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ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/oabm20

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To cite this article: Hamilton Pozo , Getulio Kazue Akabane & Takeshy Tachizava | (2019) Innovation and technology processes in micro and small business, Cogent Business & Management, 6:1, 1588088, DOI: 10.1080/23311975.2019.1588088

To link to this article: https://doi.org/10.1080/23311975.2019.1588088

Published online: 21 Mar 2019.

Pozo et al., *Cogent Business & Management* (2019), 6: 1588088
https://doi.org/10.1080/23311975.2019.1588088

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OPERATIONS, INFORMATION & TECHNOLOGY | RESEARCH ARTICLE

Innovation and technology processes in micro and small business

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Received: 01 November 2018
Accepted: 24 February 2019
First Published: 19 March 2019

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Reviewing editor:
Lorenzo Ardito, Politecnico di Bari, Italy

Additional information is available at the end of the article

Abstract: The purpose was to analyze innovation in a micro and small business (MSB) metallic frames manufacturing process located in the Campinas Metropolitan Region. Based on the collected primary data of its productive processes was to analyze the innovation and applied technology in the context of a sustainable productive chain. Thus, in the methodological approach, a data collection instrument was an interview script in 81 MSB targeted on multiple case studies (structured interviews and data collection available on the website). The managers and professionals and internal accounting and third-party accounting office were studied. The proposed research method was a qualitative approach. As a result, a diagnosis of innovation in the production process was obtained in a context of corporate sustainability through innovation indicators as well as conclusions regarding the subject, compared under MSB general law even low of reverse logistics, labor outsourcing legislation and the law of innovation and technology. As the final proposal was suggested an

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PUBLIC INTEREST STATEMENT

Manufacturing industry would be interested to examine the critical success factors of project performance to avoid cost overruns and productivity gains based on the collected primary data of productive processes for the innovation and applied technology in the context of a sustainable productive chain. The main novelty in this paper is innovation in micro and small business with applied technology in a context of sustainable productive chain strategies when applying in manufacture system combining with strategies. The managers and professionals and internal accounting and third-party accounting office were studied. The utilization of the presented process could have the advantages of competitive and acceptability in manufacturing process.

implementation of a central technical support and supply of common components for all regional frames" manufacturers.

Subjects: Social Sciences; Operation process; Management; small business

Keywords: innovation in process; small business; accounting; indicators

1. Introduction

According to SEBRAE (2017), micro and small business (MSB) have considerable relevance in the socioeconomic scenario of Brazil, since they function as an element of social promotion and act as drivers of social development.

According to the Organization for Economic Co-operation and Development (OECD, 2005), innovation is the development or acquisition of new products or services whose perspectives are: process, forms of organizations of products and services. According to Schumpeter (1934), innovation is an indispensable determinant for the socioeconomic development of a country. The perspective he proposes is attributed to the figure of the entrepreneur, who has all the responsibility and power for change and economic progress to occur through innovation. The latter, in turn, is defined as the creation and/or development of something new, a phenomenon that can be applied to: a product or significant improvement in a product, a new production method, opening a new market, a new source of supply, and adoption of a new form of organization, among others.

When we understand that only part of the innovation process can differentiate a company, then the behaviors we use in MSB management are also likely to be only partially useful, even if well intended and executed. For example, innovation is often confused with invention, howeverinvention is only the first step in a long way to bring a good idea to spread innovation.

The innovation concept can create confusion with other similar definitions, such as improvement, invention and discovery, because, according to Schumpeter (op. cit.) innovation is the launching of a new product or improvement of what already exists, or the introduction of a new method of production, i.e. innovation in the process, the opening up of a new market, a new source of raw materials or semi-manufactured goods, and a new form of industrial organization. According to Schumpeter (op. cit.), Innovation is the main factor that drives the world, when it affirms that “destructive creation” focuses on the constant change occurring through products that destroy, by obsolescence, the product that existed since the current product responds more effectively or economically to the same function as the previous one, and in this sense emphasizes that competition does not occur by focusing only on the sales price of manufactured products—to gain competitiveness—but also for innovation.

Innovation is now recognized as the key to bridging the gap between technology and business strategy. In response to this, a research project was established seeking to examine the current conceptual understanding of innovation and establish patterns, if any, that might exist in the management practice of innovation across business organizations.

One of the problems in managing innovation is people’s understanding of the term, which most people confuse with invention. In its broadest sense, the term comes from the Latin—*innovare*—which means “to do something new”. Opinion, shared by researchers and writers, as some of the following reports show, that innovation is a process of turning opportunities into new ideas and putting them into widely used practices for business success. Some important relations for the understanding of this position:

> *... Industrial innovation includes the technical, design, manufacturing, management and commercial activities involved in the marketing of a new (or improved) product or the first commercial use of a new (or improved) process or equipment*. Freeman (1982),

> *... Innovation is the specific tool of entrepreneurs, the means by which they exploit change as an opportunity for a different business or service. It is capable of being presented as a discipline, capable of being learned, capable of being practiced.* Drucker (1985),

> *... Innovation does not necessarily imply the commercialization of only a major advance in the technological state of the art (a radical innovation) but it includes also the utilization of even small-scale changes in technological knowhow (an improvement or incremental innovation)*, Rothwell and Gardiner (1985).

Additionally, the development of enterprise innovation abilities is influenced by the particulars of the industry and sector, where the company operates and external factors including national conditions [e.g. legal regulations related to innovation support activities] and region-specific conditions [e.g. legal, culture, economic and technical factors].

The result of a panel discussion is that it is important for corporate architects to start thinking like business people who know about technology and innovation. That to be relevant, we need to bridge the gap between the technology and the strategic objectives and priorities of the MSBs in which they are involved. Bridging this gap between a technological mindset and strategic business thinking may not be as "commonsense" and direct as it seems. For example, technology thinkers may come to the conclusion that a given technology system within the organization is malfunctioning and costing the organization in time and lost profits. The first step is to understand the strategic objectives of your organization and to offer technological solutions directly related to obtaining these business benefits. This includes, for example, dealing with:

- Where the company is in its life cycle—seed, start-up, growth, established, expansion, maturity, decline;
- The nature of the business—adaptive, responsive, technical, etc.
- Terminology and business fundamentals, such as the difference between revenue and margins;
- Exactly how the company makes money and what the real needs of customers are;
- Business objectives and results-based budgeting;
- The current environment in which the company is operating, for example, political, economic, social, environmental ...

Effective innovation does not depend, however, on the small business' external environment and the opportunities it may present. As with the innovation framework outlined in this paper, researchers have identified a need for both external awareness and internal capability.

The present study deals with innovation in the manufacturing process of window frames in the Campinas Metropolitan Region (Brazil). As a goal, therefore, we will diagnose innovation activities in processes at the micro and small enterprises of window frames in Campinas (SP/BR).

2. Literature review

According to Moreira (2006), the set of activities and operations that relate to each other in the manufacture of goods and services is defined as a production process. The latter can be classified according to the degree of standardization of the products and to the volume produced. More formally, a process is a group of activities carried out in a logical sequence with the aim of producing a good or service that has value for a specific group of customers. Martins and Laugeni (2006) affirm that the activities of the company aim to transform raw materials into finished products, adding value to it. As the types of products can vary in an organization, the type of process can also, because, according to Ritzman and Krajewski (2004), there is the so-called primary process, which is the physical or chemical transformation of raw materials into finished products, and there is one that involves order processing, delivery commitment with customers, and even the stock control process.

Tubino (2010) classifies the types of production process in the following way: continuous, repetitive in mass, repetitive in batches and, finally, design. Regardless of the type of process, Ohno (1997) emphasizes the importance of innovation, when he created the concept of lean production applied thereto, which was initially called the Toyota Production System (TPS). This type of production originated in Japan in the 1950s, after World War II, although it only became famous throughout the world after 1973. Its base is in the elimination of all waste—understood as the one that does not add value to the process, and is characterized in seven types: overproduction, time on hand, transportation, processing, stock at hand, movement and making defective products—which implicitly contributes to increase the efficiency of the production process. Another point that interferes in the production process, in which innovation can contribute in a considerable way, is in the production layout, which can be understood as the physical layout of machines, equipment, workstations, corridors, among others. In other words, it is where each part that composes the process is found (Rocha, 2010).

This physical arrangement, in order to present efficiency in the production process, requiresproduction management that meets the clients' needs (Corrêa & Corrêa, 2006). For this to happen, Gaither and Frazier (2004) defend the use of the Production Planning and Control System (PPCS), which is the basis of the innovation process in the production process in which it integrates people, machinery, equipment, storage space and other resources. Its main objective is to plan and control the entire process, considering the forecast of demand, as well as the planning of the capacity and quantity to be produced.

The innovations in the production process in the MSB should guarantee an increase in productivity and, with this, they contribute in social terms, given the generation of jobs that they foment. According to Banterli and Manolescu (2007), micro and small enterprises themselves have their social relevance in terms of employment and income generation, because companies this size "[...] represent 25% of Gross Domestic Product, generate 14 million jobs, or 60% of formal employment in the country, and this participation also contributes to increasing exports."

The indicated multi-sidedness and complexity of the phenomena that form the innovative capacity of enterprises forces one to search for optimum methods by which to analyze and evaluate this area. This problem particularly applies to SME sector enterprises. Various publications have

suggested new methods for the measurement of innovative capacity and potential of the enterprises that precisely account for the special character of operations performed and the effect of the regional conditions on the innovativeness of the enterprise.

2.1. Small businesses

According SEBRAE (2017) that presents a characterization for the size of the companies, using the criterion of number of people employed. The MSB are those with 0 to 99 employees in the industrial sector and 0 to 49 employees incommerce and service. For billing, a microenterprise is considered with an annual turnover of up to US$ 90,000.00, while the small enterprise is the one that has billing in the same period of up to US$ 900,000.00. The report of IBGE (2010), defines that companies still vary according to the economic segment studied.

In this context, MPEs represent more than half of Brazilian companies, representing a very high number of national GDP and reaching around 27% of this economic indicator for 2011 (SEBRAE, 2015).

In fact, smaller enterprises are often more flexible to discover new business opportunities and that could be an advantage for the innovation process management that utilizes radically new ideas. McMullen, Plummer, and Acs (2007) explain that an entrepreneurial opportunity can be either an objective construct visible to an entrepreneur or a new innovative construct created by a knowledgeable entrepreneur. However, only a few of smaller enterprises have sufficient capacity to manage the whole innovation process by themselves and this encourages them from innovation cooperation with other enterprises (Edwards, Delbridge, & Munday, 2005). Small technology firms

have an important role in revitalizing economy, but they face infrastructural, marketing, financing and internationalization challenges in their business development (Pelikka & Virtanen, 2009). Encouragement of SMEs could be a key factor for development of the economy on local, regional and national levels (Lahi & Tiit, 2014).

2.2. Reverse logistics

Reverse logistics is disciplined in a legal diploma officially called the Solid Waste Act. Federal Law No. 12,305 of August 2010 establishing the National Policy on Solid Waste (Brasil, 2010). The law reinforces the management criteria, indicating that the generator has responsibilities over the waste generated and for the final disposal of their product or service. Therefore, we have Laws that, if they are fulfilled, will provide a better scenario in the coming decades. The MSB business plan should cover the different types of waste and their appropriate destination. The municipality shall establish technical guidelines and procedures for the exercise of the responsibilities of small, medium and large generators, supported by Law 123, of 14 December 2006, which formalizes the national statute of the MPE and establishes general norms regarding the differential treatment that favors micro and small enterprises. The regional characteristics should be observed and contemplated in the diagnosis of construction waste generated in that city or state. The private sector should be invited to participate with investments in recycling plants.

2.3. Outsourcing law

The law provides for temporary work in companies and provides for the employment relationships in the company that provides services to third parties. It is a legal device to be analyzed vis-a-vis the precepts established in the subsequent labor reform with Law 13.467/17 (Brasil, 2017). In fact, business activities, for the sake of survival, outsource their activities, especially those ancillary activities (middle activities) concomitantly with the preservation of the core business. This is toward more labor productivity (using volunteers as unpaid workers). The process of outsourcing occurs in the business world with different effects depending on the type of organization (industrial, commercial and service companies).

Temporary work is provided by an individual hired by a temporary work company that makes it available to a service-taker to meet the need for temporary replacement of permanent staff or the complementary demand for services. It is prohibited to hire temporary workers to replace striking workers, except in cases provided for by law. It is considered complementary the demand for services that is derived from unforeseeable factors or, when due to predictable factors, is intermittent, periodic or seasonal (Brasil, 2016).

2.4. Innovation and technology

This Law provides incentives for scientific development, research, scientific and technological training and innovation. Law 10,973, of 2 December 2004, is amended as explained below. The measures should observe the following principles: I) promotion of scientific and technological activities as strategic for economic and social development; II) promotion and continuity of scientific, technological and innovation development processes, ensuring the human, economic and financial resources for this purpose; III) reduction of regional inequalities; IV) decentralization of science, technology and innovation activities in each sphere of government, with devolution in each federated entity; V) promotion of cooperation and interaction among public entities, between the public and private sectors and among companies; VI) stimulation of innovation activity in the Scientific, Technological and Innovation Institutions (ICTs) and in companies, including the attraction, constitution and installation of research, development and innovation centers and of technological parks and poles in the country; VII) promotion of business competitiveness in national and international markets; VIII) encouraging the creation of favorable environments for innovation and technology transfer activities; IX) promotion and continuity of formation processes, and scientific and technological training; X) strengthening the operational, scientific, technological and administrative capacities of ICTs; XI) attractiveness of the credit and development instruments, as well as their permanent updating and improvement; XII) simplification of procedures for the management of science, technology and innovation projects and adoption of control by results

in their evaluation; XIII) use of the state's purchasing power to foster innovation; XIV) support, encouragement and integration of independent inventors in the activities of ICTs and the productive system.

This scenario formalizes innovation as the introduction of novelty or improvement in the productive and social environment that results in new products, services or processes, or that understands the aggregation of new functionalities or characteristics to an existing product, service or process that may result in improvements and an effective gain in quality or performance.

In an other hand, the technological environment in which the firm operates, or the technological opportunity class, plays an important role in determining the dominant mode of rent-seeking and the dominant mode of contribution to technology accumulation processes in innovation systems (Covin. & Prescott, 1990; Rothwell, 1984; Rothwell & Dodgson, 1993). Also, Pavitt's taxonomy indicates possible contributions of large and small firms both within and between industries. The most likely sectors of new, technology-based firms are in the science-based and specialized supplier categories.

Although Pavitt maintains that science-based category is dominated by large firms, small firms also operate in such sectors. For example, the biotechnology industry, with its growing number of new, technology-based firms, can be classified as science-based. The main domain for small, technology-intensive firms, according to Pavitt, is in the specialized supplier's category. Specialized suppliers tend to link with their customers, using their operating experience and technological knowledge as the main external source of learning.

3. Methodology

The work was developed under the approach of grounded theory (Strauss & Corbin, 2001). In this type of research, the data must be observed, registered, analyzed, classified and interpreted, without any interference of the researcher on them. The data of empirical research, obtained from an inductive perspective, were the basis of the present study. In this research, the grounded theory method (Glaser & Strauss, 1967) was used, which is a qualitative research modality that seeks to generate new theories through concepts, categories and properties. The emphasis of grounded theory is learning from the data (interactive and inductive) generated by empirical research, rather than from an existing (deductive) theoretical view. Additionally, the conceptual basis of the theoretical foundation was used (see topic 2). The major difference between grounded theory and other methods of qualitative research is its specific focus on the development of theory through a continuous interdependence between data collection and analysis.

A method provides a methodological framework often lacking in other qualitative approaches, without sacrificing flexibility or scientific rigor (Glaser & Holton, 2004; Strauss & Corbin, 2001). The research sample consisted of 81 MSB in total, all located in the Campinas Metropolitan Region, to be carried out with their owners and that dedicate their activities to the manufacture of metallic window frames. The research was carried out using a script of interviews. In order to complete the data collection process, an interview was conducted with the main manager of each company at an ordinary meeting of the Commercial and Industrial Association of São Paulo and Campinas (ACISP). This association promotes regular meetings with sectorial segments. Eighty-one primary data sets were obtained, as shown in Annex 3. Additional data were collected with outsourced accounting offices (10 companies contract external bookkeeping) and other internal accountants to the companies surveyed. The final respondents were 60 MSB on multiple case studies.

The research directly with the owners was elaborated through a questionnaire with six open questions answered in the presence of the researcher and later the content analyzed by Bardin (2011). For Bardin (2011), the term content analysis designates: a set of communication analysis techniques aimed at obtaining, by systematic and objective procedures for describing the content

of the messages, indicators (quantitative or otherwise) that allow the inference of knowledge regarding the conditions of production/reception (inferred variables) of these messages (Bardin, 2011, p. 47).

Godoy (1995) states that content analysis, according to Bardin's perspective, consists of a methodological technique that can be applied in diverse discourses and to all forms of communication, whatever the nature of its support. In this analysis, the researcher seeks to understand the characteristics, structures or models that lie behind the fragments of messages taken into account. The analyst's effort, then, is twofold: to understand the meaning of communication, as if it were the normal receiver, and especially to look away, seeking another meaning, another message, which can be seen through or through the former.

After completing the research, a workshop will be held, as a reciprocity to the collaboration of the Campinas Commercial and Industrial Association (ACIC) managers/micro entrepreneurs. Other primary data were collected directly from the websites of the companies surveyed. The roadmap for data collection was formalized by the direction of ACIC and served as a conceptual basis for quantitative analysis. It was also used the strategy of group meetings, held with entrepreneurs and managers of MPEs in the segment of metallic frames, affiliated with the ACIC. Sub Chapter 2.1.

4. Analysis and result

The Brazilian market for window frames is divided into four types of materials: wood, steel, aluminum and PVC, according to the National Association of Aluminum Frame Manufacturers (AFEAL). According to the entity, the market share as to the materials indicates participation of 40% of wood products, 39% of steel, 20% of the aluminum, and 1% of PVC. The most recent statistics of the Brazilian Association of the Mechanically Processed Wood Industry (ABIMCI), in turn, identify the Brazilian production of some materials. This is the case of the 2009 sectorial study, with base year 2008 data. In this document, ABIMCI makes a detailed analysis of the production of wooden doors in Brazil.

Doors are considered to be wooden parts that rotate by hinges or run on rails, in order to close the opening in the wall that allows entry or exit to a room. The segment of solid wood doors generally supplies the civil construction sector and has been highlighted within the list of products with higher added value, quotes the report. ABIMCI lists different types and models such as smooth doors (hollow), solid doors and manufactured doors, made with reconstituted panels (MDF, plywood and others). The manufacturing process, however, is practically standardized and comprises the acquisition of the raw material, drying and actual manufacturing. In terms of numbers, ABIMCI estimated in this document that the sector would have produced around 9.3 million wooden doors in 2008.

The entity also mapped the framing market for higher value-added products. For ABIMCI, "the frames are classified as profiled pieces used almost always for interior finishes, with decorative purpose in the civil construction". In Brazil, according to the Association, wooden frames are manufactured in their largest portion of pine and are usually products for export. Still, according to ABIMCI, there are many profiles of frames, and the typologies are associated with the final applications. This explains common market names such as half-cane, footer, stop, door and window casing, among others. The entity's numbers indicate that this segment showed a constant evolution of the volume produced.

The evidence for this is the data from the period 1998 to 2007 when there was a growth in the domestic production of frames of 530.8%, representing an average annual growth of 22.7%. In ABIMCI's assessment, "in terms of consumption, only in 2004, significant values (65 thousand m^3) were obtained, reaching, in 2007, the volume of 212 thousand m^3. From this fact, it is verified that most of the production is exported", evaluates the already mentioned document. As in the case of wood, statistics on steel frames also showa market growth, according to the National Association

of Steel Frame Manufacturers (AFEAÇO). The entity has 44 associated companies, of which 36 are companies of steel frame manufacturers and eight suppliers of raw materials.

The manufacturers' market, according to the AFEAÇO, would amount to 55 producing companies (37 of them associated). According to the Association, the region of São José do Rio Preto (SP), concentrates 50% of all Brazilian production of metal window frames. The second largest producer is the region of Goiânia (GO), which would account for 16.3% of the national volume. The remaining 34.3% of the volume of metal frames would be divided among the other regions of the country. According to AFEAÇO, the Brazilian market would demand 234.5 million frames between 2010 and 2012.

This figure is based on the estimation that each housing unit demands about 10 frames and considers the study of the Getulio Vargas Foundation (FGV), called Construbusiness. According to this study, Brazil will need 23.5 million new housing units, which would mean 2 million per year. Considering all the manufacturers (associated and not associated with AFEAÇO), the Brazilian production of window frames would total 10.1 million units. With this production, the sector would consume 130.5 thousand tons of steel. The current figures of the AFEAÇO associates indicate that they account for the production of 9.8 million frames/year, with an average occupation of 87.8%, which reinforces the heating of the sector. Three markets are pointed out by AFEAÇO in the area of metal window frames: final consumers, using products for renovation and construction (through stores or building materials stores), construction companies (new housing) and state and municipal public agencies. The first one would account for more than 90%, concentrated in the segment of resale of building materials.

According to AFEAL, quoted at the beginning of this text, despite representing a fifth of the market for window frames in Brazil, aluminum products would have an upward trend in the last three decades and would present the best growth rates among the four types of materials listed (wood, steel and PVC, the other three). In the evaluation of the Association, the increment happens due to several factors. "This is due in the first place to the characteristics of the material: aluminum is light, structural and requires low maintenance," says the official text from AFEAL. "The aluminum frames are aesthetically beautiful, allow a wide variety of colors and tones in electrostatic powder or anodizing paint, harmonizing with interior decoration," adds the Association.

4.1. Analysis of innovation

One of the requirements for obtaining better results by micro and small enterprises is the optimization of the resources at their disposal. In this way, the more optimized the use of financial resources, the more investments are channeled into production innovation. Likewise, promoting compatibility of multi-use equipment and the practice of innovative working methods will allow the optimization of the resources of the technology. In this way, the empowerment of people's work would affect the organization's economic performance by combining efficiency and effectiveness in greater productivity. This productivity shows that an organization can achieve its innovation objectives in its processes, consistent with its production goals.

Therefore, it is possible to increase the dividend with the highest volume of production or, alternatively, to reduce the divisor with the least number of hours of labor spent in the productive processes. It is this quest for greater productivity that must be humanly dosed to avoid obsession with goals. The productivity improvement of Brazilian companies comes from the use of technologies incorporated in the productive structure, the process of training and education of workers because of the strong exposure of the national productive sector to international competition. With the internationalization of the markets, competition among the organizations increased, causing a real race toward greater competitiveness.

Technology is one of the most influential variables, through innovation in products and/or production processes, as evidenced by the results of automotive companies, robotized and with the best technologies and labor in the world. This productivity is differentiated according to the

sector of the economy and considers four aspects: technological progress of the sector average; technical efficiency; gains in scale and allocative efficiency. The organization as a whole has a control mechanism, which is its management process, which interprets and responds to internal and external feedback, so that the organization is balanced to the external environment.

4.2. Analysis of collected data

The primary data shown regard innovation in the production process of MSB in competing with the medium and large companies producing window frames in operation in the region studied—the Metropolitan Region of Campinas (RMC). The frequency tables explained below were consolidated from the completed collection routings. Socio-environmental management practices, according to research data, are strategies adopted or intended by companies in a differentiated way. The external frames for buildings, standardized by the Brazilian Association of Technical Standards (ABNT), constitute the largest expenses with innovation of the companies surveyed, see Table 1.

By signaling the values calculated in Table 1, we can outline possible tasks of grouping in outsourced processes (tasks flagged in the face of the opinion of 60% of the interviewees): *Potential hiring tasks; Cutting of raw materials; Welding of raw materials; Sub-set assembling; Set assembling and Formation of the basic components.*

This, segregating those tasks which will be preserved internally: final assembling of frames, painting (high specialization), finishing; storage and shipment of frames. The task of storing and shipping frames can be outsourced to intermediate customers (17% of respondents are favorable). That is, in addition to selling directly to industrial (builders), wholesale, and retail customers, partnerships with networks of construction to stock and sell to final consumers can be created, including technical and after-sales service tasks.

This grouping of outsourceable processes (see proposal of central components in item 4.6.), together with the opinion of the interviewees, translate by simple technology and little qualification of the workforce. Different from the other tasks (20% of respondents) to be maintained in the own productive processes that outline the productive chain are suggested in the topic 4.3.

4.3. Factors of innovation in processes—production

Analyzing the back-to-back production chain (reverse logistics), customers are expected to interact with organizations that are ethical, have a good institutional image in the market, and act in an ecologically responsible manner. In the opinion of about 60% of the interviewees, outsourcing the tasks that make up their productive processes is possible and would significantly reduce their costs. However, lack of confidence makes such an alternative hard to implement. What is proposed as an option to innovate these productive processes is the formation of a central of generation of

Table 1. Outsourcing in process innovation.

Outsourceable tasks	Quantity	%
Raw material cutting and welding; anodizing; antirust immersion	11	13.6%
Sub-set and set assembling; components finishing	59	72.9 %
Set assembling; final assembling; painting; finishing; storage of finished products	9	11.1%
Hiring technological support services to the innovation of productive processes.	2	2.4%
TOTAL	81	100%

Source: survey data.

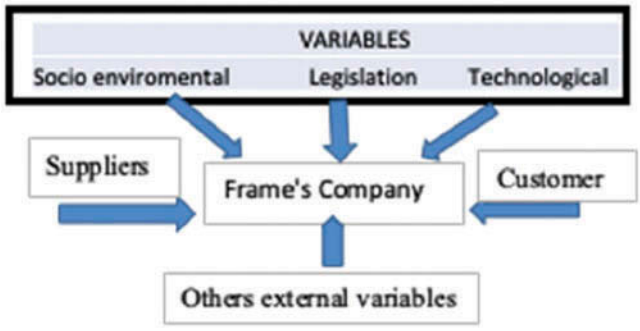

Figure 1. Production chain of metal window frames.

Source: prepared by the authors.

components that would add the tasks of cutting and welding raw materials; basic components; sub-set and set assembly, see Figure 1.

Technology provides the answers, but within the limits of the current legislation ... what was the question that motivated it? Would technology be applied to products or production processes? These questions relate to the need to insert the human factor along the productive chain of organizations that need to reconcile the economic aspects with those social and ecological to be truly sustainable. By applying the interview script and using the processes standardization concepts (Tachizawa, 2007), it is possible to identify the typical tasks and processes of a production line of a typical frames company as shown in Figure 1. These typical processes as verified in data collection unfold in: cutting and welding raw materials; sub-set and set assembling; formation of the basic components; final assembly of frames; painting; finishing; storage for final shipment.

4.4. Process innovation and sustainability

As evidenced by the research data, the use of ISO14000 (60%) and occupational health and safety standards OHSAS 18000 series (70%), apply mainly to industrial companies. On the other hand, standards such as ISO16000 are common to all organizations, with special emphasis on financial service companies, with a high socio-environmental requirement (79%), while industrial (15%) and commercial companies (30%) are average, given the peculiarities of their business operations. Complementing ISO16000, there is the OHSAS standard that, in a simplified way, prescribes conditions for the preservation of a healthy quality of working life. As a rule, the organization that obtains such certification is the holder or intends to be of ISO14000, ISO16000, or even SA8000, see Table 2.

Companies that adopt ISO9000, as a rule, seek to expand sales. On the other hand, those with ISO14000 and ISO16000 have it as a requirement of their large customers. SA8000 and AA1000 are held by those who expect to export. Companies with OHSAS18000 are usually industrial organizations whose environment presents high hazardous and unhealthy conditions. Therefore,

Table 2. Socio-environmental certification

Certificate	Number certification	%
(i) ISO9000	49	60.5%
(ii) ISO14000	10	12.3%
(iii) ISO16000	11	13.6%
(v) ISO18000	59	72.8%
Reverse logistics	9	11.1%
(iv) SA8000	2	2.5%
	81	-

Source: Data generated by the research.

it was evidenced that the ISO1600, and SA8000, essentially prescribe conditions for the preservation of a healthy quality of working life.

As a rule, the organization that obtains such certification also holds the OHSAS18000, ISO9000, or even ISO14000. The socio-environmental management practices are strategies adopted by the companies in a differentiated way. According to data provided by respondents, it has been shown that the use of environmental protection standards ISO14000 (60%) and occupational health and safety OHSAS 18000 series (70%), apply predominantly to industrial companies. On the other hand, standards such as ISO16000 are common to all organizations, with special emphasis on financial services companies, with a high social and environmental requirement (80%), while industrial companies (15%) and commercial companies (30%) are average, given the peculiarities of their business operations.

4.5. Classification by innovation factor

As evidenced previously, referring to the socio-environmental profile, it has been noticed that MPEs have a low volume of certifications, perhaps due to the lack of knowledge or access to certifiers, or perhaps the costs of certifications, but it is also noticed that most companies have an interest in obtaining the certifications.

Due to the fact that, all the other factors evidenced in the research, can signal that they go through process improvement, cost reduction, legal requirements, improvement of the work environment, increase competitiveness and even meet the green consumer, or meet the needs of their productive chain as a customer or supplier, or even targeting to improve its image in front of the society, a fact that corroborates with renowned authors, who affirm that the sustainability is a way without return. By means of these facts, it is proposed that micro enterprises should assess themselves according to the levels of sustainability.

Innovation factors can serve as a benchmark for excellence in evaluation of the companies regarding the fulfillment of the sustainability requirements, for requirements in the credit granting process, but also for all the other demands already mentioned.

This was the main difficulty of investments in innovation, according to the data evidenced in the research. Although five risk factors were considered, other intermediate levels can be interpolated among them, for example, 10 factors can be implemented. As the classification of the economic sector is generalist, there may be an industry whose classification in this ranking is dismembered. That is, there can be distinction in the final product (cigarette, which is ethically harmful) and its production process (clean production). Similarly, this happens in the armament industry (weapon, with harmful use and clean production chain and the production of gunpowder, considered as a distinct factory, with unsustainable production).

This classification of innovation in process, allows micro-enterprises to assess their sustainability condition. On the other hand, financial institutions could use this ranking classification to release credits and financing, in the context of current legislation. Consistent with the normative instruction of the Central Bank of Brazil, it was the responsibility of each financial institution to define its prerequisites for granting loans and financing.

This classification, as explained below, was made from the answers obtained in the data collection from the 81 companies interviewed. Innovation factors can serve as a benchmark of excellence for the evaluation of companies regarding the fulfillment of sustainability requirements in the process of granting credit. This was the main difficulty of investments in innovation, according to the data evidenced in the research.

Although considered five risk factors, other intermediate levels can be interpolated between them, for example, 10 factors can be implemented. As the classification of the economic sector is

Figure 2. Factor of innovation and sustainability.

Source: prepared by the authors.

FACTORS	SUSTAINABILITY	PROCESS INNOVATION
A	Productive chain whose activities do not offer any socio-environmental risk.	Organizations that have implemented only ISO9000. Therefore, process innovation does not exist. There is only standardization aiming at the quality of the processes.
B	Productive chain that generates low socio-environmental risk.	In addition to ISO9000, with uniformity and standardization of internal processes, focusing on quality, has a task of times and movements implemented to improve efficiency in the production chain.
C	Productive chain that generates moderate socio-environmental risk.	ISO14000 can be used to improve production processes. Efficiency implemented with the practice of reverse logistics, in an embryonic phase, with suppliers and customers. It is assumed that it has already internalized socio-environmental processes and is able to exercise and disclose its ethical behavior to the actors involved.
D	Productive chain that generates high socio-environmental risk.	Productivity implemented with integrated reverse logistics practice with suppliers and customers. Uses ISO14000 / 16000, SA8000, proves its actions with social balance; solidifies its interaction with the international market, since its conduct is adequate to the demands demanded.
E	Productive chain that generates a very high social and environmental impact.	Organization adopts SA8000 to better contribute in internal relations, concurrently; it unfolds to the community involved, through ISO16000. environment, being certified by ISO14000, through the process of reverse logistics and environmental labeling.

a generalist, there may be an industry whose classification in this ranking is dismembered. That is, it can have a distinction to be made from the final product (cigarette, which is ethically harmful) and its production process (clean production). Similarly, this happens in the armament industry (weapon, with harmful use and clean production chain and the production of gunpowder, considered as a distinct factory, with unsustainable production) see Figure 2.

This classification, as explained in Figure 3, was based on the answers obtained in the data collection from the 81 companies interviewed. It enables micro-enterprises to assess their sustainability condition for credit and financing purposes, in the context of current legislation. Consistent with the normative instruction of the Central Bank of Brazil, it was the responsibility of each

Figure 3. Stages of innovation applied to processes.

FACTORS	DESCRIPTIONS
A (30% of MSB at this stage):	a) does not use innovation in its productive processes; b) plans future actions to improve the current productive chain.
B (25% of MSB at this stage):	a) uses welding machines in the production process; b) the organization recognizes the impacts caused by its products, processes and facilities, presenting some isolated actions in order to minimize them.
C (25% of MSB at this stage):	a) uses mechanical and robotic welding arms; b) the organization plans to systematize the evaluation of the impacts of its products, processes and facilities.
D (15% of MSB at this stage)	a) uses reverse logistics and uses robotics for welding; b) monitors the impacts of products, processes and installations
E (5% of MSB at this stage)	a) uses reverse logistics; and uses robotics for welding and assembly of components; articulated sets and sub-sets of frames; has a returnable packaging kit for customers and suppliers; b) its production chain has expanded borders with its suppliers and customers; c) there is a commitment of top management to corporate sustainability, as can be seen from the analysis of the mission declared by the organization.

financial institution to define its prerequisites for granting loans and financing under the aegis of corporate sustainability.

The company, based on the results of this self-diagnosis can use its result for: negotiation with banks; issue a certificate of sustainable innovation in its class entity; develop innovation and technology projects; subsidize purchases of machines and equipment; guide expansion and reform of the industrial plant; subsidize the preventive and corrective maintenance programs of the industrial plant; conduct its future investments in process technology and innovation in its productive chain.

In a production chain context, it is possible to visualize a productive resource contracting under the influence of innovation factors.

These resources flow from suppliers, depending on the degree of innovation, is made in a differentiated way. Similarly, at the other end of the chain, products generated by customers may have different levels of quality (as the factor E, companies generate goods and services of excellence). On the other hand, companies associated as factor A and B may have lower quality requirements than those of factor E. Therefore, requirements in terms of ISO9000, ISO14000 and ISO16000, to be observed by their suppliers, are differentiated from the other organizations associated to factors with a higher degree of demand.

It is also suggested that the company present a social balance of its activities of contingency of its social-environmental activities. With such measures, it will be possible to plan the mitigation of socio-environmental effects by showing it in the social balance that can be elaborated. Socio-environmental risk factors can be implemented from the perspective of a sustainability thermometer. That is, on one side is the linear view of five degrees, watertight, and another in continuous form with these overlapping levels.

4.6. Innovation indicators

The concern in optimizing the resources and improving the quality of the processes in obtaining the products is conceptualized by efficiency (product ÷ resources consumed). On the other hand, efficacy can be conceptualized as the concern to achieve the highest possible value for the product next to the market (value obtained *divided by* obtained product). This value, which in the illustration is represented as revenue *R*, will be as high as the value achieved by the product, to be attributed by the market, as it satisfies their needs. The current trend in organizations is with productivity and no longer with efficiency or effectiveness, thus considered in isolation. If on the one hand the increase in efficiency levels requires a continuous improvement process to create better competitive conditions on the part of organizations, on the other hand, productivity is seen as an economic concept that unites the marketing vision of effectiveness with the operational efficiency concern that is the emphasis of the efficiency factor. For this purpose, it can be said that the increase of productivity is related to obtaining better economic results that in turn depend on the intelligence, the synergy of the people and the quality of the processes.

This process quality (ISO9000), and above all the quality of the management of such processes, is what ultimately determines the organization's productivity and its evolution and continuity. According to data collected in the research, expenses with process innovation occur modestly. A significant percentage of the managers interviewed (80%) consider it unnecessary to improve their production processes technologically. The question asked to those who invest in innovation (20%) was formulated as an expenditure indicator. This, in order to preserve the confidentiality of the accounted values and stimulate responses. As an indicator, we asked the amount of innovation expenditures made in the period (monthly or annual), divided by the sum of net sales in the same period.

Table 3. Net revenue from innovation expenditures

Manufacture type	a
Manufacture of food products	0.15
Manufacture of detergents, cleaning products and personal care products	1.11
Manufacture of rubber and plastic products	0.48
Manufacture of non-metallic mineral products	0.33
Metallurgy	0.31
Metalworking/non-ferrous metal products and foundry	0.40
Manufacture of metal products	0.26
Manufacture of furniture	0.45

Source. Research date

[a] % invested in innovation.

From the answers obtained, a monthly metric of 0.07 was found, that means an average of 7% of average net sales, which respondent companies invest in innovation. It is a significantly lower indicator than those obtained by the average companies, according to IBGE (2017) survey. That is, data from this survey indicated values of the main economic sectors, as explained in Table 3, below.

These indicators (IBGE, 2017) considered spending on innovation, encompassing product and process, while data collected essentially refer to process innovation. Another aspect that may explain the low indicators obtained in the process of accounting for investments in innovation in the processes of the frame companies.

That is, these frame companies account for innovation expenditures essentially in deferred assets and fixed assets accounts. This means that these amounts, appropriated and recorded in this way, provide for diluted amortization in future periods corresponding to the period covered by the innovation. On the other hand, equivalent amounts calculated by IBGE (op. cit.) may not have used the same accounting criteria. This measurement can be used for indicators related to the investments made and accounted for in the "deferred charges" account or in property, plant and equipment items (capital and equity assets). Values accounted in trademark and patent accounts for products and/or processes may be considered. This is because amounts accounted for in these accounts signify the amount of inventions and innovations generated by the organization, consistent with market values. By applying concepts of indicators, it is possible to establish metrics that show capitalized values in innovation and technology, applied to both products and processes, such as:

$$\text{Innovation Indicator } (\textbf{Technology}) = \frac{\text{Expenditures on product innovation in the period}}{\text{Gross sales in the period}}$$

Period is the annual, quarterly or even monthly exercise. If it is convenient, the amounts invested in products (goods or services) can be exchanged for the cost of improving processes. This involves or not the introduction of new technologies applied to products and/or production processes. As productive processes, it is systematically considered the chain of value aggregation, which can be considered sustainable or not.

This sustainability of the organization's production chain can be measured by the adoption of ISO14000 (environmental management), ISO16000 (social responsibility) or even ISO18000 (health and safety at work) certification. The billing amount (denominator of the ratio) can be replaced by the profit amount of the period. In this way, the percentage of profitability of the period invested in innovation and technology would be measured. It would be a measure of reinvested values in the business of what was noted in the period as "added value." Another

Table 4. Expenses in relation of gross sales

R&D expenses in relation of gross sales	%
Food	0.1%
Paper and paper products	2.7%
Chemicals and chemical products	0.9%
Rubber and plastic products	0.9%
Concrete and glass products	0.8%
Primary metal industries	1.4%
Metal products (except machinery)	0.5%
Industrial and commercial machines	1.8%
Electrical and electronic equipment	1.1%
Transportation equipment	1.8%
Measuring equipment	1.1%
Others	0.5%

Source: Tachizawa, 2018.

indicator of possible innovation to measure would be to relate values invested in creation to the improvement of products (goods or services) and productive processes.

$$\text{Innovation Indicator } (\textbf{Improvement}) = \frac{\text{Values in trademarks and patents in the period}}{\text{Billing in period}}$$

Analogous analysis to the previous indicator can be applied, even possibly replacing the billing value of the period with the volume recorded in the deferred asset accounts. Such an approach can be used to measure expenditure on innovation, relating it to the cost of goods sold (costing of goods/services production). That is:

$$\text{Innovation Indicator } (\text{expenditure}) = \frac{\text{Values invested in innovation}}{\text{Total cost of production for the period}}$$

Alternatively, one could calculate the same values spent on innovation in processes, divided by the total number of employees on the shop floor. This would make it possible to analyze the per capita values of labor (own and outsourced) allocated in production, analyzed in a comparative way with values before and after the implemented innovation. Whatever the indicator, the availability of equivalent metrics in the market is essential for benchmarking purposes. One example is the innovation indicator whose benchmark of market excellence is investments in innovation, on the value of gross sales of the period in focus, see Table 4.

The Productivity has been one of the themes considered relevant by the Center for Innovation and entrepreneurship of Brazilian Business, given its importance for long-term economic growth.

the country and companies. Throughout 2016, a series of surveys have been conducted and highlighting issues such as the productivity landscape in the context of economic-Brazilian entrepreneurship, the importance of education in the training of (with a focus on appropriate training in basic guarantee for a promising future for the student), investments in technology (highlighting the advancement of digitalization and industry 4.0 worldwide) and in the crucial aspects of that would be important for productivity growth, suggesting gains for companies that focus on special attention agile models of management and anticipation of the future. It is also imperative to link productivity to innovation. Typically, companies with significant investments in people and the search for their qualification, as well as in research centers, new technological arrangements, differentiated business models, partnerships with university centers and startups are highly productive. However, one of the major challenges of these same companies is the management of

Table 5. Productivity gains reported by companies.

Productivity gains (2017)	**%**
Chemicals and chemical products	6.9
Rubber and plastic products	10.6
Primary metal industries	6.5
Metal products (except machinery)	8.9
Electrical and electronic equipment	13.6
Average	**9.3**

Source: Tachizawa, 2018.

innovation, structured methodology, which is easy to understand throughout the organization and proven.

In the research, the productivity gains of the companies researched and separated by sectors were collected to know the gains of productivity obtained in the year 2017 that was 9.3%. The results are presented in Table 5, below.

The expenses with innovation and technology, in accounting terms, are allocated to deferred assets, which, for financial statements purposes, are investments to be amortized over the future periods that such expenditures would benefit. Disbursements related to machinery, equipment, furniture and utensils would be recorded in property, plant and equipment with depreciation for the period benefited (tax legislation).

4.6.1. Productivity indicators

An indicator of each company was determined, dividing the volume of sales, revenues or sales into monetary terms, in Dollar by the number of employees with employment relationship plus outsourced.

$$\textbf{Individual company indicator} = \frac{\text{Billing volume}}{\text{Number of employees}}$$

An indicator of the companies in the sample (sum of the 40 companies) was calculated, dividing the volume of billing, revenues or sales in monetary terms, in Dollar) by the number of employees, with employment relationship plus outsourced. An indicator of each company was determined, dividing the volume of billing, revenues or sales in monetary terms, in Dollar by the number of employees, with employment relationship plus outsourced. An indicator of the companies in the region (sum of the affiliated companies of the metallurgical class/union group) was calculated, dividing the volume of billing, revenues or sales into monetary terms, in Dollar by the number of employees, with employment relationship plus outsourced.

$$\textbf{Region indicator} = \frac{\text{Billing volume of all companies}}{\text{Number of employees of all companies}}$$

We tried to identify whether there is innovation in the production process or not. Thus, since it was considered that the study is carried out in a highly developed region, considered a technological pole of the country, it is possible to infer, even superficially, how innovation is found in this segment of civil construction. The conclusion is that this can serve as a reference to the same type of business in the rest of the country.

4.7. Benefits and barriers to innovation

Among the main factors that may be detrimental to innovation are those of an economic nature (costs, risks, appropriate sources of financing), internal company problems (organizational rigidity), technical deficiencies (shortage of adequate external technical services, lack of qualified personnel), information problems (lack of information about technology and markets), problems with the

National Innovation System (lack of possibilities for cooperation with other companies/institutions), and problems of regulation (difficulty to comply with standards and regulations).

Specifically, the company was asked to implement: a) new management techniques to improve work routines and practices, as well as the use and exchange of information, knowledge and skills within the company; b) new environmental management techniques; c) new methods of work organization to better distribute responsibilities and decision-making power; and d) significant changes in relationships with other companies or non-profit institutions.

As a benefit from the introduction of the innovations according to the interviewed managers, the following were highlighted: a) framework in regulations and standard norms related to internal or external market; b) possibility to control aspects related to health and safety; c) reduced impact on the environment; d) reduced water/energy consumption; e) reduced consumption of raw materials; f) reduced labor costs; (g) reduced production or service costs; h) increased flexibility of production or service provision; (i) increased production or service capacity; j) opening of new markets; k) possibility to maintain/increase the company's participation in the market; l) improved the quality of goods or services.

The main benefits of the innovations introduced were: a) improvement in the quality of goods and services (87.8%), maintenance of market share (85.2%), expansion of the company's participation in the market (70.7%), and an increase in flexibility in production or service provision (70.4%). Difficulties: high costs to innovate, lack of appropriate financing and excessive economic risks. Nonetheless, the lack of qualified personnel represented a bottleneck to innovation, being considered for the first time by the IBGE survey (2017), the second biggest obstacle in the industry: it was then assigned high or medium relevance by 72.5% of innovative industrial companies, which pointed out at least some difficulty. In the current edition, this category lost positions, occupying the fourth place in the industrial segment, with a rate of 66.1%. Economic obstacles once again emerged as the main obstacles: cost, as always, ranked first (86.0% of industries), followed by risks (82.1%) and scarcity of financing (68.8%). The high costs were also the obstacles mentioned by the interviewees. These obstacles, effects and benefits were incorporated into the proposal for the creation of a Center of Components of Frames and of institutional articulation of the class entity of surveyed segment.

4.8. Institutional articulation

The Commercial and Industrial Association of São Paulo and region (ACISP), provided the necessary support to the application of the collection routes. As a reciprocity to such collaboration with the researcher of this dissertation, a database was implemented in ACIC to: a) issue and supply a certificate of participation in the research, and which, in ancillary way, ensured that the participating company is "committed to the sustainability of their productive processes" ; b) implementation and preservation of a database with indicators of innovation of the productive processes of the member companies of ACIC and collaborators of the research; c) implementation of a database with affiliated companies and their respective classifications according to ACIC socio-environmental standard; d) the socio-environmental standard would designate for each company its stage of sustainability in terms of ISO9000, ISO14000, ISO16000, ISO18000 and compliance with the laws of innovation and reverse logistics.

Considering the results obtained in the analysis of the data collected in the research, where 45% of managers of frame companies opted to outsource the preparation of productive inputs, it is proposed to create a component center, common to ACISP affiliated companies. This center would produce components, common, to all the frame companies that adhered to the proposal. These components, as verified in the data collection, are composed of outsourced tasks such as cutting and welding raw materials; sub-set and set assembly; formation of the basic component; final assembly of frames; painting; finishing; storage for final shipment. It would, therefore, be responsible for the preparation of the tasks of preparation of raw materials for the formation of sub-

assemblies and assemblies that, in a standardized and modular way, would feed the assembly flow of metal frames. It would provide technological support services to the innovation of productive processes to the companies participating in the Central. This possibility represented 80% of the opinions of the interviewed managers, who were in favor of hiring technological support services to the innovation of productive processes.

ACISP's mission is to contribute to the sustainable development of municipalities in this region, consistent with a strategic vision. Its activities take place in the headquarters of the local agency of the Center of Industries of the State of São Paulo (CIESP). Ongoing studies and projects are carried out by the actions of their socioeconomic cells, whose members believe in the strength of the articulation of actions to promote development, with the consequent local generation of income and employment. Possible strategies to implement will depend on the extent of interaction with commercial banks and foreign funding institutions.

4.8.1. Applied in-house, in a unique way

A single company would make its diagnosis to fit one of the environmental risk factors. This information may become useful for the company to negotiate financial transaction with its commercial bank, facilitating the formation of a dossier of the company, according to prerequisites stipulated by the financial institution. For example, a social report with sustainability data could be prepared by the company, minimizing the analysis of the conditions of social and environmental risk, now in use in commercial banks.

4.8.2. Involving several companies

A group of companies affiliated to ACIC could join and negotiate with the bank manager in their area of interest. In this case, that association would preserve a database with socio-environmental information of its affiliated companies, making this sustainability cadastral data available in a corporate portal (information about the company and organizational elements available on the class association website). ISO9000 simplified export law procedures and sustainability certificates such as ISO14000, ISO1600, SA8000, AA1000, GRI – Global Report Initiative; social balance, reverse logistics law and the like. Companies, affiliated with ACIC or other associations of class, can join for the contribution of official resources to subsidized interest next to fomentation banks.

4.9. Certification of innovation in processes

ACISP or other class associations implemented a certificate of innovation in the process (CIP) for that MPE which has a process innovation. In order to do so, the class associations would maintain a database (socio-environmental "positive register") of the companies, showing the stage in which they are in terms of sustainability. The ACIC preserves the Table of Innovation Factors in the database, for technical guidance to its affiliated companies, as well as for the issuance of CSE.

5. Conclusions

The technical progress evidenced in the contextual analysis signals the technological evolution resulting from the incorporation of new methods or new products and offers differentiated results for new companies and the average of the framework sector. The technical efficiency mirrors the degree of efficiency of the company in relation to the best technique available. Efficiency of scale considers the economic gains obtained by increasing the scale of production, and the better use of installed capacity and the allocative efficiency shows the gains achieved with a better allocation of productive factors. Increasing taxes, for example, ultimately reduces business efficiency.

In general, it was sought to observe how micro and small companies see innovation from the point of view of development and productivity. The responses indicated that they consider that MSBs do not yet have a favorable environment for innovation. However, when asked about the perception of innovation in the MSB, they said that they consider it essential. Regarding the motivations, the search for greater profitability was the most cited factor. For these MSB innovation or the same is guaranteed through the purchase and use of new machines and equipment.

Finally, regarding the facilitating and inhibiting factors to innovate in MSB, the majority of respondents stated that resources, especially technological ones, facilitate innovation, and lack of information is the main inhibitor when talking about innovation.

In the manufacturing of window frames, where the study identified average annual productivity increase of 9.3%, the highest of the survey, technical progress was the main responsible for the gains recorded, and specifically as an interpretation of the data collected, a diagnosis was obtained on innovation in the production process of MSB of frames, in a context of corporate sustainability. Metrics were also established in the form of innovation indicators, as well as conclusions on the subject, compared to the current law of microenterprises, reverse logistics law, labor outsourcing legislation and law of innovation and technology. In this context delineated innovation and technology applied to processes, it was proposed the implementation of a central technical support and supply of common components, manufacturers of frames.

Funding
The authors received no direct funding for this research.

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Citation information
Cite this article as: Innovation and technology processes in micro and small business, Hamilton Pozo, Getulio Kazue Akabane & Takeshy Tachizava, *Cogent Business & Management* (2019), 6: 1588088.

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Cogent Business & Management **(ISSN: 2331-1975) is published by Cogent OA, part of Taylor & Francis Group.**