

Prospective study on rubber and plastic sector related with leather and footwear industry using Delphi method and structural analysis¹

Estudio prospectivo de la industria del plástico y el caucho asociado al sector cuero, calzado y marroquinería empleando metodología Delphi y análisis estructural¹

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Sandra Milena Velásquez Restrepo²
Gabriel Jaime Peláez Arroyave³
Diego Hernán Giraldo Vásquez⁴
Juan Camilo Ortiz Serna⁵

Abstract

In recent decades the use of plastics and rubbers in the leather goods and footwear industry has showed a remarkable increase, establishing a strong dependence between these economic activities. This work presents a prospective study for the plastics and rubber industry as provider for the leather goods and footwear industry, since such studies have been recognized as valid tools for organizations to design their action plans, regardless if companies, associations, research centers or government agencies, carry out planning. Professionals from different types of institutions, both national and international, were consulted by applying the Delphi methodology. Structural analysis was carried out to identify the main factors that will be key to the success of the plastics and rubbers industry related to leather goods and footwear industry. Twenty six key success factors grouped into seven types of strategies were identified. The results suggest that the three strategies with greater impact in the future of plastics and rubber industry are personnel training, technological development in the field of materials and manufacturing processes, and modernization of the organizations. Several mythological issues had to be taken in account in order to gather and analyze data in this type of studies. Our results differ from the most cited factors pointed out by experts, as key factors for success in this industry.

Keywords: Rubber industry; plastic; leather goods; footwear industry; prospective; Delphi methodology; structural analysis.

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² Colombian, MSc. in Engineering, Specialist in Management. Leader of Innovation and Technological Development of the Centro de Diseño y Manufactura del cuero del SENA, Itagüi, Antioquia. Group BIOMATIC-Biomechanical, Materials, TIC, Design and Quality for the Sector leather, plastic, rubber and his productive chains.

³ Colombian, MSc. in Science and Engineering material. Engineer of Materials. Instructor/Investigator of the Centro de Diseño y Manufactura del cuero del SENA, Itagüi, Antioquia. Group BIOMATIC-Biomechanical, Materials, TIC, Design and Quality for the Sector leather, plastic, rubber and its productive chains.

⁴ Colombian, MSc. in Engineering, Mechanical Engineer. Teacher of the program of Engineering material of the Universidad de Antioquia. Group of polycrystalline Materials.

⁵ Colombian, Learner of the Technology in Analysis and Development of Information systems of the Centro de Diseño y Manufactura del cuero del SENA, Itagüi, Antioquia. Group BIOMATIC - Biomechanical, Materials, TIC, Design and Quality for the Sector leather, plastic, rubber and its productive chains.

Introduction

The footwear industry and the Morocco leatherwork have increased the consumption of plastic and rubber, so much because of its minor cost in comparison with the leather or the wood, since for the effort of the industry of the plastic and the rubber for developing materials that satisfy the quality standards demanded by the worn sector and Morocco leatherwork (Saraswathy et al., 2013). The rubber is the material more widely used to make the soles, good with natural rubber or rubber (Lopes et al., 2015), or with synthetic rubbers like the SBR - copolymer of butadiene and styrene - and EVE - copolymer of ethylene vinyl acetate - for its high resistance to external agents and the good relation cost-benefit (Beliczky and Wrap, 2001), without leaving of side the comfort that the soles provide in rubber (Forest et al., 2009). Also it was investigated on the use of the rubber for the manufacture of uppers (Duerto, 2014), taking advantage of the properties that present the rubbers of thermal isolation, low density and resistance to chemical agents, specially important characteristics for the footwear of industrial safety (Beliczky and Wrap, 2001). The plastic has gained an important place in components of feminine footwear, such as the heels and the sandals; the so called synthetic leather, based in plastic as the polyurethane or the polychloride of vinyl - PVC it comes increasing his application so much in the sector worn like in the Morocco leatherwork (Patch, 2012). In the industry was observed the interest to produce plastic for footwear and Morocco leatherwork with the use of clean technologies, the decrease of chemical additives harmful to the environment, (Naime and Robinson, 2009; Highland et al., 2007), and the increase of the use of recycled materials (Alcántara et al., 2008), to manage in addition, to reduce the costs of production.

Colombia is not foreign to the world trends as for the increase in the use of plastic and rubber in the sector leather and footwear. It is pertinent to indicate that after the crisis of the national industry of the footwear, the leather and the Morocco leatherwork between 2009 and 2013, principally due to the incursion of the Asian footwear with prices difficult to be equal on the local market, the sector began to glimpse a recovery that can be late from 3 to 5 years (Celedón, 2014; Uruña, 2014). This productive chain possesses important opportunities to increase the quantity and the value added of its exports, specially to the market of The United States, aspect in which it shares opportunities with the footwear industry and the Morocco leatherwork beside being connected industries. In this panorama, the implementation of a planning strategic based on the innovation will be key to increase the competitiveness of

the sector (Quero, 2008), and it is for it that is the productive chain chosen for this study.

In agreement with Porter, the competitiveness is determined by four fundamental attributes, and the way how they interact they allow to identify the innovative character of an organization. Four attributes are: conditions of the demand, connected industries and of support, the strategy. The structure and rivalry of the companies of the same economic activity and in what it has to see directly with the subject matter of this work, the factors of success for the sector (Porter and Kramer, 2002). The above mentioned key factors can be identified using studies of futurology, in order that they are considered in the planning strategic of the organization.

Inside the support tools to the futurology, one finds the Delphi methodology that he considers to be the possible relevant scenes for the sector of interest (Saints et al., 2013), without forgetting the attention to the socioeconomic factors that interact with the technical emergent capacities that affect products and commercial services (Porter, 2010). The Delphi methodology is based on a process of construction by experts in the topic and actors who do part or have interest in the productive chain that is studied; limiting the effect of subjective judgments, the concepts of the experts remain in the anonymity, which allows to the participants to express freely exposing their royal opinion (Landeta, 1999; Velazques and Castro, 2013). This procedure obtains consensus but without affecting the autonomy of every participant, by which the capacity of prediction of the methodology Delphi is based on the systematic utilization of the intuitive judgment issued by the group of experts (Landeta, 1999). The answers of the experts were analyzed to identify the factors that they considered to be determinants, and there was effected a structural analysis across which there was realized a quantitative and objective valuation of the proposed factors. The structural analysis consisted of identifying if a factor affects on other factors, which named motility, or if on the contrary it is influenced by other factors, characteristic so called dependence. With the opposing values the plane was elaborated of motility and dependence, in which the most influential factors located, that is to say, the motive forces of the change, as well as those that only are dependent on others and therefore they are not priority to change to a sector (Saints et al., 2013).

This work used the Delphi methodology and the structural analysis to identify the factors of success of the industry of the rubber and plastic associated with the sector leather, footwear and Morocco leatherwork. This

information will be useful in order that the executives of the sector define strategies to generate added value and to preserve or to improve its competitiveness, since the sector can take advantage if there are adopted the strategic suitable decisions, for which a study of futurology is opportune. Especially it is of interest for entities of formation as the SENA, to rely on information of the environment to open new identical programs of formation for the needs of the industry, and to modify the programs that it offers at present.

Methodology

The Delphi methodology was in use for identifying the factors that will determine the future of the sector rubber and plastic as industry associated with the sector leather, footwear and Morocco leatherwork. There were consulted 18 experts, 5 of foreign entities and 13 Colombians, of manufacturing organizations, of services, unions and entities of formation of the worn sector and Morocco leatherwork and / or to the sector rubber and plastic. In the Table 1 they present the profiles of 18 consulted experts, with the codes of identification assigned. The following question appeared them: **“ To your judgment, which are the factors that will determine the future of the sector rubber and plastic as industry associated with the sector leather, footwear and Morocco leatherwork?”**.

The number of consulted experts was adapted taking as a reference Dalkey's work, in which the ideal number of experts decided to effect an analysis Delphi (Dalkey, 1969); it was found that the average mistake of the group exponentially diminished up to a size of sample of 17 individuals, point from which it diminished of linear form. This work indicated also that the suitable size of the experts' panel will change according to the object of analysis and the homogeneity of the group. In a later study, Adler and Ziglio, 1996, determined that when the group of experts is homogeneous, consistent results can be obtained by a group formed between 10 and 15 persons, and when it is a heterogeneous group is advisable that the group is of, at least between 11 and 20 individuals. Once identified the factors in the answers of the experts, the structural analysis was effected obtaining the counterfoil of motility and dependence, establishing the key factors for the sector.

Results and analysis

In the Table 1 appears the profile of the experts consulted, arranged according to its profile and origin;

a code was assigned to every expert but the anonymity remained. Observed the plurality in the profiles of the consulted persons, which contributed that the panorama of the problem is considered from multiple perspectives.

In the Table 2 appear in alphabetical form twenty-six factors of success identified by the experts for the sector of the plastic and rubber associated with the industry of the leather, footwear and Morocco leatherwork and the code assigned to every factor, in order to facilitate its presentation in the tables and graphs of the following sections.

In the Table 3 appear the factors of success identified by every expert, the number of experts who coincide with every factor. It was observed that the competitiveness in price and quality was the factor mentioned by the major number of experts, followed by the technological and innovation thirdly by the use of synthetic materials. Also it is of highlighting that nine of twenty-six factors only were proposed by an expert, which would indicate a low importance if to the answers the treatment of a survey should give to them. These trends will be confirmed later by the results of the structural analysis.

In the Table 4 are shown the factors grouped in transverse strategies; it was found that the subject matter with the major quantity of factors were the materials and the processes of manufacture, followed by the related ones to the modernization organizational and thirdly the strategies of marketing. In the Figure 1 appears the quantity of factors identified by every expert in their response, grouping the factors for color according to the transverse strategy to which they belong.

In the Table 3 and the Figure 1 it was observed that the number of proposed factors neither depended on the profile of the expert who did not have any relation with the type of transverse strategy to which there belongs the factor that he proposes, in such a way that the proportionate answers are not affected by the type of entity to which the expert belongs, differences were not even observed in the quantity and type of factors issued by the national experts with regard to the international ones. It is relevant also to annotate that with the exception of the factor associated with the need to rely on guarantees for the national industry opposite to the products of Asian origin, factor that was only proposed by one of the experts, all the rest factors and transverse strategies were proposed indistinctly by experts of the productive, trade-union, academic sector, so much of national as international character. This characteristic of the answers of the experts is highly significant for the Delphi methodology.

Table 1. Profile of the experts who took part in the study.

Code	Profile	Origin
E-1	Private executive company of the worn sector dedicated to the manufacture and commercialization	Colombia
E-2	Private executive company of the sector articles in rubber dedicated to the manufacture and commercialization	Colombia
E-3	Private executive company of the sector articles in rubber dedicated to the manufacture and commercialization	Colombia
E-4	Private executive company dedicated to the manufacture and commercialization of footwear	Colombia
E-5	Professional research and development in private company dedicated to the manufacture and commercialization of industrial articles in plastic and rubber, and engineering polymer	Colombia
E-6	Professional research and development in private company dedicated to the manufacture and commercialization of industrial articles in plastic and rubber.	Colombia
F-1	Educator in entity of formation	Colombia
F-2	Educator in entity of formation	Colombia
F-3	Educator in entity of formation	Colombia
F-4	Educator in entity of formation	Colombia
F-5	Educator in entity of formation	Colombia
F-6	Educator in entity of formation	Colombia
I-1	Private executive company of consultancy in management organizational, engineering and productive processes	Brazil
I-2	Executive of manufacturers' unionization of the footwear	Argentina
I-3	Executive of innovation center	Mexico
I-4	Executive of innovation center	Colombia
I-5	Executive of manufacturers' unionization of the footwear	Chile
I-6	Direc Executive of manufacturers' unionization of the footwear	México

Source: The Authors.

In the Figure 2 appears the number of experts who in their answers propose the same factor of success for the sector of plastic and rubber associated with the industry of the leather, footwear and Morocco leatherwork. The factors gathered in crowds for color according to the transverse strategy to which they concerned, as are observed in the Figure 2, though the experts established twenty-six determinant factors for the success of the plastic sector and rubber associated with the industry of the leather, footwear and Morocco leatherwork, in sixteen of these factors there are at least two authors who

coincided in identifying them as keys for the future of the sector, obtaining a level of relevant convergence for the intention and the validity of this work. Once identified the factors of success by means of the Delphi methodology, one proceeded to realize a structural analysis based on the approach of futurology. There was elaborated a counterfoil of double entry; the dependence was established of each one of the factors by the remaining ones as well as the influence of every factor on the remaining ones. In this study only it was considered to be the royal and direct influence of the factors, scorning the indirect or potential influences.

Table 2. Factors identified by the experts who

Description of the Factor	Code of Factor
Adaptability to the environment of the market	AdaMer
Joint with the suppliers of raw material	ArtPrMP
Low performance of the plastic and the rubber opposite to the environment	PrBaEspT
Qualification of the personnel	CalPers
Changes of the model of business with approach towards the service	CaMNeg
Construction and positioning brand	Marca
Give to the companies an international approach	Enflnt
Give added value to the leather	ValAgCu
Development and use of ecological materials	MatEco
To differ in design	DifDis
Decrease of wastes	DismDesp
Decrease of the use of the natural leather and increase in the use of synthetic materials	SinReCue
Shortage of the leather as a raw material	EscCuMP
Guarantees for the national producers against Asian products	GarPr
Implementation of efficient processes of production	ImPrEf
Implementation of real organizational structures	IEstOrg
To incorporate a suitable planning	PlanAd
Technological innovation	InnTec
Marketing and commercialization	MercCom
Offer products with high technical specifications	PrAIEspT
Offer products with major times of guarantee, with after-sales associate service	GarSPos
Highlight the unique characteristics of the products, granting status to them	StatProd
Customer satisfaction	SatClie
To be competitive in price and quality	CompPyC
Use of natural materials	UMatNat
Intensive use of technologies of information and communication	TIC

Source: The Authors.

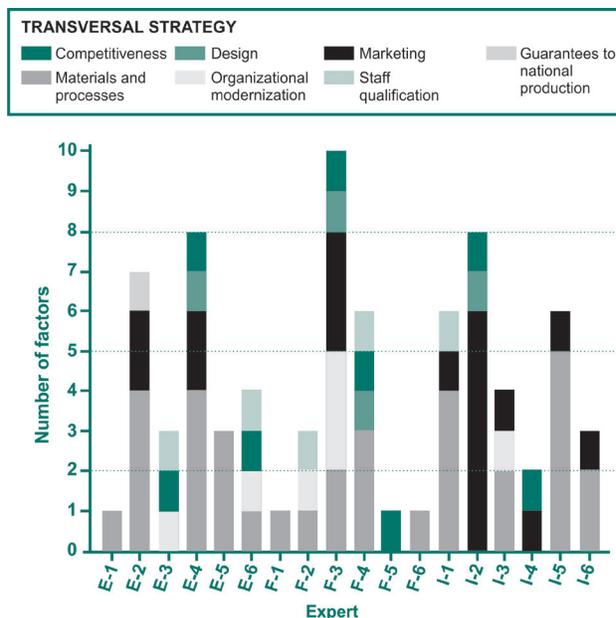


Figure 1. Number of factors identified by every expert and transverse strategy to which the factors identified by the experts belong.

Source: The Authors.

The Table 5 presents the counterfoil of double entered with the results of the structural analysis. From the information recorded in the Table 5, the Table constructed 6 itself in which the absolute values and the percentages are compiled of motility and dependence associated with each of the identified factors. With the information calculated in the Table 6, the plane was obtained of motility and dependence showed in the Figure 3, bearing in mind that the percentage of separation of the zones of the plane of motility and dependence is 3,8 % since it is the value obtained on having divided 100 (total percentage of motility and dependence) between twenty-six factors of success found in the answers of the experts.

In the Figure 3 is observed that the motility forces for the future of the plastic sector and rubber in relation with the worn sector and leather, are first the qualification of the personnel, which makes clear for the impact that it has in other factors. This result coincides with the trends raised in the regional and national plans of development, that have chosen the education as one of the axes articuladores of growth. Also it is particularly of interest for the SENA, which fulfills in the country a strategic paper for the formation. In the zone of power of the Figure 3, also are factors associated with the transverse strategy named organizational modernization, as the implementation of real organizational structures and the accomplishment of a suitable planning which have a motility discharge since they allow that a significant quantity of other factors could be reached by them.

Table 3. Factors of success identified and the number of experts who coincided with every factor.

EXPERT	FACTOR																				TOTAL							
	AdaMer	ArtPrMP	BaDesPla	CalPers	CaMNeg	CompPyC	DifDis	DismDesp	EnfInt	EscCuMP	GarPr	GarSPos	IEstOrg	ImPrEf	InnTec	Marca	MatEco	MercCom	PlanAd	PrAIEspT		SatClie	SinReCue	StatProd	TIC	UMatNat	ValAgCu	
E-1																											1	
E-2																												7
E-3																												3
E-4																												8
E-5																												3
E-6																												4
F-1																												1
F-2																												3
F-3																												10
F-4																												6
F-5																												1
F-6																												1
I-1																												6
I-2																												8
I-3																												4
I-4																												2
I-5																												6
I-6																												3
TOTAL	2	1	1	5	1	8	4	1	1	4	1	1	1	3	7	1	4	5	3	4	2	6	5	1	2	3		

Source: The Authors.

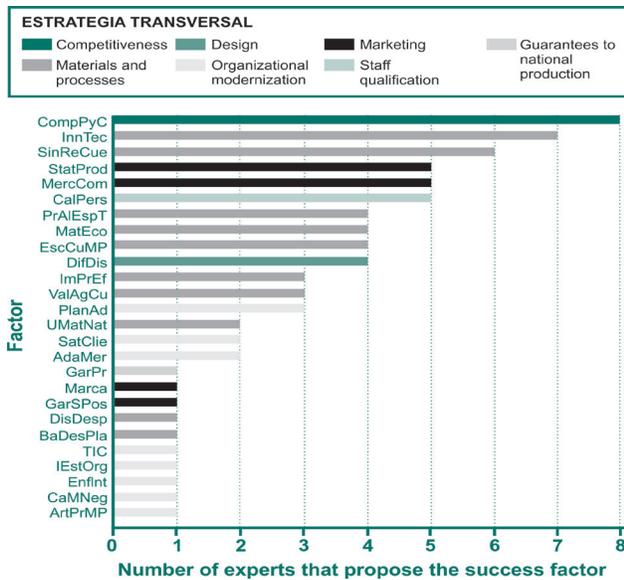


Figure 2. Number of experts who propose every factor of success identified by type of transverse strategy to which they belong.
Source: The Authors.

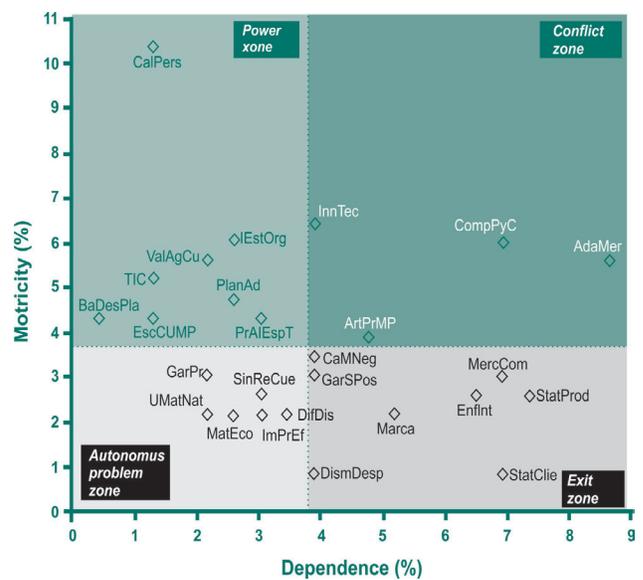


Figure 3. Plane of motility and dependence for the factors identified by the experts
Source: The Authors.

Table 4. Group of the factors of success in transverse strategies.

Transverse strategy	Factors identified by the experts who have been included in the strategy
Design Materials and Processes of Manufacture	<ul style="list-style-type: none"> • To differ in design • Under performance of the plastic and the rubber opposite to the environment • Decrease of wastes • Shortage of the leather as a raw material • Implementation of efficient processes of production • Technological Innovation • Development and use of ecological materials • Products Offer with high technical specifications • Decrease of the use of the natural leather and increase in the use of synthetic materials • Use of natural materials • To give added value to the leather
Marketing	<ul style="list-style-type: none"> • Products offering with major times of guarantee with after-sales associate service • Construction and positioning brand • Marketing and commercialization • Highlight the unique characteristics of the products, granting status to them • Adaptability to the environment of the market • Joint with the suppliers of raw material • Changes of the model of business with approach towards the service • Give an international approach to the companies
Modernization organizational	<ul style="list-style-type: none"> • Implementation of real organizational structures • Incorporate a suitable planning • Costumer satisfaction • Intensive use of technologies of information and communication
productivity and competitiveness	<ul style="list-style-type: none"> • To be competitive in price and quality
Guarantees to the National production	<ul style="list-style-type: none"> • Guarantees for the national producers against Asian products
Qualification of the personnel	<ul style="list-style-type: none"> • Qualification of the personnel

Source: The Authors.

It is of highlighting that four of the factors of the zone of power associate to the materials and the processes of manufacture since are: to add value to the natural leather, the obtaining product with high technical specifications, the shortage of the natural leather as raw material and the low properties of the plastic in comparison with the natural leather, factors that imply that enormous efforts develop in the field of the formation, the science and the engineering of the plastic and the rubbers. And another factor of the

power zone, it corresponds to the implementation and utilization of the technologies of the information and the communication, without losing of sight that the technological innovation, although it does part of the zone of conflict, is closely together of the border with the zone of power, therefore also leather and footwear might be considered to be one of the motility forces for the future of the plastic and the rubber in relation by the sector.

Table 5. Counterfoil of structural analysis.

Factor	Factor																				Dependence							
	AdaMer	ArtPrMP	BaDesPla	CalPers	CaMNeg	CompPyC	DifDis	DismDesp	EnfInt	EscCuMP	GarPr	GarSPos	IEstOrg	ImPrEf	InnTec	Marca	MatEco	MercCom	PlanAd	PrAIEspT		SatClie	SinReCue	StatProd	TIC	UMatNat	ValAgCu	
AdaMer	-																											20
ArtPrMP		-																										11
BaDesPla			-																									1
CalPers				-																								3
CaMNeg					-																							9
CompPyC						-																						16
DifDis							-																					7
DismDesp								-																				9
EnfInt									-																			15
EscCuMP										-																		3
GarPr											-																	5
GarSPos												-																9
IEstOrg													-															6
ImPrEf														-														8
InnTec															-													9
Marca																-												12
MatEco																	-											6
MercCom																		-										16
PlanAd																			-									6
PrAIEspT																					-							7
SatClie																						-						16
SinReCue																							-					7
StatProd																								-				17
TIC																									-			3
UMatNat																										-		5
ValAgCu																											-	5
Motricidad	13	9	10	24	8	14	5	2	6	10	7	7	14	5	15	5	5	7	11	10	2	6	6	12	5	13	231	

Source: The authors.

The competitiveness in price and quality was the factor most mentioned by the experts as key for the success of the sector; as 3 are observed in the Table 3 and in the figures 1 and 2, are not one of the motility forces found in the study. The explanation resides in that though the fourth major motility presents, it is highly dependent on other factors, for which it is a question of an effect of the implementation of other strategies as the qualification of the personnel, the organizational modernization and the technological development in the field of the materials and the processes, in such a way that then it must be understood more as the result of the implementation of other key strategies, that as a strategy in itself.

The decrease of the use of the natural leather and increase in the use of synthetic materials, the third factor most mentioned by the experts like estimates in the Figure 2, is located in the zone of autonomous problems, which assumes to its low impact in other factors of success. It is then about a characteristic of the environment of the market that cannot be altered by the sector of the plastic and the rubber, but that it can be taken as an opportunity for the development of the sector. A similar situation was detected for the use of ecological materials and the use of materials of natural origin.

Table 6. Values and percentages of motility and dependence associated with every factor.

Code Factor	Motility		Dependence	
	Number	%	Number	%
AdaMer	13	5.6	20	8.7
ArtPrMP	9	3.9	11	4.8
BaDesPla	10	4.3	1	0.4
CalPers	24	10.4	3	1.3
CaMNeg	8	3.5	9	3.9
CompPyC	14	6.1	16	6.9
DifDis	5	2.2	7	3.0
DismDesp	2	0.9	9	3.9
EnfInt	6	2.6	15	6.5
EscCuMP	10	4.3	3	1.3
GarPr	7	3.0	5	2.2
GarSPos	7	3.0	9	3.9
IEstOrg	14	6.1	6	2.6
ImPrEf	5	2.2	8	3.5
InnTec	15	6.5	9	3.9
Marca	5	2.2	12	5.2
MatEco	5	2.2	6	2.6
MercCom	7	3.0	16	6.9
PlanAd	11	4.8	6	2.6
PrAlEspT	10	4.3	7	3.0
SatClie	2	0.9	16	6.9
SinReCue	6	2.6	7	3.0
StatProd	6	2.6	17	7.4
TIC	12	5.2	3	1.3
UMatNat	5	2.2	5	2.2
ValAgCu	13	5.6	5	2.2

Source: The Authors.

Conclusions

• The qualification of the personnel, the technological development in the related thing to materials and processes of manufacture and the organizational modernization are three transverse strategies with major impact in the future of the industry of the plastic and the rubber, in agreement with the developed study using the Delphi methodology complemented with structural analysis. This information is highly relevant in order that the actors of the productive chain of the plastic and the rubber, and the sector leather

and footwear as users of this type of materials, evaluate in force its action plans and design the future ones. In the specific case of the entities which mission is the formation and the innovation, since it is the case of the SENA, this study contributes criteria in order that the strategies check nowadays used to seek to improve still mas the relevancy with the needs and trends of the productive environment of the plastic, the rubber, the footwear and the leather.

- The qualification of the personnel in aspects related to the materials and the manufacturing processes, as well as in management organizational into special emphasis in the modernization of the organizational structures incorporating the use of information and communication technologies, it appears as the strategy that would produce the major impact on the future of the plastic sector and rubber, since it includes all the factors located in the power zone.

- The factors of success most mentioned by the experts on having applied the Delphi methodology do not coincide with the identified ones with the structural analysis as the motility forces for the sector, which demonstrated the need to complement both technologies in order that the studies of futurology generate information of major relevancy. For the accomplishment of this type of studies, it is necessary that the persons in charge are extremely careful with the interpretation of the answers supplied by the experts when there is applied the methodology Delphi, provided that the structural analysis identified that different of the factors mentioned in the surveys actually they treat each other about the results that are expected to obtain on having implemented the strategies mentioned in other factors. The most relevant example is the competitiveness in price and quality, the factor most mentioned by the experts, but that actually is an effect of the implementation of the motility forces identified with the Delphi methodology and the structural analysis.

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