TECHNOLOGICAL RECONVERSION POTENTIAL OF LOCAL MANUFACTURING COMPANIES: ANALYSIS FROM THE PERSPECTIVE OF TECHNOLOGY MANAGEMENT AND INNOVATION

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Abstract

Guanajuato (Mexico) has attracted significant foreign investment in the automotive sector: the assembly plants of Mazda, Honda and GM, the VW engine plant, and supply companies for this industry; however, the local footwear industry, which is important as a source of employment generation, has been weakened. In this investigation we studied footwear supply companies: chemicals and plastics; textiles and synthetic fibres; hides and skins; lasts, heels and soles; components, accessories and fittings as well as machinery for footwear, and their potential for technological reconversion to become suppliers for other industries such as the automotive industry. The study is descriptive and cross-sectional, with a quantitative methodological strategy implemented through two methods: the linear probability model (LPM), and the logit model. According to the results, the reconversion potential of the footwear supply companies is medium (McFadden's R^2 = 0.716746 and a likelihood ratio of 71.61809 with a χ^2 distribution, three degrees of freedom and a p-value of zero).

Keywords: technology management, innovative capacity, technological reconversion, footwear supply companies.

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Introduction

It has been demonstrated that companies are currently facing problems that are caused largely by their environment, set up by factors that are not under their control but that do affect their behaviour and performance: market trends, technological advances, information and communication technologies, infrastructure, culture, the business environment, among other aspects that change with time.

The companies that comprise the footwear production chain are not exempt from this reality. In Mexico, this industry is made up of more than 7,398 footwear manufacturing companies, highly concentrated in only a few states; Guanajuato represents 68%, Jalisco 18%, Mexico City and its metropolitan area 13% and the rest of the Mexican Republic 1%. The industry annually produces around 248 million pairs of footwear products while domestic consumption is estimated at 285 million pairs. 18.7 million pairs are exported, 58.6 million pairs are imported (CICEG, 2011) and this generates approximately 275,000 jobs (INEGI, 2011).

This industry is in crisis; levels of competitiveness of the footwear manufacturing companies have not responded to the demands of the market. On the one hand, Asian products inhibit their participation in price competition and on the other hand, with respect to competitive differentiation, their participation is hindered by high added-value products in terms of quality and fashion: Italian products, for example.

Equally problematic is the fact that in Guanajuato, direct foreign investment has been prioritised in recent years as a strategy to promote economic growth in the region, which has attracted very large investments in the automotive industry. The automotive value chain has been driven by the assembly plants, with production processes that utilise advanced technology (Sturgeon et al., 2008), which should result in an increase in the technological level of the local suppliers.

The aim of this paper is to analyse the local footwear supply companies' potential for technological reconversion to become suppliers for other industries, due to their capacity for employment, among other reasons.

The local supply companies in Guanajuato are characterised by a marked heterogeneity and poor technological dynamism. Only 1.76% of them have a department of research, technological development and innovation (RD&I) and their sources of innovation are specialised magazines and fairs; it seems that there are few companies with potentially

innovative manufacturing processes. The hypothesis is based on the assertion that the footwear supply companies have a low to non-existent potential for the implementation of a technological reconversion process (Alvarez, 2010). The type of research employed in this study is descriptive and cross-sectional, and the method used was qualitative response regression analysis through two methods: the linear probability model (LPM) and the logit model.

This work is structured in four sections. The first outlines the theoretical stance that provides a foundation for the study. The second analyses the leather and footwear supply chain in Mexico, in order to construct the object of study. The third section presents the methodological strategy, and the fourth comprises the analysis and discussion of results, in order to close with some conclusions.

1. Innovation

Globalisation has encouraged competition between geographically distant regions for the provision of supplies to large corporate buyers that dominate the major consumer markets. This trend towards global supply has resulted in strong pressure on producers to improve their competitiveness with regard to innovation and technological levels, which depend heavily on the capacity of the companies' suppliers (Modi and Mabert, 2007).

When the capacities of their suppliers are deficient, corporate buyers have the following options: identify and select suppliers in other regions; evaluate and provide feedback to potential suppliers, waiting for the suppliers' initiative to improve their capacities, with the incentive of future purchases; implement training and support programs in order to improve the suppliers' performance; encourage innovation and the increase of their technological levels (Sánchez-Rodríguez et al., 2005). The latter is essential in order to increase value in the industrial chain.

In the analysis and comparison of the multiple definitions proposed for innovation, specificities in the definitions are apparent, but it is also identified as a common factor that innovation implies a new idea made reality and/or put into practice. Innovations are linked to inventions and discoveries applied to the improvement or emergence of solutions to human problems or those created in response to the expectations of society; they are discoveries and inventions that are applied to the creation of solutions to certain social problems or aspirations (Dussauge, 1992).

In this study innovation is defined as: "A process aimed at a market under a business approach that detects organisational opportunities and capacities for the generation of novel products, processes and services accepted by consumers" (IMNC, 2007); four dimensions of analysis are considered: organisation, systems and tools; resources for innovation; product design; and product development.

2. Technology Management

Technology is a social issue that involves and relates infrastructure to the human resources of an organisation. In this respect, technology management (TM) responds to the need to manage a social process that is driven, on the one hand, by the dynamism of the markets, and on the other, by the pressing need for management to specialise its functions towards the activities of research, technological development and innovation. In recent times, TM has become a differentiated field of knowledge in which science, engineering and administration coexist.

Lichtenthaler (2009) defines TM as a company's ability to make knowledge and information productive, linked to a set of specific technologies and the development of strategies. Puranam(2006) proposed that it consists of the effective use of technical knowledge and skills in order to improve products, processes and services, while at the same time improving existing technology and generating new knowledge and skills.

Lai and Shyu(2005) define it as a function of time, this being a key factor in TM, for the synchronisation of technological advances and capacities with the response offered by organisations to their environment. This makes TM a fundamental aspect of competitiveness, as it manages technological, material and financial resources as well as process efficiency: the level of quality, production speed and flexibility with regard to changes in the environment, among others.

A consensus on the definition of TM has not been reached, but it is agreed that it includes processes for the creation of new technology, research and technological development, adaptation of technologies created by third parties, and processes for technology transfer and use, among others (Lichtenthaler, 2009; Lai and Shyu, 2005; Orlikowski, 2000; Carroll, 2014; among others).

In Mexico, the National Model of Technology Management and Innovation is based on the premise that TM promotes organisational congruence and it provides a method for

technological development efforts and the integration of technologies; it comprises a series of five processes: monitoring, planning, enabling, protection and implementation (PNTI, 2013).

Gaynor (1996) proposed a systems approach to TM, in five phases: awareness, acquisition, adaptation, advancement and abandonment; he proposed technology forecasting, strategic focus, training, innovation and learning-understanding from the experience of success and failure as pillars of TM.

None of the models can be generalised; TM is multidimensional and diverse, with many interacting participants as sources of new ideas. In consideration of the foregoing, a systematic analysis of the implementation of the TM process in local manufacturing companies in Guanajuato is clearly indispensable.

3. Empirical Research

The social fact addressed by this study involves innovative activity and technology management in local manufacturing companies that supply the footwear industry in Guanajuato, Mexico; this supply comprises seven industrial activities: machinery and equipment for footwear; machinery and equipment for tanning; chemicals and plastics; hides and skins; synthetic materials and textiles; lasts, heels and soles; components, accessories and fittings. The object of study focuses on the effort and the business results of innovative activity and technology management. The central question of this study is: Is it viable for the footwear supply companies to become automotive industry suppliers through technological reconversion?

3.1. Footwear Supply Companies in Guanajuato, Mexico as the Object of Study.

In several parts of Mexico, the footwear industry is relevant to economic activity. According to INEGI (National Institute of Statistics and Geography, Spanish initials) statistics, the leather and footwear industry currently represents 0.22% of the nation's GDP, 1% of the GDP in the manufacturing sector and 13.7% in the division of textiles, clothing, and leather and footwear production. In Mexico, consumption per capita is 2.7 pairs per year. Further INEGI data indicate that 80% of the population uses some type of formal footwear. The remaining 20% uses other types of footwear such as sandals or shoes made of rubber, canvas and fabric. According to the economic census (2009) of this same institute, the Mexican footwear industry comprises more than 7,398 companies.

The production value of these companies as a whole is greater than 24.029 billion pesos. Of this amount, Guanajuato represents 68%, Jalisco 18%, Mexico City and its metropolitan area 13% and the rest of the Mexican Republic 1%. These establishments employed 112,727 workers, contributing 2.4% of the total employment in manufacturing industries. As to the gender of the employees in manufacturing industries, 65% are men and 35% women, whereas in the footwear industry, 61% men and 39% are women.

With regard to the size of the establishments, micro-enterprises in the footwear industry represented 78.5% of the companies, employing 19.0% of the personnel employed in this industry and generating 6.2% of the total gross output. By contrast, large companies represented 1.0% of the total companies, employed three out of ten people and generated almost 40% of the output.

With respect to the most important activities of the footwear industry, footwear manufacturing is highly concentrated in manufacturing with cutting of skins and hides, since this economic activity represented 73.3% of employed personnel and 78.0% of the output; this economic activity is followed in importance, as to the production generated, by the manufacturing of plastic footwear.

In this context of the footwear industry, now we shall discuss the footwear supply companies. According to data from the INEGI economic census (2009), at the national level there are 11,538 companies in the supply chain, distributed throughout the country. This chain employs 547,456 workers, which makes it one of the most important supply chains at the national level.

According to the INEGI (2011), the percentage of installed capacity utilised in the Guanajuato footwear cluster averages 66.2%. Specifically, micro-enterprises utilise 54%, small companies 57%, medium-sized 68% and large companies 86%. As this evidence shows, larger companies utilise their resources better. This also implies that there is a correlation between the size of a company and its ability to use more existing resources.

The large companies, in turn, offer technological assistance so that the small companies can develop the production capabilities necessary to comply with the requirements imposed thereon. This assistance is focused on the redistribution of production lines and the management of materials. According to Cruz (2013), despite the multiple benefits that the industry generates, in recent years there has been poor performance with regard to indicators of production, marketing and employment, factors that directly impact the competitiveness of the sector since

with regard to final demand private consumption is the main destination of the footwear products, accounting for 87% of total production, while exports represent 8 per cent.

Cruz (2013) also indicates that in terms of the distribution channels of the cluster, on average, 44% of production is distributed through wholesalers, 17% by retailers, 3% by companies vertically and the rest in department stores or other stores. The exchange rate is a critical point in the sector of the footwear industry, due to dependence with regard to certain types of vital inputs in the production chain such as leather, specialty finishes and chemical inputs. This aspect creates a high degree of vulnerability in the sector and limits the development of strategies for expansion and growth.

The entry of products from foreign markets, especially from Asian countries, has been the main problem in the Mexican footwear industry in recent years, because the product is cheaper for the domestic market, and this has become a threat to Mexican businesses due to the fact that much of the production in the country is for the domestic market (Cruz, 2013).

3.2. Methodological Strategy

The type of research conducted in this study is descriptive and cross-sectional. The method used is qualitative response regression analysis. This study seeks to explain innovative activity and technology management in local manufacturing companies that supply the footwear industry, in terms of the viability of their technological reconversion to become suppliers of other industries and in particular of the automotive industry as a potential economic activity in Guanajuato, Mexico; innovation and technology management are considered explanatory variables and the qualitative response variable is reconversion potential.

Technology management is a social process that refers to more than an organisation's infrastructure; it is a process in which the talents of people who comprise the organisation interact with its infrastructure and the static and dynamic knowledge that it implies (Bartel, 1965; Hatch, 1997; Mowery and Rosenberg, 1998; Elster, 1997; Orlikowski, 2000; Bontis, 2002; Carroll, 2014; among others). We quantified TM with the following indicators: the number of industrial property records registered in the previous three years; the number of R&D projects that generated new products or processes; the number of projects conducted in collaboration with Research Centres or Higher Education Institutions; the number of failed projects; % of projects, % of R&D expenses, % of projects cancelled after investing 50% or more of the value of the project; the number of overseas

projects involving technology transfer; the cost of technology acquisition divided by the fixed cost of manufacturing; and the cost-benefit ratio of completed R&D projects.

Reconversion potential is the ability of an organisation to achieve a multidimensional change: technological, organisational and social. There are different types of changes (Garratt, 1987; McGill, Slocum and Lei, 1992; Drew and Smith, 1995; among others), so it is appropriate to determine which type of change is promoted by the local manufacturing companies in Guanajuato. Reconversion potential aims to achieve a "first-order" change, which involves the incorporation of seemingly small changes associated with adjustments in the behaviour of the organisation (Garratt, 1987). But the transformation of the supply companies is possible only when they achieve a "second-order" change (Garratt, 1987), which, in the words of Miller and Friesen (1984 as cited by Garratt, 1987), is a revolutionary change characterised by radical changes in the interior of the participating companies.

Innovative capacity refers to the companies' ability to identify opportunities and capabilities for the generation of new products, processes and services that involve technology and are accepted by consumers; we quantified this variable by considering four categories: organisation, systems and tools; resources for innovation; product design; and product development. The instrument of measurement was built as an ordinal scale and then analysed as a proportion; on that basis the geometric mean was calculated.

The indicators for organisation, systems and tools were: the number of designers and engineers who use computer-aided design (CAD) as a work tool; the number of designers and engineers with training in design for manufacturing; the number of products in the CAD database or technical databases; the number of products manufactured with advanced product configuration systems; the number of products manufactured with statistical process control (SPC); the number of teams or projects that use robust design techniques: methods for the design of experiments, failure mode and effects analysis, value analysis, functional analysis, among others.

The indicators used in order to quantify resources for innovation were: the number of projects delayed or cancelled due to lack of human resources; the number of individuals in product development who perform more than one function; the number of projects delayed or cancelled due to lack of funding; R&D expenses for added value; and the number of persons devoted to R&D divided by the average number of total staff. For product design, the following

indicators were measured: the number of new product ideas and ideas for improvement of products evaluated the previous year; sales/profits from products introduced in the previous three years; sales/profits from products with significant improvements in the previous three years; the number of generations of products in the planning horizon; and market share percentage.

Product development was quantified by: the duration of the development period, from conception to launch as well as the duration of each phase (conception, design, prototyping, initial production, release); the coefficient of variation of the delay time; the percentage of projects that did not meet the planned commitment date; the coefficient of variation between product improvements or redesigns; product results, measured by the degree of satisfaction of new clients; process parameters, measured by the number of products in manufacturing and manufacturing times; the number of new processes or significant process improvements in the previous year; and the number of preventive and improvement actions proposed divided by the number of completed corrective actions.

The study population was the local footwear supply companies in Guanajuato. This study period for this investigation was from June 2012 to December 2013. The type of sampling done was random; from among the companies affiliated with the ANPIC (National Association of Footwear Industry Suppliers, Spanish initials), a sample of 74 companies was chosen, representing six of the seven industrial activities of the footwear supply companies (table 2). The measurement instrument was applied to individuals holding mid- and high-level positions in the study units and direct observation of a convenience sample was performed in order to compare and explain the phenomena observed.

Table 2. Composition of the sample

Sector	Ratio of economic units	Sampling distribution
Components, accessories and fittings	12%	9
Leather and hides	21%	25
Lasts, heels and soles	21%	15
Machinery and equipment shoes	14%	**5**
Machinery and equipment tanneries	2%	-
Chemical products	15%	14
Synthetic fibres and textiles	16%	**6**

Source: prepared by the authors.

Qualitative response regression analysis was used, since these are models in which the dependent variable is qualitative in nature; in this case it is a dichotomous variable - it takes the

value of one when it is determined that the company has the potential for technological reconversion to become a supplier for the automotive industry, and of zero when the company does not demonstrate such potential. The objective of this model is to determine the probability that the supply industry in Guanajuato industry could technologically reconvert in order to supply the automotive industry; two methods are tested: the linear probability model (LPM), and the logit model.

In this respect and now that the field work has been systematised, the analysis can begin, first with some descriptive statistics regarding the object of study and then with the qualitative response regression analysis, described in the following section.

4. Analysis and discussion of results

In the industrial activities studied, 75% of the jobs are concentrated in three activities (table 3): hides and skins; lasts, heels and soles; and synthetic fibres and textiles. However, in the proportion of economic units, these same activities, along with that of chemical products, represent 75%.

Table 3. Proportion of employment and economic units of the footwear supply companies

Sector	Ratio of employments	Ratio of economic units
Components, accessories and fittings	12.6%	12%
Leather and hides	21.9%	21%
Lasts, heels and soles	20.8%	21%
Machinery and equipment shoes	3.1%	14%
Machinery and equipment tanneries	0.2%	2%
Chemical products	9.8%	15%
Synthetic fibres and textiles	31.5%	16%

Source: prepared by the authors based on data obtained in fieldwork.

With regard to the qualities of companies that would facilitate the companies' technological reconversion processes, 21.4% of them are registered with the RENIECYT[2] (National Registry of Science and Technology Institutions and Companies, Spanish initials) (table 4), and the hides and skins companies are those that conduct the most scientific and technological activities (36.5% of the total number of certified companies). In 2011, 522

[2] The National Science and Technology Council accredits institutions and companies carrying out scientific and technological activities through a registry called RENIECYT, pursuant to Article 19 of the Law of Science and Technology. Article 42 of this law establishes that this registration is valid for three years, after which the organisation must update its information and apply for reaccreditation.

organisations from Guanajuato were registered, of which 379 were companies (Alvarez, 2012). As of February 2014, in the Integrated System for Information on Scientific Research, Technological Development and Innovation (SIICYT, Spanish initials) there were 321 Guanajuato's companies currently registered; the number of companies engaged in scientific and technological activities has decreased by 15%.

Table 4. Indicators of the technological reconversion potential of the supply companies

Sector	RENIECYT	Quality certification	Incorporation of IT
Components, accessories and fittings	0.8%	2.5%	7.0%
Leather and hides	7.8%	4.5%	11.5%
Lasts, heels and soles	3.3%	6.6%	8.6%
Machinery and equipment shoes	2.1%	2.5%	7.8%
Machinery and equipment tanneries	0.0%	0.0%	0.8%
Chemical products	4.1%	2.9%	10.3%
Synthetic fibres and textiles	3.3%	4.9%	12.3%

Source: prepared by the authors based on data obtained in fieldwork.

With respect to the quality of their processes, only 23.9% have obtained quality certification for their processes (table 4). Besides ISO 9000, the certification issued to the footwear supply companies is that of *Mexican Sourcing Quality*[3] (MSQ). ANPIC (2013) confirms that in the four years of operation of the MSQ certification, around 18,000 workers have been involved, and more than 2,200 of them have been trained in topics including quality, process optimisation, customer satisfaction and human resources through 17,000 hours of training courses.

With respect to the incorporation of information technology in the operation of its processes, 58.4% of the supply companies incorporate ICTs in the operation of their processes; chemical products, hides-skins and synthetics-textiles are the most dynamic in this respect (table 4). The companies commonly use their own developments, with which they control the production process, and for the operation of finance and distribution they use commercial administrative systems; usually they consolidate their information manually using spread sheets. Only 8.5% use *Enterprise Resource Planning* (ERP) platforms, but 100% of the companies have an internet connection, usually used for compliance with their fiscal obligations.

[3] This certification deals with human capital, multifunctionality, product planning and development, production scheduling and control, layout, the 5S program, engineering, cost management, commercial management and supply chain integration, among others.

In this context within which the footwear supply companies operate, we intend to determine the reconversion potential of the companies. In the calculation of the linear probability model, the simple model was used:

$$Y_i = \beta_1 + \beta_2 X_i + u_i$$

Where X = innovation and Y = 1 if it is determined that the company has the potential for reconversion and 0 if it does not. According to Gujarati (2010), since Y is dichotomous, $E(Yi|X_i)$ can be interpreted as the conditional probability that Y will occur given X; in other words, $P\ (Yi\ =\ 1\ |\ Xi)$ is the probability of technological reconversion given the company's innovative capacity. Based on the data collected and using EViews8SV[4], the following result was obtained: $\hat{Y} = -1.108085 + 9.877104X_{.i}$; the intercept of -1.108085 gives the probability that a company with zero capacity for innovation will have this reconversion potential. As this value is negative, the probability is almost zero, and the slope of 9.877104 indicates that the total innovative capacity increases the probability of technological reconversion by approximately ten per cent.

We shall also use $Y_i = \beta_1 + \beta_2 X_i + u_i$ for the regression analysis of technology management with reconversion potential, where X = technology management and Y = 1 if it is determined that the company has the potential for reconversion and 0 if it does not. According to Gujarati (2010), this function is expressed as $E(Yi|X_i) = \beta_1 + \beta_2 X_i + u_i = P_i$; that is, the conditional expectation of the model is interpreted as the conditional probability of Yi. Based on the data collected, the causal relationship between technology management and reconversion potential is expressed by: $\hat{Y} = -0.111842 + 7.291728X_i$. In this case, the intercept of -0.111842 indicates the probability that a company with zero technology management will have the potential for reconversion, and the slope of 7.291728 indicates that the probability of technological reconversion increases by approximately seven per cent with each TM action implemented.

Now, in consideration of the constraints of the linear model, we shall calculate the logit model, since we need a probability model that increases as $Xi, Pi\ =\ E(Y = 1|X)$ increases but that never goes outside the 0-1 interval and the relationship between Xi and Pi must be non-linear. In other words, "one which approaches zero at slower and slower rates as Xi gets small,

[4]EViews ® is a registered trademark of HIS Global Inc. This software is designed to perform statistical and econometric functions.

and approaches one at slower and slower rates as Xi gets very large" (Aldrich as cited in Gujarati, 2010).

In this case the logitmodel is expressed by: $L_i = ln\left(\frac{P_i}{1-P_i}\right) = \beta_1 + \beta_2 GT_i + \beta_3 CI_i + \beta 4NATi + ui$. The model was estimated in Eviews8SV using the maximum likelihood method; convergence was achieved after six iterations and the covariance matrix was calculated with second derivatives. We obtained a McFadden's R^2 of 0.716746, a likelihood ratio of 71.61809 with a χ^2 distribution, three degrees of freedom and a p-value of zero. From the logit model calculated, the following can be inferred:

1. The relationship between technology management and reconversion potential is positive, since a β_1 of 22.94102 indicates that while the other variables remain constant, if the TM is increased by one unit, on average the estimated logit increases by approximately 23 points;
2. The antilogarithm β_1 indicates that a company that manages its technology is exponentially more likely to have potential for reconversion;
3. The antilogarithm of $\beta_2 = -24.33067$ indicates that a company that has innovative capacity does not necessarily have reconversion potential;
4. There is a 61.52% probability that the reconversion potential will increase for each technology management action implemented (antilogarithm of $\beta_3 = 4.119440$).

The empirical evidence also reflects several cases of success in the sample companies, which have achieved technological reconversion of their production lines and supply the footwear industry while at the same time supplying other industries such as the automotive industry. Table 5 lists some examples of reconverted processes.

It can be inferred that technology management processes depend on the size of the organisation, the number of information flows, the economic activity of the company as well as the workforce's involvement with and commitment to the organisation and vice versa. This involvement and commitment is indicated in both directions because technology management also generates changes in both directions. They occur in the companies with the use of new technologies which leads to changes in the workforce, even in the case of technology acquisition. This coincides with Etzkowitz (2010), who emphasised that technology management is the

process of implication and operation of decisions on policies, strategies, plans and actions related to the generation, production, dissemination and use of technology.

Table 5. Technological reconversion of industrial processes in footwear supply companies, some examples

Previous production line	New production line, after the technological reconversion process
Leather for footwear or leather goods	Leather for automobiles
	New composite materials made from leather fibre and biopolymers
Bonded leather	Furniture and accessories
Lasts	Roadway signage
Leather cutting dies for the manufacture of footwear and leather goods	Specialized parts for tier 3 companies (die-cutting, cast parts, among others) in the automotive industry
Soles	Specific gaskets for automotive engines
Machinery for footwear	Systems for automated visual inspection, with application in various industries that manufacture small objects
Adhesives for footwear manufacturing	Components for cosmetics
	Adhesives and paints for the glass industry
Textiles, labels and elastics	Belts and bands used for strapping, transporting and moving containers
	Seat belts for automobiles
Interfacings and linings for footwear	Non-woven backings, thermal and acoustic insulating materials for the supply of tier 2 and tier 3 companies in the automotive industry

Source: prepared by the authors based on data obtained in fieldwork.

Conclusion

The potential for technological reconversion of the local manufacturing companies that supply the footwear industry is medium and the initial hypothesis is rejected, since there are several ways in which the footwear supply companies can produce an innovation in the market, this innovation usually being incremental.

The heterogeneity in the operation of the activities studied is notable; there are significant differences within the business sector, as well as within the organisations studied. It appears that this may result in distinct processes of socialisation, directly affecting the companies' innovative capacities.

The economic inertia of Guanajuato underscores the importance of companies' innovation potential and technological reconversion for the improvement of their economic, social and environmental integration; with the current economic crisis and technological revolution, there has arisen a need to define a new model of development that involves enhancing the innovative capacity and potential for technological reconversion of companies and

institutions; where the capital of the region will be differentiated according to the companies' and institutions' knowledge, technology and innovation, which will allow them to strengthen their comparative advantages and define other competitive advantages.

Innovation operates as an active participant in the model of technology management in Guanajuato, and encourages in local companies the creation of value in their innovation systems and the implementation of mechanisms to strengthen the organisations in their environment, thus allowing for an evolution from innovative companies to an innovative region. Alvarez (2012) indicates that the process of innovation has a functional relationship and a degree of correlation with the region/sector of influence, which has been corroborated by this study. The study continues and will continue to contribute to the complex task of studying technology management in local manufacturing companies; one possibility for the continuation of this study is to explain the behaviour of technological reconversion using a cumulative distribution function based on the theory of utility[5] -rational selection based on behaviour- (Gujarati, 2010).

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[5]Model developed by McFadden.

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