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Innovation components for the internationalization of the TIF meat companies in Mexico

Componentes de la Innovación para la internacionalización de empresas cárnicas TIF de México

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Resumen

Existe una preocupación en el sector privado y público debido a que muchas PYMES no tienen las capacidades para competir en mercados globales, bajo este contexto la innovación en las empresas puede ser un catalizador para lograr la competitividad y extender los horizontes a nuevos mercados. El objetivo de esta investigación es encontrar los componentes y factores más relevantes de la innovación que le permita a las Pymes cárnicas TIF lograr competir en mercados internacionales, estas demostraciones se hicieron mediante una técnica cuantitativa. Los factores que encontramos con mayor peso provienen de estas variables: 1) innovación tecnológica, 2) la cooperación en innovación y 3) la innovación de productos de valor agregado.

Se concluye que, en primer lugar, se eliminan 3 de 8 componentes que se proponen por representar bajos niveles de relación; en segundo lugar, se concluye que los componentes principales de la innovación para lograr competir en mercados globales son: para el factor uno: la adquisición de tecnologías de punta, la colaboración entre empresas para innovar en productos y la innovación de

productos exportables. Para el factor 2, los componentes principales fueron la adquisición de maquinaria y la adquisición de software.
Los materiales y métodos de trabajo para cumplir el objetivo fue el Análisis de Componentes Principales (PCA) que en esencia es una técnica de carácter correlacional y exploratorio que nos ayudan a discernir cuales son los factores con mayor peso dentro de un conjunto de variables con un soporte teórico, se encuestaron a 99 expertos de la industria en territorio mexicano (gerentes y empresarios de diferentes compañías), lo cual representa un 21.3% del total de empresas cárnicas TIF a nivel nacional, se usaron escalas Likert para las mediciones.

Palabras clave: Componentes principales, industria cárnica mexicana, innovación de empresas, internacionalización de la firma, tecnología.

Abstract

There is concern in the private and public sector because many SMEs do not have the capabilities to compete in global markets. In this context, innovation in companies can be a catalyst to achieve competitiveness and extend horizons to new markets. The objective of this research is to find the most relevant components and factors of innovation that allow TIF meat SMEs to compete in international markets, these demonstrations were made using a quantitative technique. The most important factors & components come from these variables: 1) technological innovation, 2) cooperation in innovation, and 3) innovation of added-value products.
It is concluded that, firstly, we eliminate 3 of 8 components that are proposed because they represent low levels of relationship; Secondly, it is concluded that the main components of innovation to compete in global markets are: for factor one: the acquisition of cutting-edge technologies, collaboration between companies to innovate in products & the innovation of exportable products. For factor 2, the main components were the acquisition of machinery and the acquisition of software.
The materials and methods to meet the objective was the Principal Component Analysis (PCA), which is essentially a technique of a correlational and exploratory nature that assist us to discern which are the factors with the greatest weight within a set of variables with a theoretical support, we surveyed 99 industry experts in Mexican territory (managers and businessmen from different companies), which represents 21.3% of the total TIF meat companies nationwide, also Likert scales were used for measurements.

Keywords: Enterprise innovation, firm's internationalization, Mexican meat industry, principal component analysis, technology.

1. Introduction

Innovation is a key element that every organization must carry out for continuous improvement and thus achieve competitive advantages that endure over time. In the case of Mexico, innovation is not yet relevant, nor is it carried out constantly, for example in the research made by García-Alcaraz et al (2016) they comment that “maquiladoras”

companies in that country are characterized by having sophisticated and complex production processes, which make them specialists in the manufacture of certain products. However, when they need to use these established production capacities to generate new products, their main problem is that they do not have sufficient knowledge of the market for these new products, since the parent company traditionally establishes the production orders and is their main customer and they have a deep dependency.

On the other hand, the internationalization of companies is nothing more than reaching new global markets thanks to an adequate management of the company. According to Szymon & Ruigrok (2013) the degree to which interactions occur outside the country. Depth is measured by financial indicators, which include foreign sales versus total sales, foreign assets versus total assets, and employees in foreign locations.

Thinking about the word innovation, this can be somewhat ambiguous and very general, something that has too many meanings and depends on the context in which it is spoken, for the case of business and industry, here are some concepts accepted by various theorists.

In the Oslo Manual (2018), innovation is defined as follows:
"An innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and has been made available to potential users (product) or put into use by the unit (process)".

They also define process innovation as: “a new or improved business process for one or more business functions that differs significantly from the firm’s previous business processes and that has been brought into use by the firm” (Oslo Manual, 2018).

For example, the company might expect new or improved features of a product (or business process) to increase utility for users or to increase its own competitive position in the local or global markets.

Mejía et al. (2013) comment that innovation is the main key to the development of companies and nations. Likewise, Ceceña (2013) says that large local companies must adapt their processes to maintain constant innovation to remain competitive in international markets.

While the authors Schiefer and Hartmann (2008) refer to the leader and follower in an industry, they say that in product development organizations can follow two different objectives. First, they may aim to achieve the position of technological leader, developing products with a high level of innovation. Second, they can seek to have a high proportion of innovative products in their product portfolio, without worrying about the novelty of these developments. The relevance of both strategies for performance will be tested.

Furthermore, the objective of this paper is to determine the main factors and components that are relevant and have “high loadings” for innovation in TIF (Federal Inspection Type) meat companies, this companies are SMEs trying to make business under the international framework. The TIF distinction means that these are companies have a SENASICA (National Health, Safety and Quality Service) certification that allows them to export products, based on a survey conducted with industry executives and managers.

2. Theoretical support

It is worth mentioning that we are looking for the innovation factors and components that have the greatest load weight in the

internationalization of Mexican TIF meat companies. Therefore, the classic I-M theoretical model of innovation for internationalization is suitable for this research. This model was initially proposed by classics such as (Rogers, 1962; Adersen, 1993; Bilkey & Teaser, 1977; Cavusgil, 1980; Reid, 1981) in this theoretical model it is explained that each step of exporting is considered an innovation. They also lead to the process of knowledge acquisition, not only in the stage of entering a foreign market. The beginning of internationalization is the acquisition of knowledge to introduce innovations and new developments related to management.

Now that the basic theory of innovation for companies has been explained, we will now comment on the dimensions of the innovation variable and its initial factors. It is relevant to point out that the initial factors that appear on the right side of figure 1, basically are the Likert scale questions (for example, we always do it - we have never done it) that were asked to the executives and managers of the industry.

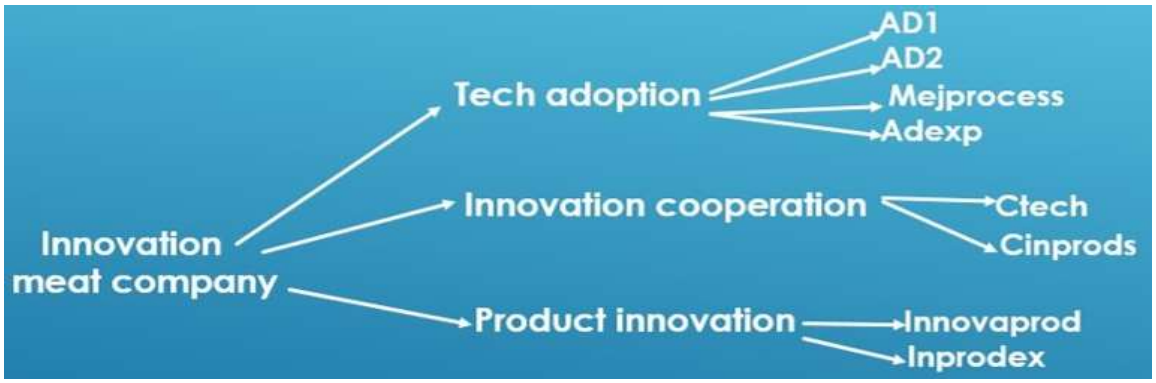

Figure 1. Classification of the innovation variable for the internationalization of Mexican TIF companies.

Likewise, starting with the "Technology Adoption" dimension and its initial components described below:

- AD1. Adoption of machinery.
- AD2. Adoption of software.
- MEJPROCESS. Process improvement derived from technology acquisitions.
- ADEXP - Adoption of state-of-the-art technology.

These initial components or factors of technology adoption find their theoretical support in several indicators proposed by the Oslo Manual (2018).

Table 1. Classification of innovation indicators proposed in the Oslo Manual.

Topic in general	Indicator
Collaboration of companies	Collaboration participation of companies that collaborated with other parties on innovation activities (by type of partner or location of partner)
Product and business process innovations.	Participation of companies with innovations in products and business processes.
Advanced use of technology	Percentage of companies in the industry using advanced, enabling or emerging technologies.
Digital platforms	Percentage of businesses using digital platforms to sell or buy goods or services.

Source: Own elaboration based on Oslo Manual (2018)[1].

However, these "indicators" do not have a mathematical foundation where any empirical quantitative technique has been used.

On the other hand, Barreiro (2012) clarify that innovation and technology are essential for the development and growth of companies, which presupposes an extremely challenging aspect in cases such as product safety, sensory aspects, consumer confidence or price. Barreiro (2012) also made a distinction between the investments made by European meat companies in some of the items they consider to be innovations in the meat sector and consider the acquisition of technology as an innovation. Several of the investments made by European companies such as "acquisition of machinery, hardware and software, acquisition of external R&D (research and development)" are the same as the components of Likert scales that were carried out with the survey carried out for businessmen and managers of the meat industry of SMEs & TIF companies in Mexico.

Figure 2 & 3. R+ d investment in European meat companies. From Cruz & Barreiro (2012)[2 & 3].

As we realize, several of the investments made by European companies such as "acquisition of machinery, hardware and software, acquisition of external R&D" is the same as the Likert scale components that were carried out with the survey that was carried out for businessmen and executives of the meat industry of TIF & SMEs companies in Mexico.

Digitalization in companies is imperative to be more competitive (software acquisition) it is now used to gather data on innovation outside of the business sector. This can assist companies to reduce responder burden by using identification technology in conjunction with the resources already in place, for as by identifying the most crucial business partner (supply or customer), secondly, to obtaining statistical information on innovation and company traits (Oslo Manual, 2018).

While a classical theorist such as Barney (1991) emphasizes that resources should be characterized as "valuable resources". They become valuable when they allow a company to conceive or implement strategies that improve its efficiency and effectiveness, such as internationalization.

The adoption of technology such as specialized machinery or software can be elements that are characterized as valuable resources for the organization and that generate a competitive advantage. The fact of acquiring such technologies implies that the company is innovating in adjusting its operational processes, such innovations can lead to advantages to compete in the market that ultimately result in the internationalization of firms.

On the other hand, in the innovation dimension called "Collaboration in innovation" we basically find questions (initial components or factors) that were asked to entrepreneurs and managers with an orientation to know if they cooperate with other companies in order to carry out joint investments such as technology acquisitions and joint support to innovate in the creation of value-added products that meet the needs of customers and consumers.

They are classified as follows:

- CTECH. Collaboration of meat companies to acquire machinery and software.
- CINPRODS. Collaboration of meat companies to innovate in added-value products.

These initial components have their theoretical support in the Oslo Manual, they explain that collaboration is the participation of companies that collaborated with other parties on innovation activities (by type of partner or location of partner) (Oslo manual, 2018).

Additionally, Sereia et al (2015) highlights that companies aiming to meet the knowledge requirements necessary for the development of new products and processes and follow the consumer trend to implement cooperative arrangements, such as strategic alliances, in such a way as to gain access to technology where it is available, no single company can, in isolation, develop all the competencies for the development of innovative products and processes.

Likewise, one more finding by authors Brown & Guzmán (2014) suggests the need to promote a culture of cooperation between companies, and from companies to universities and development centers, since unfortunately and tentatively there is a lack of cooperation to innovate between companies, which could be a determining factor for internationalization.

Furthermore, Oslo Manual (2018) considers that a typical product innovation must have these features:

"New designs or improved design features can influence the appearance or "look" of a product and consequently enhance the user's utility, for instance through a substantial design change that creates a positive emotional response".

On the other hand, the dimension called "Product Innovation" is, as its name implies, individual, without the need for collaboration between companies, which assumes that if companies innovate, they can compete in new global markets.

This dimension of innovation is composed of the following initial factors-components:

- INNOVAPROD. Innovation of meat products
- INPRODEXP. Innovation of exportable added-value products.

In the Oslo Manual (2018) product innovation is considered as matter of fact recommended to create indicators with the following characteristics.

Table 2. Indicators of product innovation in companies.

Topic in general	Indicator
Product innovation / value-added products	Participation of innovative products in companies with one or more types of product innovation.
Product innovations in local and global markets	Proportion of companies with one or more product innovations (may also focus on international product innovations).
Product innovation development method	Share of companies with one or more types of product innovations that developed these innovations through imitation, adaptation, collaboration or entirely in-house.

Own elaboration based on Oslo Manual (2018) [1].

We start from the assumption, as in the other dimensions of innovation, that if product innovation is achieved, export capabilities are greater and therefore this leads us to reach global markets. Value-added products also help with this.

It is also important to note that value-added meats include marinated cuts, cooked ribs, kebabs, corned beef and fresh burgers, as well as shaved steak for use in tacos, fajitas, stir-fries and sandwiches (Mitchel, 2019).

Kondaiah (2004) comments that some of the purposes of value-added meat processing are: To increase demand and marketing, as well as to meet the daily needs of consumers, to combine and complement different types of meat with a comparative advantage as well as to produce value-added foods for a greater diversity and portfolio of products.

3. Experimental methods

3.1 Research question

What are the principal components of the innovation variable in Mexican SMEs & TIF meat companies?

3.2 Materials

In Mexico there are currently 463 meat producing companies with the TIF distinction; this distinction means that they are relatively important companies. Furthermore, an e-mail was sent with the survey and we request support from SENASICA (National Service of Health, Safety and Agrifood Quality) so that the managers-owners of the companies could respond; the survey was sent electronically in the year 2021 and SENASICA was the institution who distributed it through a link in Google Forms format; Of the total number of companies, only 99 responded, that is, 21% of the TIF meat companies in Mexico. These data were used to run the PCA and make conclusions.

The objective of the survey was to understand the managers and/or company owner's point of views on what items and/or factors may be related to innovation within their network & towards the final consumer, based on their experience and based on a series of Likert scales used in the survey.

3.3 Explanation of the quatitative technique (PCA)

The principal component analysis will help us to reduce the dimensionality of the innovation variable in order to find the principal component & factors of this variable, which can be a combination of various components, thus summarizing our analysis to determine which are the most important ones that can help Mexican meat companies to achieve internationalization. Additionally, we point out that all the proposed factors and components of the innovation variable have been supported by the theoretical framework of this study.

Otherwise, Jolliffe & Cadima (2016) comment that principal component analysis (PCA) is a technique for reducing the dimensionality of such data sets, increasing interoperability but at the same time minimizing information loss. It does this by creating new uncorrelated factors that successively maximize variance. Finding these new factors, the principal components, boils down to solving an eigenvalue/eigenvector problem, and the new variables are defined by the data set in question, not a priori, making PCA an adaptive data analysis technique.

The standard context for PCA as an exploratory data analysis tool involves a data set with observations on numerical variable-items, for each of the entities or individuals. These data values define dimensional vectors X1,..., XP or, equivalently, a data matrix whose JTH column is the XJ Vector of observations on the JTH variable (Jolliffe & Cadima, 2016).

Ringnér (2008) points out that by using a few components, each sample can be represented by relatively few numbers instead of values for thousands of variables. The samples can then be plotted, which allows one to visually assess the similarities and differences between samples and to determine whether the samples can be grouped together.

3.4 PCA implementation

It is worth mentioning that the measurement is based on Likert scales for each of these initial component-factors; these scales come from the survey sent to businessmen-managers of SMEs & TIF meat companies in Mexico, therefore our results are based on this people experience and opinion. The Likert scale that we proposed has some little changes in every question but overall, it was as follows: a) we never do; b) we seldom do; c) we sometimes do; d) we often do, e) we always do.

It is worth reminding the reader that each question is an item, therefore the 8 items of the innovation could be reduced to 2 or 3 factors-components, depending on what this technique explains us and thus simplify the analysis.

The steps for obtaining the factors & components are explained below:

1. Moreover, we wanted to know the feasibility to perform the PCA, thus we executed the KMO tests (Keiser-Meyer-Olkin) and the P-Value, for this purpose we take the results of the survey of Likert scales with values ranging from 1 to 5; the sample was 99 companies that responded to the survey, the software used to run this quantitative technique was STATA.

The KMO test is 0.78 and the P-value is 0.00. The KMO test being greater than 0.5 means that it is acceptable to proceed with the PCA, also the P-value is statistically significant, likewise the variables are not correlated so we proceed to run the PCA.

2. Now we run the *pca* command with the corresponding items to undestand the amount of principal components, the image is shown.

Table 3. PCA results and Eigenvalue greater than 1.

Component	Eigenvalue	No. of observations
Comp 1	3.69	99
Comp 2	1.29	99

Source: Own elaboration based on STATA results.

In the table 3, we can see the vectors and the values of the components (8 items), what matters most to us here is that there are only 2 components with a value (Eigenvalue) above 1, we now know that of the 8 items we proposed, it will reduce them to only 2 factors.

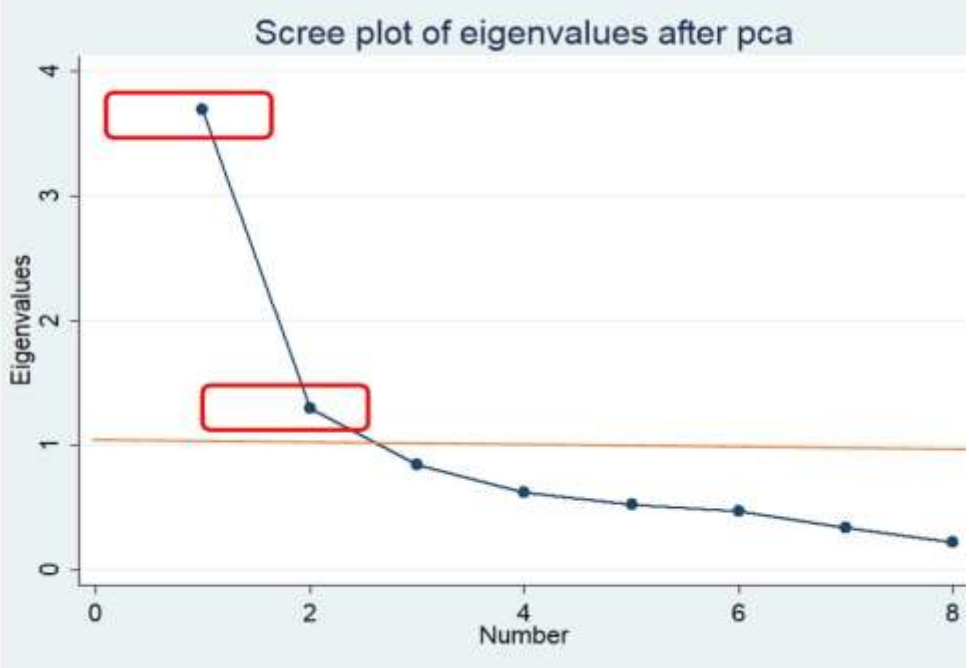

Figure 4. Eigenvalue graphic, values above 1. Extracted from STATA software.

3. Now, we are going to determine the rotated factor loadings with the Varimax method, with this we will be able to know which are the most important components that load more on each of these two factors on the innovation variable. The factors rotated with Varimax are a method of orthogonal rotation to reduce dimensionality within a 90-degree angle, that is, it is a simplification of the factors.

Table 4. Rotation of factors with varimax method.

Component	Factor 1	Factor 2
Ad1	0.30	0.80
Ad 2	-0.06	0.85
Bestprocesses	0.41	0.69
Adexp	0.75	0.23
Ctech	0.60	0.41
Cinprods	0.77	0.11
Innovaprods	0.54	0.06
Inprodexp	0.87	0.13

Source: Own elaboration based on STATA software.

Now we can see that factor 1 is mostly loaded by: *Adexp*, *Inprodexp*, *Cinprods*, and the factor 2 is mostly loaded by *Ad2*, *Ad1;* thus, reducing these 8 items to these 2 factors. This reduction makes sense according to the structure and wording of the questions asked to the company managers. Those components have a high correlation with innovation, it is also observed the amount of factor loadings. In the next graph there is a different approach for a better explanation.

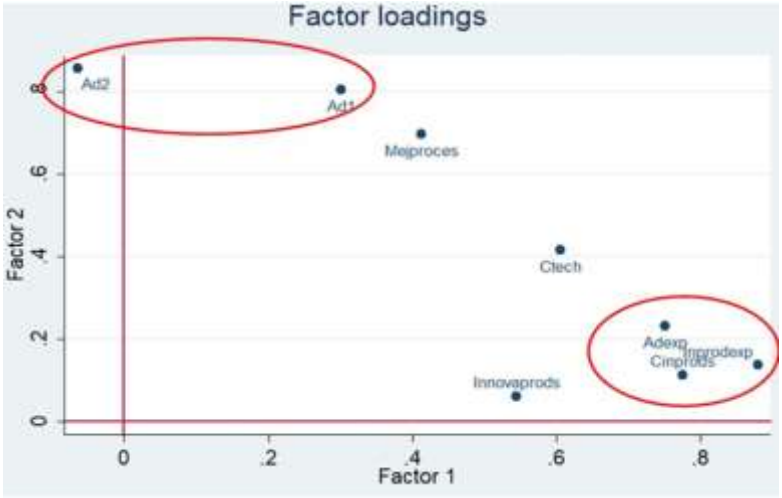

Figure 5. Graph of the rotated factors. Extracted from STATA software.

4. Discussion

Now that this principal component analysis has been run, we have arrived at some interesting results and can answer the research question. It can be seen that of the 8 initial components, five are relevant to innovation and three are irrelevant, so it is suggested to omit these 3 components (*ctech, innovaprods, mejprocess*) for future research in this sector.

But why these 3 components were irrelevant for innovation?

Mejprocess improvement derived from technology acquisitions. The reality is that the improvement of a process such as productive, innovative, or commercial, brings with it support for the acquisition of technologies, that is, by itself, changing a process does not imply a great change.

To implement an improvement in the production process, technology is first needed, such as machinery that helps meat producers develop new value-added products such as marinated meats, shredded meat, food seasoning or baked chicken wings, all of which implies the acquisition of cutting machines, seasoning machines, and special ovens to bring the meat to a certain temperature.

To implement an improvement in the business process, you could access data analytics technologies such as Power B.I to learn about customers, competitors, and characteristics such as prices and sales volumes, as well as software technologies such as CRM to track leads. sales, provide post-sale service or even to prospect new customers.

On the other hand, the *Innovaprods* item only implies innovating in meat products, this item is similar to what we explained previously, firms cannot just innovate but there are other elements that could be attractive for customers and consumers that help to export the products, that is why *inprodexp* was a component with high weight at the time of running this quantitative technique because it implies further elements such as innovation in value-added products, innovating not only in the product but also that the packaging, logo and branding must be attractive to customers or consumers of the foreign market to buy the products; thus it implies marketing strategies for an effective commercialization.

Otherwise, due to figure 5 we can infer that the components *Adexp, Inprodexp and Cinp*rods generate a new factor that could be called "product innovation that includes a framework of business cooperation and acquisition of cutting-edge technology", while in the second factor we find the components *ad1* and *ad2* with very significant loadings, so this new factor is created and we can name it "acquisition of machinery and software for the achievement of internationalization".

Why is the acquisition of technology *(ad1, ad2, adexp)* and cutting-edge technology related to innovation?

As previously mentioned, for an SME to obtain a competitive advantage of international hierarchy, processes must be optimized, this occurs through the acquisition of machinery or software. The new machinery is affordable for international meat clients because when they review the processes of their suppliers, they would have certainty that they are going to receive quality products and a service that generates a greater bond of trust.

In such a way that the internationalization can be associated with innovation and this also has a close relationship with the I-M models previously cited (Rogers, 1962; Adersen, 1993; Bilkey & Teaser, 1977; Cavusgil, 1980; Reid, 1981), who mention several steps for internationalization with an innovation approach, although it is worth mentioning that they do not consider the acquisition of technology.

The collaboration of companies to carry out a better integration in the supply chain is very relevant, this type of integration comes from the classic theories of “Marshall's industrial

districts". In this case, the collaboration of meat companies to innovate in added-value products (*cinpords)* has a good relationship with innovation according to our results. Working as a team to create products together, combining knowledge, technologies and efforts is something that apparently can lead meat companies in Mexico to innovate in order to internationalize.

5. Conclusions

This was an analysis to detect the main factors of innovation that would eventually help SMEs companies to compete in foreign markets, especially those companies that have certain capabilities or minimum requirements to be able to export (TIF companies).

Our results have similarity with the results of other studies in the innovation variable, where technology adoption is contemplated within the study done by Galati et al (2016) where they comment that Italian food companies used to adopt mainly two implementation strategies, reminiscent of the traditional market pull and technology push innovation strategies, which they re-categorize as Push to technology and Pull innovation strategies to attract customers. For example, they consider certain characteristics of product innovation, process, acquisition/exploitation of scientific knowledge, high costs for innovation, among others.

Although our research has similar results for this food sector, there are some differences because we specify that the acquisition of machinery & cutting-edge tech is a valuable resource to increase quality, productivity, and safety, as well as software that helps us to have a better management of the company and share information in real time with customers & to create a competitive service strategy.

Furthermore, the PCA results has likeness with Saguy et al (2018), they projected a significant difference in addressing innovation, soft skills (skills associated with communication according to Food Science and Technology) which was also revealed by the employability of such technologies between the educational geographic region of North America, Canada and the others, especially Europe. The findings offer new insights into the need to re-evaluate curricula and the perceived importance of innovation, research, technology utilization and impact. In our research we did not consider any of these elements for innovation, however they open another range of possibilities that we did not have in mind to consider some of these relationships also in future research.

Likewise, our results will be useful for the Mexican meat industry, specifically for executives, company CEOs & managers in the export or innovation area to make better decisions and strategies when deciding to compete in international markets. Knowing that the acquisition of technology would help improve your internal processes in order to be more effective, of course this could be done with adequate employee's technologies training.

These results also contribute to the area of knowledge of international business management. A contribution to knowledge is made for future research and the door is opened for other researchers to take our results as a reference in this important industry.

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