they have low levels of development technology and they are referred to as small and medium-sized enterprises (SMEs) [3,4]. Even though these types of companies must overcome constant crises they have an important role to play because they employ significant numbers of workers, mainly in developing countries with high rates of unemployment.

SMEs with their own brand often experience difficulties in managing the development of clothing products because, in most cases, these companies have no structure or skilled labor; they also often have people simultaneously working in the design and production of clothing. For these reasons, it is important to consider the relevant management criteria for SMEs in developing clothing products so that such enterprises can be more competitive and successful. The objective of this research was to identify and analyses the level of importance of management criteria in the development of products by SMEs in the clothing industry and how to rank those criteria.

II. LITERATURE REVIEW

The literature review that was performed found 28 research articles about product development in clothing companies. However, some of these studies only focused on the development of new raw materials (fabrics) that were used for high-performance clothing, which was not the focus of this study. Within these limitations 18 articles were studied and they are presented in Table 1.

Table 1 – Management criteria for development of clothing products in SMEs found in literature review. Source: the authors.

Criteria in relation to product development	Authors
Integration (a)	15,17,11, 18, 5, 12 and
Speed or agility (b)	11,13,9 and 19
Differentiation of products (c)	3,10 and 14
Structure and organisation (d)	7 and 2
Tools and technology (e)	20, 22 and 1
Value (f)	8,9

An integrated approach for product development management to create value is achieved by means of partnership between the supplier, the firm that develops the product, and the retailer. Speed or agility means the ability to focus on optimizing the development of clothing rapidly and flexibly to produce clothing in accordance with changes in the market. Differentiation of products to compete with the large-scale quantity of mass production.

A structured model for activities in relation to developing products during all phases of production and within all internal sectors of the enterprise. Integration of the people

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involved in developing products, by means of the use of tools and technology to acquire them. The importance of value and the desire to meet all customer requirements, with complete focus on the market that the enterprise wishes to reach.

These criteria are factors that are required to make SMEs in the clothing industry more competitive in the present market.

III. MATERIALS AND METHODS

This study is divided into the following four stages: the management criteria for the development of clothing products that were identified by a literature review (LR); the management criteria for the development of clothing products that were identified by multiple-case studies (MCSs); the importance of these criteria indicated by specialists in the field (SP); and a multi-criteria analysis of the best alternatives to rank these criteria to be applied by SMEs.

The methodological approach of this study in relation to the analysis of MCSs consisted of semi-structured interviews with eight professionals from the product development sector of SMEs. These were researched according to the product development management criteria found in the literature (using 28 open questions) and periodic visits during the period of two fashion collections to the companies to view the technologies and processes used in the development of products. Fourteen retailers and ten suppliers (fabric and trimmings) were interviewed to verify their participation in product development in relation to the clothing SMEs that were surveyed, using the same research method that was performed in the SMEs themselves. This action was intended to identify the activities related to product development that the shopkeepers and retailers participated in, together with the SMEs, to identify the criteria used in product development management. Subsequently, the level of importance of the criteria was ranked by 22 experts with over three years' experience of product development in the clothing industry by means of a questionnaire.

Finally, for the multi-criteria analysis, data normalization was performed and then the ELECTRE I multi-criteria tool was applied. This tool analyses the dominance of an alternative and is based on non-compensatory logic by comparing peer-to-peer alternatives or actions. This method uses the notions of concordance and discordance to build relationships that incorporate the preferences of the decision maker regarding the best alternative to be used in relation to a given problem. The alternatives in this study consisted of the importance of managerial criteria in product development found in the literature, in multiple-case studies, and indicated by specialists in the field. When comparing pairs of alternatives, five situations can occur using this model [24]:

a) Strong preference (P) between an alternative in relation to others;

b) Weak preference (Q) between an alternative in relation to others;

c) Indifference (I) between an alternative in relation to others;

d) Incomparability (R) between an alternative in relation to others;

e) Outranking (S) between P, Q or I.

In dealing with a multi-criteria problem it is first necessary to establish the purpose of the analysis. There are normally three types of multi-criteria problems: ordering (Py); choice (Pα); and allocation into classes (Pβ). In this particular study, the objective was to analyses the level of importance of management criteria in product development in SMEs dealing with clothing by means of ordering (Py) using the ELECTRE I method. This method was used because it was important not to exclude any criteria, and to indicate the most important criteria for the SMEs to start implementing in an ordered fashion.

The first step in the multi-criteria analysis was to calculate the concordance index (ci,k) for the research using Equation 1.

$$c_{i,k} = \sum_{j \in C(x_i, x_k)} W_j \quad (1)$$

Where x_i S x_k.

The level of discordance was calculated using Equation 2.

$$d_{i,k} = \max_{positivo} \frac{[w_{2j} - A_{1j}]}{\delta} \quad (2)$$

In the differences between the alternatives there are points known as thresholds:

P* = concordance threshold;

Q* = discordance threshold.

Equations 3 and 4 were used to calculate the thresholds (concordance and discordance).

$$P^* = \frac{\sum_i \sum_j c_{ij}}{n(n-1)} \quad (3)$$

$$Q^* = \frac{\sum_i \sum_j d_{ij}}{n(n-1)} \quad (4)$$

The following algorithm was used to establish the optimal alternative from the outranking matrix that was generated by the thresholds:

Se Ci,j > P* and Di,j< Q*

Si,j = 1

If not

Si,j=0

Thus, it was possible to identify the importance of the alternatives in relation to the suggested product management criteria in relation to clothing companies.

The study of multiple cases was intended to analyses the state of product development in the clothing SMEs and to challenge it by using important points related to product development management in the clothing industry, which were found in the literature review. Table 2 presents the general data received from the firms that provided the multiple-case studies.

Table 2– General data regarding SMEs. Source: the authors.

Cases	Number of Works	Product	Average number of products developed/year
A	150	Women's fashion	240 products in three collections
B	50	Lingerie	24 products in one collection
C	110	Clothing for pregnant women	492 products in three collections
D	130	Children's clothing	840 products in three collections
E	37	Lingerie	36 products in one collection
F	24	Special sizes	210 products in three collections
G	44	Children's clothing	600 products in three collections
H	117	Men's clothing	408 products in three collections

In the MCSs a strong integration was observed in the retailers (in seven SMEs) in terms of product development management designed to identify the type of clothing product with highest sales and negotiating product pricing, but not in terms of focusing on understanding the customer's ultimate needs or the value for the end customer. Only one SME showed an integrated approach in relation to their suppliers of raw materials (specifically fabric material), indicating that although integration is an important factor in clothing product development management it was not performed by the majority of those involved in this process.

With integration only present for some of the firms, the MCSs presented problems related to information, even internal communication within the same company, due to a failure to use technology and management tools designed to assist in product development management specifically for clothing. The factors of speed and differentiation were scored according to the product and the type of marketing. The SMEs that sold to large stores focused on speed (two SMEs); however, the companies that had their own brands and stores, or sellers representing their brands, did not show concern about the issue of speed in developing a greater number of new products or about following trends in clothing. Of the eight SMEs that were surveyed, five of them indicated the importance of having product development management structured and organized in a specific sector within their company. The highest scoring criteria in eight of the SMEs were the cost involved in product development (travel to research trends, labor, technology) and product development. However, the criterion of costs was not found in the literature review.

IV. THE IMPORTANCE OF MANAGEMENT CRITERIA IN PRODUCT DEVELOPMENT IN THE OPINION OF SPECIALISTS IN THE FIELD

The assessment was conducted by eight fashion designers and fourteen engineers, of which nine were textile engineers and five were production engineers. From the total sample of specialists seven worked in firms and fifteen worked on an academic basis, but had already worked for a period of at least three years in the clothing industry. Table 3 presents the importance that the specialists highlighted for each surveyed criterion in terms of product development management in SMEs specializing in clothing.

Table 3 – Values for the assessment of criteria for product development. Source: the authors.

Criteria	Points
Integration	4
Speed	3
Differentiation	2
Structure and organization	0
Information	3
Tools and technology	3
Costs	2
Value	5

The options of 'no importance' and 'little importance' were not scored by the specialists for any of the criteria. The results shown in Table 3 confirm the importance of the management of product development in a similar way to that found in the LR and the MCSs. The specialists found that the criterion of differentiation had an average level of importance. This represented a contradiction because there is a general assumption that product differentiation is a way to be competitive in the textile market. The criterion of value received the highest percentage of importance from the specialists but it was not clear whether that referred to value for the customer or the monetary value for the company. Therefore, competitiveness is achieved by identifying what is the value for the customer and not only in terms of product differentiation.

The criterion of integration was very important for the specialists, and integration is a key factor for the management of product development in SMEs in the clothing industry. The criterion of tools and technology was also very important for the specialists in the evaluation of the model. However, the latter criteria were not found in the MCSs. The criteria of speed and costs are criteria that were also important in the model for the evaluators. In SMEs, these criteria are necessary and difficult to implement in product development within clothing companies. However, these criteria were not identified as factors in the literature review.

V. ALIGNMENT OF IMPORTANCE BY USE OF MULTI-CRITERIA

This study found three alternatives regarding the importance of the criteria. Alternative 1 was the frequency of the criteria found in the literature review (LR). Alternative 2 was the frequency that these criteria were found in the multiple-case studies (MCSs) and Alternative 3 was the importance attributed by the specialists (SP) to the criteria. Table 4 presents the data and the normalized data for the calculation of the multi-criteria tool.

Table 4 – Importance of alternative criteria. Source: the authors.

Real data				Normalised data			
Criteria	**LR**	**MCSs**	**SP**	**Criteria**	**LR**	**MCSs**	**SP**
Integration	7	7	4	Integration	0.39	0.39	0.22
Speed	3	2	3	Speed	0.38	0.25	0.38
Differentiation	1	0	2	Differentiation	0.33	0.00	0.67
Structure and organisation	2	5	0	Structure and organisation	0.29	0.71	0.00
Tools and technology	3	1	3	Tools and technology	0.43	0.14	0.43
Information	0	2	3	Information	0.00	0.40	0.60
Costs	0	7	3	Costs	0.00	0.70	0.30
Value	2	0	5	Value	0.33	0.00	0.67

Equations 1 and 2 were used to calculate the concordance and discordance indices for the alternatives in this study. To identify the point between concordance and discordance between the alternatives, Table 5 shows these indices by means of two matrices.

Table 5 – Concordance and discordance matrices. Source: authors.

Alternatives	**Concordance**			**Discordance**		
LR	0.00	5.00	4.00	0.00	1.00	1.00
MCSs	4.00	0.00	3.00	1.67	0.00	1.66
SP	6.00	6.00	0.00	1.56	1.56	0.00

To construct the outranking matrix for the actions of concordance and discordance of the alternatives in relation to the criteria, the indices of thresholds of concordance and discordance were calculated by using Equations 3 and 4; these obtained respective results of p = 5 and q = 1.55.

The outranking matrix was used to construct the graph of outranking relationships. Table 6 identified Alternatives 1 and 3, which over-classified Alternative 2. However, Alternative 3 showed a higher outranking value compared to the others because it presented a higher outranking value in relation to Alternatives 1 and 2. This alternative was identified by the specialists in the field.

Thus, the greatest dominance calculated using the multi-criteria tool was Alternative 3, which were the criteria recommended by the specialists in the field and which were ranked in the following order:

1. The first step should be to identify value for everyone involved in the process of the product development of clothing, especially for the end customer;

2. In the search for value, the importance of integration must be clear for all those involved in the management of product development of clothing, whether internal or external to the company;

3. Speed in developing new products must be automatically increased through the integration of everyone involved in product development and through the use of tools and technologies, as well as the divulgation of information to all those involved;

4. The use of tools and technology to optimize product development management, especially in relation to time and cost, should be the fourth criteria to be implemented;

5. Information must be provided to all those involved in the development of clothing products. It is advisable to use a communication tool to transmit this information more efficiently and to create a culture of trust through the integration of all those involved in this process;

6. The cost of both the product and product development management are key factors in generating profit in SMEs and this should be prioritized as the sixth stage. However, this criterion can also be placed in fourth position because it received the same score as the criteria ‘tools and technology’, and the criteria ‘information’;

7. The criterion of differentiation is the seventh stage in product development management because this focuses exclusively on the product to be developed and not on the management of the development of the product;

8. Finally, the criterion of structure and organization was not scored as being important by the specialists, but it was indicated in the MCSs and the literature review. However, whilst the other seven criteria were developed in the management of product development in the clothing industry, the criterion of structure and organization in relation to this process was absent in the case of the SME’s.

It should be noted that the criteria identified in this study are dependent upon each other and they are often dependent on the implementation of the other criteria. For example, the transmission of information is dependent upon the need for technology, which shows the interdependence of the criteria.

VI. Conclusion

This study analyzed the level of importance of management criteria in relation to product development in small and medium-sized clothing enterprises, and also the order in which they should be implemented by companies. It was concluded that in terms of managing product development, SMEs specializing in clothing should firstly work towards the internal integration of the company and then the integration of the company with its suppliers, retailers and end customers. Based on this integration, it is important that the companies, suppliers and end customers should be involved in the development of products that above all have value for the end customer. The criteria of ‘tools and technology’, ‘information’, ‘speed’ and ‘cost’ were ranked as having equal importance and they should be optimized in product development management to support the factors of integration and the search for value for a product to be developed. The use of the criterion ‘tools and technology’ offers support for the management of product development as a management tool and as a process to develop a product using software design to better stimulate future products and because of the use of tools and technology obtain greater speed in developing clothing products. However, because information is the basis for integration it is necessary to use technology to transmit information between all those involved in product development (companies, suppliers, retailers and end customers). Costs should be minimized throughout product development; however, this should not override the importance of achieving value for the clothing product to be developed.

The criterion of ‘differentiation’ was ranked with less importance by the specialists, compared with the information found in the literature review. Nevertheless, the search for value for the product in terms of the end customer indicates the index of differentiation that the end customer requires.

This is a criterion that has critical importance in the development of clothing products because it can lead to the development of clothing without any marked differentiation from products made by competitors and thus developed products may not find favor with potential customers.

Finally, the criterion of 'structure and organization' in product development management was identified by the literature review and by the MCSs and was not identified as being important in the MCSs. It was concluded that if all the other criteria identified in this study were used in product development management within clothing enterprises then structure and organization would automatically result in such companies.

REFERENCES

[1] Thomassey, S. Sales forecasts in clothing industry: The key success factor supply chain management. *International Journal of Products Economics* 2010; 12, p.470-483.
[2] Ciato, F.; Caridi, M.; Castelli, C. and Golini, R. Supply chain management in the luxury industry: a first classification of companies and their strategies. *International Journal of Production Economics* 2011; 13: p. 622–622.
[3] Sen, A. The US fashion industry: a supply chain review. *International Journal of Production Economics* 2008: 11: p. 571-593.
[4] Treptow, D. *Inventing Fashion*: Collection Planning. Brusque: D. Treprow, 2003.
[5] Milašius, R. and Mikučionienė, D. Comparative Analysis of Textile and Clothing Industry in the EU and Turkey. *Fibres & Textiles in Eastern Europe* 2014; 22: p.8-16.
[6] Kachba, Y.;Plath, A.; Ferreira, M. G. and Forcellini, F. A. Alignment of quality management in SMEs with the market performance. *Journal of Technology Management & Innovation* 2012; 7: p. 103-111.
[7] Teng, G. and Jaramillo, H. Integrating the US textile and apparel supply chain with small companies in South America. *Supply Chain Management*: An International Journal 2006; 11: p.44-55.
[8] Abecassis, C. Integrating design and retail in the clothing value chain: an empirical study of the organization of Design International. *International Journal of Operations & Production Management* 2006; 26: pp. 412-28.
[9] Bruce, M.; Daly, L. and Towers, N. Lean or agile. A solution for supply chain management in the textile and clothing industry? *International Journal of Operations & Production Management* 2004; 24: p.151-170.
[10] EURATEX. *European Apparel and Textile Confederation*. Research and Development for SMEs. Access in: www.euratex.org. Retrieval in: 05 Jan. 2014.
[11] Brun, A. and Castelli, C. Supply chain strategy in the fashion industry: Developing a portfolio model depending on product, retail channel and brand. *International Journal of Production Economics* 2008; 11: p. 169–181.
[12] Jiang, B.; Talluri, S. and Yao, T. Improving supplier's situation through supplier cooperation: the case of Xintang jeans town. *International Journal of Production Economics* 2011; 13: p. 125-133.
[13] Perreira, G. M.; Baiason, I. M.; Sellitto, M. A. and Borchardt, M. Comparing flexibility in the product, costs and speed of development in the Chinese and Brazilian Fashion Industries. *Revista Produção* 2011; 21:p. 27-38. (in Portuguese)
[14] Tyler, D.; Heeley, Jo; B. T. Supply chain influences on new product development in fashion clothing. *Journal Fashion Marketing and Management* 2006; 10: p. 316-328.
[15] Redfern, R. and Davey, C. Supply chain market orientation in new product development in the UK: a pilot case. *Journal of Fashion Marketing and Management* 2003; 7: p. 66-77.
[16] Senh, M.; Carroll, K. and Cassill, N. Critical review on smart clothing product development. *Journal of Textile and Apparel, Technology and Management* 2012; 4: p. 1-18.
[17] Christopher, M., Lowson, R., and Peck, H. Creating agile supply chains in the fashion industry. *International Journal of Retail & Distribution Management* 2004; 32; p. 367-376.
[18] Goworek, H. An investigation into product development processes for UK fashion retailers: a multiple case study. *Journal of Fashion Marketing and Management* 2010; 14: p. 618-662.
[19] Kincade, D.; Regan, C. and Gibson, F. Concurrent engineering for product development in mass customization for the apparel industry. *International Journal of Operations & Product Management* 2010; 27: 627-649.
[20] Vaagen, H. and Wallace, S. Product variety arising from hedging in the fashion supply chains. *International Journal of Products Economics* 2008: 11: p.431-455.
[21] Vanathi, R. and Swamynathan, R. Competitive advantage through supply chain collaboration – an empirical study of the Indian textile industry. *Fibres & Textiles in Eastern Europe* 2014; 22: p.8-13.
[22] Young-jin, Liu; D. and Zhang. M. A survey on CAD methods in 3D garment design. *Computers in industry*: an international 2010; 61: 576-593.
[23] Roy, B. Decision science or decision-aid science? *European Journal of Operational Research* 1993:66: 184-203.