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INCIDENCE OF ORGANIZATIONAL INNOVATION IN INDUSTRY SECTORS BASED ON PINTEC

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Objective of the study: To investigate the incidence of Organizational Innovation (OI) in industry sectors in Brazil, grouped by the degree of technological intensity (GIT).
Methodology: The quantitative study used the 2011, 2014 and 2017 editions of the Innovation Research (PINTEC) as a database. The manufacturing industries that performed OI typified in Management Techniques, Environmental Management Techniques, Work Organization and External Relations were selected, organized by sector according to the National Classification of Economic Activities (CNAE) and grouped by GIT (Low, Medium-low, Medium-high and High). The information obtained was organized and presented in tables, which were analyzed descriptively and the results were discussed with previous studies.
Originality/Relevance: The data structure developed for the study is unprecedented as it presents the types of OI by industry sector and classified by the GIT.
Results: Two thirds of the industries are in the Low and Medium-low GIT; emphasis on performing OI in Management Techniques; the higher the GIT, the greater the percentage of companies that performed OI in Management Techniques and Work Organization; the OI in Environmental Management Techniques had greater emphasis in the Petroleum, Chemicals and Drinks sectors; Medium-high and High GIT industries are the most likely to perform OI in Management Techniques.
Theoretical/methodological contributions: The structure and treatment of data by industry sector, types of OI and GIT, can be replicated in future studies.
Social/Management Contributions: The study presents information for the elaboration of strategies and policies to encourage OI that may favor companies and generate employment, income and tax collection.

Keywords: Innovation. Organizational innovation. Industry sectors. Degree of technological intensity. PINTEC.

INCIDÊNCIA DA INOVAÇÃO ORGANIZACIONAL DOS SETORES DA INDÚSTRIA COM BASE NA PINTEC

RESUMO

Objetivo do estudo: Investigar a incidência da Inovação Organizacional (IO) dos setores da indústria no Brasil, agrupados pelo grau de intensidade tecnológica (GIT).
Metodologia: O estudo quantitativo utilizou como base de dados as edições de 2011, 2014 e 2017 da Pesquisa de Inovação (PINTEC). Foram selecionadas as indústrias de transformação que realizaram IO

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tipificadas em Técnicas de Gestão, Técnicas de Gestão Ambiental, Organização do Trabalho e Relações Externas, organizadas por setor conforme a Classificação Nacional de Atividades Econômicas (CNAE) e agrupados pelo GIT (Baixo, Médio-baixo, Médio-alto e Alto). As informações obtidas foram organizadas e apresentadas em tabelas, que foram analisadas de forma descritiva e realizado debate dos resultados com estudos anteriores.
Originalidade/Relevância: A estrutura dos dados desenvolvida para o estudo é inédita por apresentar os tipos de IO por setor da indústria e classificadas pelo GIT.
Resultados: Dois terços das indústrias estão nos GIT Baixo e Médio-baixo; ênfase na realização de IO em Técnicas de Gestão; quanto mais alto é o GIT, maior é o percentual de empresas que realizaram IO em Técnicas de Gestão e Organização do Trabalho; as IO em Técnicas de Gestão Ambiental tiveram maior ênfase nos setores de Petróleo, Químico e Bebidas; as indústrias de GIT Médio-alto e Alto são as mais propensas a realizar IO em Técnicas de Gestão.
Contribuições teóricas/metodológicas: A estrutura e tratamento dos dados por setor da indústria, tipos de IO e GIT, podem ser replicados em estudos futuros.
Contribuições sociais/para a gestão: O estudo apresenta informações para a elaboração de estratégias e políticas de incentivo à IO que poderão favorecer as empresas e geração de emprego, renda e arrecadação de impostos.

Palavras-chave: Inovação. Inovação organizacional. Setores da indústria. Grau de intensidade tecnológica. PINTEC.

INCIDENCIA DE LA INNOVACIÓN ORGANIZACIONAL EN SECTORES DE LA INDUSTRIA CON BASE EN PINTEC

RESUMEN

Objetivo del estudio: Investigar la incidencia de la Innovación Organizacional (IO) en sectores de la industria en Brasil, agrupados por el grado de intensidad tecnológica (GIT).
Metodología: El estudio cuantitativo utilizó como base de datos las ediciones 2011, 2014 y 2017 del Innovation Research (PINTEC). Se seleccionaron las industrias manufactureras que realizaron IO tipificadas en Técnicas de Gestión, Técnicas de Gestión Ambiental, Organización del Trabajo y Relaciones Externas, organizadas por sectores según la Clasificación Nacional de Actividades Económicas (CNAE) y agrupadas por GIT (Bajo, Medio-bajo, Medio-alto y Alto). La información obtenida fue organizada y presentada en tablas, las cuales fueron analizadas descriptivamente y los resultados fueron discutidos con estudios previos.
Originalidad/Relevancia: La estructura de datos desarrollada para el estudio no tiene precedentes ya que presenta los tipos de IO por sector industrial y clasificados por el GIT.
Resultados: Dos tercios de las industrias se encuentran en el GIT Bajo y Medio-bajo; énfasis en la realización de IO en Técnicas de Gestión; a mayor GIT, mayor porcentaje de empresas que realizaron IO en Técnicas de Gestión y Organización del Trabajo; la IO en Técnicas de Gestión Ambiental tuvo mayor énfasis en los sectores de Petróleo, Químicos y Bebidas; Las industrias de GIT Medio-alto y Alto son las más propensas a realizar IO en Técnicas de Gestión.
Aportes teóricos/metodológicos: La estructura y tratamiento de datos por sector industrial, tipos de IO y GIT, puede ser replicado en futuros estudios.
Contribuciones sociales/gerenciales: El estudio presenta información para la elaboración de estrategias y políticas de fomento de las OI que favorezcan a las empresas y generen empleo, ingresos y recaudación tributaria.

Palabras clave: Innovación. Innovación organizacional. Sectores industriales. Grado de intensidad tecnológica. PINTEC.

INTRODUCTION

Faced with several factors such as technological evolution, competition, consumer demand standards, changes in scenarios caused by the pandemic, war, and environmental factors, companies began to look for solutions to remain in the market, whether by developing new products, processes, ways of organizational and marketing management. In this context, innovation can be understood as the introduction of new products, new production methods, the opening of new markets, the conquest of new sources of supply and the adoption of new forms of organization (Schumpeter, 1982).

The introduction of Technological Innovation (TI) in the productive system, in the form of new products and new processes, inducing Organizational Innovations (OI) and related managerial innovations, determines the pace of productivity growth in the economic system and its level at every moment of time (ABDI, 2011). By OI is meant the implementation of new organizational methods, such as changes in business practices, workplace organization or external relations of the company (OCDE, 2005).

Innovation is no longer understood by researchers as an aspect related only to technology, and they began to consider it as part of organizations, and this brought a new look considered of fundamental importance for OI to emerge (Araujo, Modolo, & Carneiro Júnior, 2018). The management of innovative companies must be supported by an organizational structure that makes the innovation effort viable, otherwise the structure will be a barrier or delay any innovative initiative (Barañano, 2005). The construction and maintenance of organizational conditions is a fundamental part of innovation management (Tidd, Bessant, & Pavitt, 2008).

International empirical studies show that the absorption of TI may require significant organizational changes (OI) for companies, that is, there is a complementarity between TI and OI (Lam, 2005; Ganter & Hecker, 2013, 2014; Guan & Liu, 2007), and the indirect effects of OI on TI can contribute to the growth of the organization (Lee et al., 2017; Martínez-Costa et al., 2019).

Although some studies show the importance of OI for business performance, it is still underemphasized (Armbruster et al., 2008; Evangelista & Vezzani, 2010; Bowen, Rostami, & Steel, 2010; Camisón & Villar-López, 2011), and despite the existence of the OI concept since the 1960s, the definition of OI is still under construction (Alves, Galina, & Dobelin, 2018).

OI can lead to the development of specific strategic capabilities, providing competitive advantage and superior performance (Liao, Fei & Liu, 2008; Bowen, Rostami, & Steel, 2010). It is considered that OIs should be encouraged because they impact the competitiveness of companies (Armbruster et al., 2008; Gusmusluoglu & Ilsev, 2009; Evangelista & Vezzani, 2010; Faria, Lima, & Santos, 2010; Camisón & Villar-López, 2011; D'Este et al., 2012).

Some recent studies about OI have presented a diversity of approaches, such as the degree of acceptance of OI by the use of intentional inputs and outputs of knowledge to accelerate internal innovation and market resources for external use of innovation (Aichouche & Bousalem, 2016), OI convergence, technological innovation system and milk production chain (Rauta, Revillion, & Winck, 2018), implementation of OI to improve efficiency in the provision of jurisdictional public services (Baptista, Rodrigues, & Costa, 2019), gains from the use of OI, with emphasis on increased operational efficiency and restructuring of management and procedures (Rauta, 2020), complementarity of the OI with the TI of the industries (Oliveira & Avellar, 2021), OI impact on TI cores (Reina, Thomaz, & Magalhães, 2021), factors that lead the company to adopt a flexible work environment, understood as an OI, and the results of its implementation (Souza, Catelli, & Zilber, 2021), influence of OI and technology on the growth of employed persons in brazilian companies (Barbosa et al., 2022), impact of OI on the financial and productive performance of industries (Oliveira & Avellar, 2022). In view of the studies on OI, a gap was identified regarding the incidence of OI in the sectors of the manufacturing industries, grouped by degree of technological intensity.

Given the importance of OI for the sustainability of companies in a competitive market over time, this study aims to present the incidence of OI in sectors of industries located in Brazil. The Innovation Research (PINTEC) database was used, and information about the types of OI was collected and the results presented by sector of the manufacturing industry, and grouped by degree of technological intensity (GIT). The data collection and organization format intends to contribute to the theoretical increase on the subject and serve as a basis for future studies. In addition, the results are intended to provide information for the development of strategies and policies to encourage and promote OI, specific to each sector of industrial activity.

The existing international literature on OI makes a contribution to the topic, however, little investigation has been carried out. It is important to emphasize that OI can be considered not only an important form of non-technological innovation, but also the most difficult to understand, both conceptually and empirically (Evangelista & Vezzani, 2010). These aspects are important and justify the development of studies that can contribute to the investigation of this topic.

THEORETICAL FRAMEWORK: SOME ASPECTS OF ORGANIZATIONAL INNOVATION (OI)

Over the years, OI has gained prominence as an area of study (Araujo, Modolo, & Carneiro Júnior, 2018). The existing literature on OI is diverse and not very well integrated into a coherent theoretical framework. The OI phenomenon is subject to different interpretations within different strands of literature (Lam, 2005). Researchers from different areas of knowledge have used the term to describe different aspects of the relationship between organization and innovation and its concept has been used in a generic way. This conceptual indeterminacy reflects the fact that OI encompasses a very wide range of phenomena (Lam, 2005).

OI can be understood as those introduced in the organizational structure, administrative processes and/or human resources (Damanpour & Evan, 1984), new management and work concepts and practices (Damanpour, 1987), changes in the structure and processes of the company due to the implementation of new management and work concepts and practices (Armbruster et al., 2008), adoption of an internally generated or acquired device, system, policy, program, process, product or service that is new to the organization (Uzkurt , Kumar, & Ensari, 2013), new management practices, organization and business strategies (Battisti & Stoneman, 2010), new processes that produce changes in strategy, organization structure and administrative systems (Damanpour & Aravind, 2011), introduction of new management practices to the company to improve its performance (Mol & Birkinshaw, 2009), new management, concepts and practices for value creation within an organizational context (Armbruster et al., 2008; Gusmusluoglu & Ilsev, 2009), which affect the social system of an organization (Damanpour et al., 1989).

OI can function as a necessary adaptation for the introduction of new technologies, or as a precondition for the success of product or process innovations (Armbruster et al., 2008). It is considered that the other types of innovations, in a certain way, depend on an organizational structure that facilitates the realization of innovations, whatever their type. So OI can favor the realization of other types of innovation.

A widely considered definition of OI is that presented in the Oslo Manual, where OI is taken as the implementation of a new organizational method in the company's business practices, in the organization of its workplace or in its external relations (OECD, 2005). They aim to improve company performance by reducing administrative or transaction costs,

stimulating satisfaction in the workplace, gaining access to non-tradable assets or reducing supply costs (OECD, 2005).

The Innovation Survey (PINTEC), carried out by the IBGE, follows the definition of OI from the third edition of the Oslo Manual, and adds that OI is the result of strategic decisions taken by management and must constitute an organizational novelty for the company (PINTEC, 2011).

Innovation depends on there being a supportive organizational context, in which creative ideas can emerge and be effectively implemented, and no matter how well-developed the systems for defining and developing innovative products and processes are, they will only succeed if the organizational context environment is favorable (Tidd, Bessant, & Pavitt, 2008).

The company's strategic dimensions are its managerial and organizational processes, its current position and the paths available to it (Tidd, Bessant, & Pavitt, 2008). In the elaboration of the OI strategy, the items that can drive them must be considered. The OECD (2005) considers business practices, organization of the work environment and external relations of the organization, as the three main items that drive OI. Table 1 presents some characteristics of the OI driving items.

Table 1

OI booster items

Booster items	Characteristics
Business practices	Implementation of new methods for organizing work routines and procedures, for example, the implementation of new practices to improve the sharing of learning and knowledge within the company, the first implementation of practices for the codification of knowledge, establishment of databases of best practices, lessons and other knowledge so that they are more accessible.
Organization of the work environment	Stimulating workplace satisfaction (and thus labor productivity) by gaining access to non-tradable assets (such as external uncodified knowledge) or reducing procurement costs. Workplace innovations include new methods for distributing responsibilities and decision-making power among employees in the division of labor that exists within and across company activities (and organizational units).
External relations of the organization	Implementing new means of organizing relationships with other firms or public institutions, such as establishing new types of collaborations with research organizations or consumers, new methods of integration with suppliers, and the use of outsourcing or the introduction of subcontracting of research activities the businesses in production, provisioning, distribution, recruitment and ancillary services.

Source: Adapted from OCDE, 2005.

Regarding business practices, they stand out as drivers of OI, the first implementation of practices for the development of employees and improvements for their permanence, such as education and training systems. Other examples are the first introduction of management systems for general manufacturing or sourcing operations, such as supply chain management systems, business re-engineering, lean production and quality management systems.

OI can be differentiated into structural and procedural (Armbruster et al., 2008). Table 2 presents these characteristics.

Table 2

Differentiation of OI

OI	Characteristics
OI structural	They influence, change and improve responsibilities, accountability, command lines and information flows, as well as the number of hierarchical levels, the divisional structure of functions (research and development, production, human resources, financing, etc.), or the separation between line and support functions. Such structural OI's include, for example, changing an organizational structure of functions (product development, manufacturing, human resources, etc.) in customer-oriented lines with the product or, segments, divisions or business units.
IO procedural	They affect the routines, processes and operations of a company. They change or implement new procedures and processes in the company, such as concurrent engineering or zero reservation rules. They can influence the speed and flexibility of production (teamwork, just-in-time concepts) or the quality of production (continuous improvement process, quality circles).

Source: Adapted from Armbruster et al. (2008).

Armbruster et al. (2008) also comment that OI can be further differentiated along an intraorganizational dimension (within the company) and interorganizational dimension (new structures or organizational procedures beyond the company's borders).

The interorganizational dimension comprises new organizational structures in the company's environment, such as R&D cooperation with customers, just-in-time processes with suppliers or customers, or supply chain management practices with suppliers. The intraorganizational, on the other hand, concern certain departments or functions or may affect the global structure and strategy of the company as a whole, and include the implementation of teamwork, quality circles, continuous improvement processes or certification by ISO standards (Armbruster et al., 2008).

Another contribution by Armbruster et al. (2008) is the differentiation between structural and procedural OI with an intraorganizational and interorganizational focus. Table 3 presents this differentiation.

Table 3

Focus of OI

Focus	Intraorganizational	Interorganizational
Structural	• Multifunctional teams; • Decentralization of planning, operation and control functions; • Manufacturing cells or segments; • Reduction of hierarchical levels.	• Cooperation / networks / alliances (R&D, production, services, sales, etc.); • Outsourcing; • Offshoring/Relocating.
Procedural	• Teamwork in production; • Extending job/employment enrichment; • Simultaneous engineering / reverse engineering; • Continuous Improvement Process / Kaizen; • Quality Circles; • Quality, audit / certification (ISO); • Environmental Audit (ISO); • Zero resource principles (KANBAN); • Preventive maintenance.	• Just-in-time (for customers, with suppliers); • Supply Chain Management; • Customer quality audits.

Source: Adapted from Armbruster et al. (2008).

The detailing of structural and procedural OI components that are intraorganizational and interorganizational can contribute to managers in the development of innovation planning, so that the framework of a certain activity, its attributions and possible consequences can be clarified at the firm level.

It is observed the existence of a significant amount of definitions for OI. The creation of a new definition for OI that encompasses all aspects of research is complex, as it would take into account many aspects of the different areas of knowledge.

PREVIOUS STUDIES

This section presents some recent previous studies on OI. Aichouche and Bousalem (2016) analyzed the degree of acceptance of OI in algerian pharmaceutical companies, considering as openness the use of intentional inputs and outputs of knowledge to accelerate internal innovation and market resources for external use of innovation. The results showed that open innovation is positively and significantly related to OI, and that there is a positive and significant impact of OI on organizational performance.

Rauta (2020) presented a conceptual framework that demonstrates the dynamics and movement of the OI, and found that there has been progress in the understanding of the theme, comes as a series of gains from the use of the OI, with emphasis on the increase in operational

efficiency, encouraging a culture of innovation, restructuring management and procedures, and increasing the satisfaction of employees and other stakeholders.

Oliveira and Avellar (2021) analyzed the relationship between OI and TI in the manufacturing industry located in Brazil, using the PINTEC database, editions of 2008 and 2011, where it was possible to observe that most of the strong and positive correlations were between groups of companies that carried out more than one type of innovation concurrently with the OI, and the performance of the OI simultaneously with another type of innovation, causes superior results in most of the investigated items, with emphasis on cooperation relations, foreign capital, if it is part of a group, exports government support and continuous R&D, as well as it was possible to observe the existence of correlation between OI and TI.

Souza, Catelli and Zilber (2021) aimed to identify which factors lead a company to adopt a flexible work environment, which can be understood as an OI, which allows flexibility both in the workday and in the physical space of the companies, in addition to identifying some results of its implementation. A case study was carried out at Procter & Gamble (P&G) in Brazil. The results demonstrate that the main factor that led to the adoption of flexible working was the need to adapt the organizational structure to the company's business model, and obtained as main results the best assertiveness and speed in making decisions and projects, greater satisfaction of employees, greater attraction and retention of talent and reduced operating costs.

Oliveira and Avellar (2022) aimed to analyze the impact of OI on the financial and productive performance of industries located in Brazil, and used the 2011 edition of the Innovation Research (PINTEC). Linear regression was performed and as a result, in relation to financial performance, it was found that companies that carried out only product innovation and only innovation in marketing had positive coefficients, and the explanatory variables "Foreign Capital" and "Expenditure on Innovative Activities" exercised positive influence. Regarding the productive performance, the companies that carried out only product innovation had a positive coefficient, and the explanatory variables "Foreign Capital", "Cooperation", "Government Support" and "Quality of Labor" positively influenced the productive performance. Considering a certain set of variables, it is suggested that OI did not significantly influence the financial or productive performance of companies.

The study by Barbosa et al. (2022) aimed to analyze the influence of OI and technology on the growth of employed persons in brazilian companies. The growth of employed personnel of companies that combine OI and technology was compared with companies that carry out only technological innovation, based on PINTEC. The results point out that the probability of

a company having high growth when some initiatives in terms of innovation are present, of which the emphasis on OI in methods and work organization and external relations.

METHODOLOGY

Data were collected from the Innovation Survey (PINTEC) on the IBGE website. The 2011, 2014 and 2017 editions were used. The industry sectors follow the PINTEC editions, which uses the classification of the National Registry of Economic Activity (CNAE).

The sectors were grouped according to the Degree of Technological Intensity (GIT), according to Technical Note 17 of the Institute of Applied Economic Research (IPEA) prepared by Cavalcante (2014), and is aligned with that presented by the OECD (2011), which supports the relationship between R&D spending and added value and spending on intermediate and capital goods or the relationship between R&D spending and revenue (Cavalcante, 2014). Industry sectors and classification by GIT are detailed in Table 4.

Table 4

Industry sectors grouped by degree of technology intensity (GIT)

GIT	Sectors	Description of industry sectors (PINTEC, 2017)
	Total Industries	**Total companies surveyed Manufacturing industries**
Low	Food	Food products
	Drinks	Drinks
	Leather	Leather preparation, manufacture of leather goods, travel goods and footwear
	Tobacco	Tobacco products
	Print	Printing and playback of recordings
	Wood	Wood products
	Furniture	Furniture
	Paper	Pulp, paper and paper products
	Textile	Textile product manufacturing
	Clothing	Manufacture of clothing and accessories
Medium-low	Rubber	Rubber and plastic items
	Metal	Metal products
	Metallurgy	Steel products, non-ferrous metals and foundry
	Minerals	Non-metallic mineral products (glass, cement, plaster, ceramics, lime)
	Petroleum	Coke, petroleum products and biofuels
Medium-high	Electric	Electric machines, appliances and materials
	Maintenance	Maintenance, repair and installation of machinery and equipment
	Machines	Machines and equipment
	Chemical	Chemicals products
	Transport	Other transport equipment
	Vehicles	Motor vehicles, trailers and bodies
High	Pharmaceutical	Pharmacochemical and pharmaceutical products
	Computing	Computer equipment, electronic and optical products
	Medical	Instruments and materials for medical, dental and optical use

Source: Own elaboration, based on PINTEC (2017) and Cavalcante (2014).

PINTEC (2017) classifies OI into 4 types:

- Management Techniques (TG): new management techniques to improve work routines and practices, as well as the use and exchange of information, knowledge and skills within the company;
- Environmental Management Techniques (TGA): new environmental management techniques;
- Work Organization (OT): new methods of work organization to better distribute responsibilities and decision-making power; it is
- External Relations (RE): significant changes in relations with other companies or non-profit institutions.

The absolute and relative data of the companies that carried out each type of OI, by industry sector, were observed.

Regarding the results of the study, specifically in Tables 5 to 9, regarding the column that presents the type of OI, it should be noted that for each sector of the industry, the numbers of companies from three tables prepared by PINTEC, for each of the editions, that is, companies that performed OI and that:

- No product and process innovations and no projects (SIPPSP),
- Performed product and process innovation and with projects (CIPPCP), it is
- Did not carry out product and process innovations and with projects (SIPPCP).

This is important to emphasize because PINTEC presents these separate tables, and the data presented in the results of this study are grouped. The expressions that represent these calculations are the following:

- $TG = \sum SIPPSP\_TG + \sum CIPPCP\_TG + \sum SIPPCP\_TG$.....*(1)*
- $TGA = \sum SIPPSP\_TGA + \sum CIPPCP\_TGA + \sum SIPPCP\_TGA$.....*(2)*
- $OT = \sum SIPPSP\_OT + \sum CIPPCP\_OT + \sum SIPPCP\_OT$.....*(3)*
- $RE = \sum SIPPSP\_RE + \sum CIPPCP\_RE + \sum SIPPCP\_RE$.....*(4)*

Expression 1 presents the total number of companies that performed OI in TG, and corresponds to the sum of the number of companies that performed OI in TG, but did not carry out product and process innovations and without projects ($\sum SIPPSP\_TG$), the sum of the number of companies that carried out OI in TG and that also carried out product and process innovation and with projects ($\sum CIPPCP\_TG$), and the sum of the number of companies that carried out OI in TG but did not carry out product and process innovations and with projects ($\sum SIPPCP\_TG$). Expressions 2, 3 and 4 follow the same calculation method, referring specifically to the types of OI performed by the companies (TGA, OT and RE).

Having defined the research construct, the next section presents the results of the study.

RESULTS ANALYSIS

The data presented in the tables provide complex and comprehensive analysis. For reasons of space, only some of these results were analyzed descriptively. It is noteworthy that these results will serve as a basis since no similar studies were found to perform such a comparison.

Table 5 presents the industry sectors classified by degree of technological intensity (GIT) referring to the 2011, 2014 and 2017 editions of the Innovation Survey (PINTEC).

Table 5

Industry Sectors Ranked by Degree of Technological Intensity (GIT)

GIT	Sectors	Number of Companies PINTEC		
		2011	2014	2017
	Total Industries	**128.699** / **114.212**	**132.529** / **115.268**	**116.962** / **100.216**
Low	Food	14.013	13.846	14.362
	Drinks	926	967	1.043
	Leather	5.686	4.921	3.720
	Tobacco	63	68	65
	Print	3.204	3.037	2.395
	Wood	5.473	5.235	4.206
	Furniture	5.799	6.168	5.141
	Paper	2.234	2.133	1.882
	Textile	3.968	3.856	3.339
	Clothing	18.506	17.582	14.365
	Total Low GIT	**59.871**	**57.812**	**50.518**
	% of Industry	*52,4%*	*50,2%*	*50,4%*
Medium-low	Rubber	6.992	7.148	6.328
	Metal	11.479	11.935	9.667
	Metallurgy	1.907	1.776	1.388
	Minerals	9.905	10.982	9.134
	Petroleum	296	295	291
	Total GIT Medium-Low	**30.579**	**32.136**	**26.808**
	% of Industry	*26,8%*	*27,9%*	*26,7%*
Medium-high	Electric	2.201	2.170	1.891
	Maintenance	3.209	4.088	3.953
	Machines	6.228	6.588	5.579
	Chemical	3.517	3.632	3.509
	Transport	530	598	540
	Vehicles	2.872	2.765	2.422
	Total GIT Medium-high	**18.556**	**19.840**	**17.894**
	% of Industry	*16,2%*	*17,2%*	*17,9%*
High	Pharmaceutical	458	406	436
	Computing	1.618	1.542	1.310
	Medical	3.130	3.531	3.251
	Total GIT High	**5.206**	**5.480**	**4.997**
	% of Industry	*4,6%*	*4,8%*	*5,0%*

Source: Survey data.

Analyzing the information in Table 5, it can be seen that in the 2017 edition of PINTEC there was a reduction in the number of industries participating in the survey, compared to the 2011 and 2014 editions. According to Agência Brasil (2020), the economic downturn in the period assessed by the 2017 edition of PINTEC (which presents the innovation results for the 2015-2017 triennium) directly affected innovation initiatives, not only with the decline in the

rate of innovation (which was 33,6% of companies that carried out innovation, a lower percentage than that indicated in the 2014 edition, which was 36%), but also with the drop in investments in innovative activities and in government incentives for innovation.

The Institute of Studies for Industrial Development (2020) points out that the low willingness to innovate in Brazil, based on PINTEC 2017, among others, is due to the lack of engagement by companies, insufficient public programs to support science, technology and innovation, little integration and coordination between research institutions, companies and the public sector, little international integration and lack of qualified labor.

Most companies are part of the group that has a low degree of technological intensity (GIT), with emphasis on the Clothing, Food, Furniture, Wood and Leather sectors. In general terms, observing the groups of industries by degree of technological intensity (GIT), it can be noted that most companies are in sectors considered as Low GIT, with emphasis on the 2011 edition (59.871 companies, 52,4% of all industries). This can be observed by the total number of companies in each group, in all editions of PINTEC. The sectors with Medium-low GIT have the second largest number of companies, with emphasis on the 2014 edition (32.136 companies, 27,9%). It is suggested that the higher the GIT, the smaller the number of sectors and companies. Table 6 shows the number of companies that performed OI in Management Techniques (TG).

Table 6

Companies that performed OI in Management Techniques (TG)

GIT	Sectors	PINTEC 2011 TG	2011 %	PINTEC 2014 TG	2014 %	PINTEC 2017 TG	2017 %	% Average
	Total	**50.126**	**38,9**	**54.767**	**41,3**	**42.667**	**36,5**	**39,0**
	Industries	**43.762**	**38,3**	**47.111**	**40,9**	**36.155**	**36,1**	**38,5**
Low	Food	5.807	*41,4*	5.606	*40,5*	5.580	*38,9*	**40,2**
	Drinks	506	*54,6*	609	*63,0*	433	*41,5*	**52,7**
	Leather	2.303	*40,5*	1.820	*37,0*	933	*25,1*	**35,3**
	Tobacco	28	*43,8*	33	*49,3*	26	*39,9*	**44,4**
	Print	1.264	*39,5*	1.123	*37,0*	666	*27,8*	**35,4**
	Wood	1.469	*26,8*	2.209	*42,2*	1.710	*40,7*	**36,1**
	Furniture	2.137	*36,8*	2.545	*41,3*	1.322	*25,7*	**35,1**
	Paper	787	*35,2*	895	*42,0*	784	*41,6*	**39,5**
	Textile	1.152	*29,0*	1.814	*47,0*	1.112	*33,3*	**36,5**
	Clothing	6.657	*36,0*	6.286	*35,8*	5.014	*34,9*	**35,6**
	Total Low GIT	**22.110**	**36,9**	**22.942**	**39,7**	**17.579**	**34,8**	**37,2**
	% of Industry	*50,5*		*48,7*		*48,6*		
Medium-low	Rubber	2.940	*42,0*	2.629	*36,8*	2.199	*34,7*	**37,9**
	Metal	4.049	*35,3*	4.181	*35,0*	2.931	*30,3*	**33,7**
	Metallurgy	652	*34,2*	886	*49,9*	527	*37,9*	**40,7**
	Minerals	2.797	*28,2*	4.328	*39,4*	2.942	*32,2*	**33,5**
	Petroleum	159	*53,8*	170	*57,6*	159	*54,8*	**55,4**
	Total GIT Medium-Low	**10.598**	**34,7**	**12.194**	**37,9**	**8.757**	**32,7**	**35,2**
	% of Industry	*24,2*		*25,9*		*24,2*		
Medium-high	Electric	1.027	*46,7*	986	*45,4*	938	*49,6*	**47,1**
	Maintenance	1.545	*48,1*	1.564	*38,2*	1.438	*36,4*	**40,4**
	Machines	2.886	*46,3*	3.216	*48,8*	2.384	*42,7*	**46,1**
	Chemical	1.798	*51,1*	1.567	*43,1*	1.584	*45,1*	**46,4**
	Transport	294	*55,4*	407	*68,0*	237	*43,8*	**56,2**
	Vehicles	1.296	*45,1*	1.189	*43,0*	1.222	*50,4*	**46,0**
	Total GIT Medium-high	**8.845**	**47,7**	**8.928**	**45,0**	**7.802**	**43,6**	**45,4**
	% of Industry	*20,2*		*19,0*		*21,6*		
High	Pharmaceutical	48	*54,1*	267	*65,7*	214	*49,1*	**56,1**
	Computing	710	*43,9*	939	*60,9*	631	*48,1*	**51,0**
	Medical	1.252	*40,0*	1.841	*52,1*	1.172	*36,1*	**43,0**
	Total GIT High	**2.210**	**42,4**	**3.047**	**55,6**	**2.017**	*40,4*	**46,4**
	% of Industry	*5,0*		*6,5*		*5,6*		

Source: Survey data. *%Average=∑TG÷∑Total.*

Based on the information presented in Table 6, the Low GIT has 10 sectors of the manufacturing industry, having the largest number of sectors compared to the other GIT

(Medium-low: 5 sectors, Medium-high: 6 sectors, High: 3 sectors). GIT Low also has the highest average number of companies that performed OI in TG (20.877 companies), compared to the average of companies in GIT Medium-Low (10.516 companies), GIT Medium-High (8.525 companies), and GIT High (2.425 companies).

It can be seen that the total number of industries that performed OI in TG was lower in the 2017 edition of PINTEC (36.155), compared to the other editions (2011: 43.762; 2014: 47.411). The percentage of companies that performed OI in TG in the 2017 edition was also lower (36,1%) being below the average performed between the 3 editions (38,5%), compared to the 2014 edition (40,9%) which obtained the highest percentage, and the 2011 edition (38,3%).

In absolute terms, observing the total number of companies by sector, the most distinguished companies participating in the editions were, in descending order: Clothing (Low GIT), Food (Low GIT) and Metal (Medium-low GIT). The largest number of companies that performed OI in TG in each edition of PINTEC can be found in the 2011 edition: Clothing (6.657), 2014: Clothing (6.286), 2017: Food (5.580).

In relative terms, the highest percentages of companies that performed OI in TG of each PINTEC edition were observed in the 2011 edition of the Transport sector (55,4%), in the 2014 edition of the Transport sector (68,0%), and in the 2017 edition the Petroleum sector (54,8%). Considering the decomposition of the industry in the 24 sectors, it is highlighted that:

- 9 sectors have an average percentage (%Average) lower than those of industry, of which 6 of these groups have Low GIT (Leather: 35,3%, Print: 35,4%, Wood: 36,1%, Furniture: 35,1 %, Textiles: 36,5%, and Clothing: 35,6%) and 3 of them are from the group that has Medium-low GIT (Rubber: 37,9%, Metal: 33,7%, and Minerals: 33,5%);
- The 3 industry sectors with the lowest average percentages (%Middle) were: Minerals (Medium-low GIT, 33,5%), Metal (Medium-low GIT, 33,7%) and Furniture (Low GIT, 35,1%);
- The industry sectors with the highest %Average were the following: Transport (Medium-high GIT, 56,2%), Pharmaceutical (High GIT, 56,1%) and Petroleum (Medium-low GIT, 55,4%).

The number of companies that performed OI in TG was higher in the Low GIT group. On the other hand, the industry sectors considered as having a High GIT have the highest

%Average, compared to the other groups. Based on the results about performing OI in TG, it is suggested that the sectors that have Medium-high and High GIT are the ones that care more about performing OI in TG compared to the other groups.

The results of the study by Rauta (2020) point out that there were a series of gains from the use of OI, with emphasis on the restructuring of management and procedures. It should be noted that the present study did not intend to identify the elements contained in the OI in TG, suggesting this detail for future studies.

Table 7 shows the number of companies that performed OI in Environmental Management Techniques (TGA).

Table 7

Companies that performed OI in Environmental Management Techniques (TGA)

GIT	Sectors	PINTEC						% Average
		2011		2014		2017		
		TGA	%	TGA	%	TGA	%	
	Total	**33.795**	**26,3**	**34.994**	**26,4**	**22.183**	**19,0**	**24,1**
	Industries	**31.057**	**27,2**	**32.234**	**28,0**	**20.421**	**20,4**	**25,4**
Low	Food	4.049	*28,9*	3.760	*27,2*	3.247	*22,6*	**26,2**
	Drinks	464	*50,1*	455	*47,1*	315	*30,2*	**42,0**
	Leather	2.109	*37,1*	1.871	*38,0*	422	*11,3*	**30,7**
	Tobacco	25	*40,2*	23	*34,6*	24	*36,3*	**37,0**
	Print	896	*28,0*	802	*26,4*	336	*14,0*	**23,6**
	Wood	1.586	*29,0*	1.854	*35,4*	989	*23,5*	**29,7**
	Furniture	1.651	*28,5*	2.402	*38,9*	1.321	*25,7*	**31,4**
	Paper	916	*41,0*	661	*31,0*	254	*13,5*	**29,3**
	Textile	965	*24,3*	953	*24,7*	556	*16,7*	**22,2**
	Clothing	2.842	*15,4*	2.853	*16,2*	1.865	*13,0*	**15,0**
	Total Low GIT	**15.504**	**25,9**	**15.635**	**27,0**	**9.329**	**18,5**	**24,1**
	% of Industry	*49,9*		*48,5*		*45,7*		
Medium-low	Rubber	1.779	*25,4*	1.853	*25,9*	1.530	*24,2*	**25,2**
	Metal	3.538	*30,8*	2.951	*24,7*	1.655	*17,1*	**24,6**
	Metallurgy	552	*29,0*	631	*35,5*	413	*29,8*	**31,5**
	Minerals	2.839	*28,7*	3.916	*35,7*	2.289	*25,1*	**30,1**
	Petroleum	151	*51,1*	144	*48,8*	119	*41,1*	**47,0**
	Total GIT Medium-Low	**8.861**	**29,0**	**9.496**	**29,5**	**6.006**	**22,4**	**27,2**
	% of Industry	*28,5*		*29,5*		*29,4*		
Medium-high	Electric	620	*28,2*	484	*22,3*	346	*18,3*	**23,2**
	Maintenance	594	*18,5*	768	*18,8*	517	*13,1*	**16,7**
	Machines	1.637	*26,3*	1.760	*26,7*	1.117	*20,0*	**24,5**
	Chemical	1.503	*42,7*	1.495	*41,2*	1.158	*33,0*	**39,0**
	Transport	82	*15,4*	342	*57,1*	128	*23,7*	**33,0**
	Vehicles	1.177	*41,0*	808	*29,2*	716	*29,6*	**33,5**
	Total GIT Medium-high	**5.612**	**30,2**	**5.656**	**28,5**	**3.983**	**22,3**	**27,1**
	% of Industry	*18,1*		*17,5*		*19,5*		
High	Pharmaceutical	147	*32,1*	141	*34,7*	104	*23,8*	**30,1**
	Computing	287	*17,7*	333	*21,6*	223	*17,0*	**18,9**
	Medical	647	*20,7*	973	*27,6*	776	*23,9*	**24,2**
	Total GIT High	**1.081**	**20,8**	**1.447**	**26,4**	**1.103**	**22,1**	**23,1**
	% of Industry	*3,5*		*4,5*		*5,4*		

Source: Survey data. *%Average=∑TGA÷∑Total.*

Regarding the OI in TGA, the highest average percentages (%Average) of the Petroleum (47,0%), Drinks (42,0%) and Chemical (39,0%) sectors stand out. As they have an average % higher than the industry average, it is suggested that the sectors that produce greater relationships with the environment were those that had the highest percentages of OI in TGA.

The highest percentages of companies that performed OI in TGA in each edition of PINTEC:

- 2011: Petroleum (51,1%);
- 2014: Transport (57,1%);
- 2017: Petroleum (41,1%).

The percentage (% average) of manufacturing industries that performed OI in TGA was 25,4%, and the Low (24,1%) and High (23,1%) GIT were below this average.

The average % of industries that are below the industry average:

- Low GIT: Clothing (15,0%), Textiles (22,2%) and Printing (23,6%);
- Medium-low GIT: Metal (24,6%) and Rubber (25,2%);
- Medium-high GIT: Maintenance (16,7%), Electrical (23,2%) and Machines (24,5%);
- High GIT: Computing (18,9%) and Medical (24,2%).

It should be noted that the present study did not intend to identify and analyze the elements contained in the OI in TGA, such as the study by Raffaelli and Manthey (2017), which analyzed the implementation of Environmental Management in a software company to analyze waste and waste produced, resulting in a decrease in consumption and a reduction in costs with electricity, water, raw materials and the disposal of electronic waste.

The results of the OI in TGA, segregated by industry sector and grouped by GIT of the present study, present a relevant base of information that can be used in more detailed future studies. The limitation of the study is that it did not carry out the analysis of the various TGA existing in the literature and present in the companies, and in this direction, it is suggested to carry out future studies that specifically cover this detail.

Table 8 shows the number of companies that carried out OI in Work Organization (OT).

Table 8

Companies that performed IO in Work Organization (OT)

GIT	Sectors	PINTEC						% Average
		2011		2014		2017		
		OT	%	OT	%	OT	%	
	Total	**44.426**	**34,5**	**52.690**	**39,8**	**41.289**	**35,3**	**36,6**
	Industries	**38.394**	**33,6**	**44.660**	**38,7**	**34.684**	**34,6**	**35,7**
Low	Food	4.697	*33,5*	5.457	*39,4*	4.935	*34,4*	**35,7**
	Drinks	403	*43,5*	629	*65,1*	354	*33,9*	**47,2**
	Leather	1.910	*33,6*	2.227	*45,2*	1.046	*28,1*	**36,2**
	Tobacco	18	*28,5*	26	*38,9*	27	*42,1*	**36,6**
	Print	1.111	*34,7*	910	*30,0*	588	*24,5*	**30,2**
	Wood	1.210	*22,1*	1.839	*35,1*	1.526	*36,3*	**30,7**
	Furniture	1.804	*31,1*	2.463	*39,9*	1.422	*27,7*	**33,3**
	Paper	938	*42,0*	619	*29,0*	537	*28,5*	**33,5**
	Textile	1.143	*28,8*	1.802	*46,7*	1.035	*31,0*	**35,7**
	Clothing	6.394	*34,6*	5.751	*32,7*	4.864	*33,9*	**33,7**
	Total Low GIT	**19.628**	**32,8**	**21.724**	**37,6**	**16.334**	**32,3**	**34,3**
	% of Industry	*51,1*		*48,6*		*47,1*		
Medium-low	Rubber	2.699	*38,6*	3.192	*44,7*	1.964	*31,0*	**38,4**
	Metal	3.711	*32,3*	3.456	*29,0*	3.299	*34,1*	**31,6**
	Metallurgy	672	*35,3*	715	*40,3*	441	*31,8*	**36,1**
	Minerals	3.071	*31,0*	4.360	*39,7*	3.441	*37,7*	**36,2**
	Petroleum	110	*37,1*	143	*48,5*	155	*53,2*	**46,2**
	Total GIT Medium-Low	**10.263**	**33,6**	**11.867**	**36,9**	**9.300**	**34,7**	**35,1**
	% of Industry	*26,7*		*26,6*		*26,8*		
Medium-high	Electric	867	*39,4*	980	*45,2*	907	*48,0*	**44,0**
	Maintenance	1.355	*42,2*	1.426	*34,9*	1.559	*39,4*	**38,6**
	Machines	2.137	*34,3*	2.650	*40,2*	2.113	*37,9*	**37,5**
	Chemical	1.611	*45,8*	1.681	*46,3*	1.411	*40,2*	**44,1**
	Transport	79	*15,0*	313	*52,4*	216	*39,9*	**36,5**
	Vehicles	819	*28,5*	1.197	*43,3*	922	*38,1*	**36,5**
	Total GIT Medium-high	**6.868**	**37,0**	**8.248**	**41,6**	**7.127**	**39,8**	**39,5**
	% of Industry	*17,9*		*18,5*		*20,5*		
High	Pharmaceutical	237	*51,8*	212	*52,1*	195	*44,7*	**49,5**
	Computing	541	*33,5*	1.028	*66,7*	588	*44,9*	**48,3**
	Medical	856	*27,4*	1.581	*44,8*	1.141	*35,1*	**36,1**
	Total GIT High	**1.635**	**31,4**	**2.821**	**51,5**	**1.923**	**38,5**	**40,7**
	% of Industry	*4,3*		*6,3*		*5,5*		

Source: Survey data. *%Average=∑OT÷∑Total.*

OI in OT was more evident in companies from the sectors of GIT High (40,7%) and Medium-high (39,5%), as they were the groups that had higher averages than the industry (35,7%) for this OI type.

The sectors with the highest %Average OI in OT were: Pharmaceutical (49,5%), Computing (48,3%), and Drinks (47,2%); and with the lowest %Average were: Printing

(30,2%), Wood (30,7%) and Metal (31,6%). Regarding the industry, the highest percentage of companies that performed OI in OT was in the 2014 edition of PINTEC (38,7%).

The highest percentages of companies that performed OI in OT of each edition of PINTEC:

- 2011: Pharmaceutical (51,8%);
- 2014: Computing (66,7%);
- 2017: Petroleum (53,2%).

As the sectors that are in the High and Medium-high GIT had average % higher than the industry average, it is suggested that Work Organization (OT) OI matter more for companies in these sectors compared to those of Low GIT companies and Medium-low. Despite the study by Morais, Brejão and Costa Neto (2019) pointing out that the process of change provoked by the OI was absorbed in a positive way by the employees, allowing greater agility in the process in the metallurgical industry, it is emphasized that no studies were found in the researched literature which refer to the fact that OI in OT matters more for companies in sectors with a medium-high and high degree of technology intensity (GIT), compared to the other GIT.

A possible explanation for the result obtained could be that companies belonging to the medium-high and high GIT sectors understand that OI in OT can improve the efficiency of the company in its most diverse departments, and this can increase its competitiveness in a competitive market fierce. Technology has contributed to new work organizations, and as a recent example there was the implementation and intensification of remote work, in the face of the COVID-19 pandemic. It is suggested that companies with greater technological intensity have better conditions for implementing new forms of work organization. Future studies may, for example, capture the effects of COVID-19 on OI in OT, and the results of the present study may serve as a basis for comparisons.

The results of the study by Souza, Catelli and Zilber (2021) point out that the implementation of the flexible work environment, considered an OI in OT, leads to the sharing of ideas and increased creativity and innovation (greater autonomy, freedom, agility, relaxed environments and for rest, well-being in the work environment), talent attraction and retention (presence of new generations, environments emulating “startups”, appreciation by those with young children), cost reduction (reduction of physical space, reduction use of paper, files,

cartridges, concern for sustainability), and employee satisfaction (there is no boundary between personal and professional life, adaptation, communication, culture change).

Table 9 shows the number of companies that performed OI in External Relations (RE).

Table 9

Companies that performed OI in External Relations (RE)

GIT	Sectors	PINTEC						% Average
		2011		2014		2017		
		RE	%	RE	%	RE	%	
	Total	**22.008**	**17,1**	**17.607**	**13,3**	**15.439**	**13,2**	**14,6**
	Industries	**19.213**	**16,8**	**14.388**	**12,5**	**12.570**	**12,5**	**14,0**
Low	Food	2.484	*17,7*	2.025	*14,6*	1.587	*11,1*	**14,4**
	Drinks	135	*14,6*	134	*13,9*	218	*20,9*	**16,6**
	Leather	1.577	*27,7*	1.147	*23,3*	598	*16,1*	**23,2**
	Tobacco	5	*7,9*	6	*8,6*	5	*8,3*	**8,3**
	Print	606	*18,9*	321	*10,6*	353	*14,7*	**14,8**
	Wood	801	*14,6*	623	*11,9*	497	*11,8*	**12,9**
	Furniture	542	*9,3*	727	*11,8*	362	*7,0*	**9,5**
	Paper	484	*21,7*	221	*10,4*	161	*8,6*	**13,9**
	Textile	759	*19,1*	369	*9,6*	511	*15,3*	**14,7**
	Clothing	2.819	*15,2*	1.457	*8,3*	2.077	*14,5*	**12,6**
	Total Low GIT	**10.211**	**17,1**	**7.029**	**12,2**	**6.369**	**12,6**	**14,0**
	% of Industry	*53,1*		*48,9*		*50,7*		
Medium-low	Rubber	966	*13,8*	700	*9,8*	546	*8,6*	**10,8**
	Metal	2.296	*20,0*	1.416	*11,9*	1.121	*11,6*	**14,6**
	Metallurgy	411	*21,6*	195	*11,0*	207	*14,9*	**16,0**
	Minerals	1.256	*12,7*	1.313	*12,0*	1.111	*12,2*	**12,3**
	Petroleum	65	*22,0*	51	*17,2*	70	*24,1*	**21,1**
	Total GIT Medium-Low	**4.995**	**16,3**	**3.674**	**11,4**	**3.055**	**11,4**	**13,1**
	% of Industry	*26,0*		*25,5*		*24,3*		
Medium-high	Electric	509	*23,1*	243	*11,2*	207	*10,9*	**15,3**
	Maintenance	688	*21,5*	423	*10,3*	609	*15,4*	**15,3**
	Machines	1.032	*16,6*	823	*12,5*	831	*14,9*	**14,6**
	Chemical	605	*17,2*	709	*19,5*	440	*12,5*	**16,5**
	Transport	53	*10,0*	197	*32,9*	61	*11,4*	**18,7**
	Vehicles	239	*8,3*	473	*17,1*	326	*13,5*	**12,9**
	Total GIT Medium-high	**3.126**	**16,8**	**2.868**	**14,5**	**2.474**	**13,8**	**15,0**
	% of Industry	*16,3*		*19,9*		*19,7*		
High	Pharmaceutical	136	*29,7*	124	*30,5*	60	*13,8*	**24,6**
	Computing	387	*23,9*	218	*14,1*	207	*15,8*	**18,2**
	Medical	357	*11,4*	475	*13,4*	405	*12,5*	**12,5**
	Total GIT High	**881**	**16,9**	**817**	**14,9**	**672**	**13,5**	**15,1**
	% of Industry	*4,6*		*5,7*		*5,3*		

Source: *Survey data. %Average=∑RE÷∑Total.*

The average percentage (average %) of the sectors that performed OI in External Relations (RE) is higher in the sectors of companies that are in the High GIT (15,1%) and

Medium-high (15,0%), compared to the Industry average % (14,0%). No correlated studies were found to compare the results.

The sectors that most stood out regarding the average % of OI in RE were: Pharmaceutical (24,6%), Leather (23,2%) and Petroleum (21,1%). On the other hand, the sectors that performed the least OI in RE were: Tobacco (8,3%), Furniture (9,5%) and Rubber (10,8%).

The highest percentages of companies that performed OI in RE of each edition of PINTEC:

- 2011: Pharmaceutical (29,7%);
- 2014: Pharmaceutical (30,5%);
- 2017: Petroleum (24,1%).

The study by Aichouche and Bousalem (2016) analyzed the degree of acceptance of OI in algerian pharmaceutical companies, where External Relations (ER) were measured by the degree of openness with the use of intentional inputs and outputs of knowledge to accelerate internal innovation and markets resources for external use of innovation, with the result that open innovation is favorable and related to OI, including a favorable impact of OI on organizational performance. In comparison, the present study found that the brazilian pharmaceutical sector was the one that most performed OI in RE in the 2011 and 2014 editions of PINTEC, with this, it is suggested that OI in RE matters more for the pharmaceutical sector compared to the other sectors.

Oliveira and Avellar (2022), using linear regression, based on data from the 2011 edition of PINTEC, identified that, among others, the elements of External Relations (ER) “Foreign Capital”, “Cooperation” and “Support of the Government” positively influenced the productive performance of the manufacturing industries.

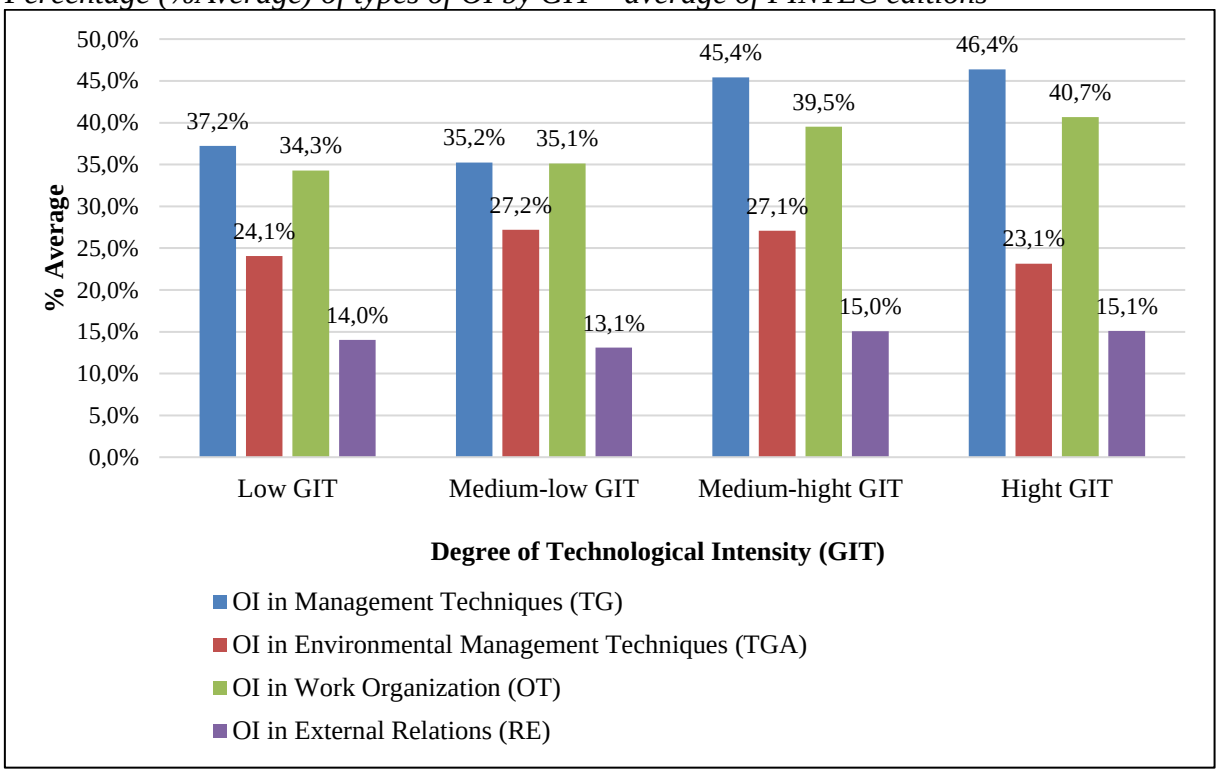
As industries that are in the High and Medium-high GIT had mean % higher than the industry average, it is suggested that External Relations (ER) OI matters more for companies in these sectors compared to companies in Low GIT and Medium-low.

However, it should be noted that of the four types of OI, RE had the lowest average % (14% of the industry) compared to the other types of OI (TG: 38,5%, TGA: 25,4%, OT: 35,7%). Given this, it is suggested that OI in RE is the least important among the types of OI for companies.

Figure 1 shows the average percentage of OI types by GIT.

Figure 1

Percentage (%Average) of types of OI by GIT – average of PINTEC editions



Source: Own elaboration.

It is observed in Figure 1 that the average percentage (%Average) of OI in Management Techniques (TG) is higher than the other types of OI, and is also higher in the Medium-high and High GIT. The same is observed for OI in Work Organization (OT). In these two types of OI, the larger the GIT, the greater the propensity to perform OI in TG and OT.

The OI in TGA are more pronounced in the Middle-Low and Medium-High GIT, and the OI in RE are less evident in the Low and Medium-Low GIT. No correlated studies were found that could be used as a basis for comparing the results of the average percentage of OI types segregated by GIT.

With the exception of teamwork in new product development, human resources is not a predominant theme in innovation studies in general, so it is believed that this is a promising area of research and should receive more attention (Alves, Galina, & Dobelin, 2018). OI has the ability to generate a significant impact on the performance of technological innovation centers (Reina, Thomaz, & Magalhães, 2021).

FINAL CONSIDERATIONS

This study aimed to present the incidence of OI in manufacturing industries located in Brazil. The literature was visited where it was possible to present some aspects of OI. The theoretical context shows that innovation is considered important for the company to obtain competitive advantage, and that OI is fundamental for the evolution of organizational management, in addition to facilitating the realization of other types of innovation.

Having prepared the organization of industry sectors by degree of technological intensity (GIT), it was found that just over half of the number of companies is in the Low GIT, and approximately two thirds of the companies are in the Low and Medium-low GIT. Part of this result is explained by the number of sectors that fall into these groups. These results demonstrate that a significant part of the industries located in Brazil are of low technological intensity.

Among the types of OI, the emphasis on carrying out Management Techniques (TG) was evident, compared to other types of OI, which on average 38,5% of the industries carried out this type of innovation. When analyzed considering the GIT, it is observed that the higher the GIT, the greater the percentage of companies that performed OI in TG (Low GIT: 37,2%, Medium-low GIT: 35,2%, Medium-high GIT: 45,4%, and High GIT: 46,4%).

Another type of OI that deserves to be highlighted and carried out by the companies was the Work Organization (OT), and it was possible to observe that on average 35,7% of the companies carried out this type of innovation, with greater emphasis by the companies of the High and Medium-high GIT (Low GIT: 34,3%, Low-Medium GIT: 35,1%, High-Medium GIT: 39,5%, and High GIT: 40,7%).

The OI in Environmental Management Techniques (TGA) had an average percentage of 25,4% of companies that carried out this type of innovation, and unlike TG and OT, greater emphasis was given to companies that have a Medium-low and Medium- high, probably due to the characteristics of the companies and their need to advance in environmental issues, with emphasis on the Petroleum (47,0%), Chemical (39,0%) and Drinks (42,0%) sectors, which were above average (Low GIT: 24,1%, Low-Medium GIT: 27,2%, High-Medium GIT: 27,1%, and High GIT: 23,1%).

And the OI in External Relations (RE) presented less emphasis when compared to the other types of OI, demonstrated by the average percentage of 14,0% of the industries that mentioned the realization of this type of innovation, with emphasis on the sectors that are part

of the High-Medium and High GIT (Low GIT: 14,0%, Low-Medium GIT: 13,1%, High-Medium GIT: 15,0%, and High GIT: 15,1%).

Therefore, OI in TG were the ones with the highest average percentage, compared to the other types of OI. This suggests that manufacturing industries prefer to perform OI in TG. As performing the types of OI are not mutually exclusive, it is suggested that OI be performed concomitantly. Another item observed was that the Medium-High and High GIT industries are the most likely to perform OI on TG, OT and RE, and that the Medium-Low and Medium-High GIT industries are the most likely to perform OI on TGA.

It is important to highlight the relevance of continuing the studies that deal with OI and its various relationships, such as, for example, with Technological Innovation (TI). The study by Oliveira and Avellar (2021) suggests that there is a correlation between OI and TI in industries located in Brazil, and that the number of companies that performed OI concomitantly with another type of innovation (product, process or marketing) is higher, compared to TI (product and process), in addition to having better results in terms of cooperative relationships, foreign capital, being part of a group, exporting government support and continuous R&D.

The results of the study contribute to the theory in the sense of presenting OI data and its types, carried out by industries located in Brazil, and classified by the degree of technological intensity, which makes the work unprecedented for the literature on the subject, and will serve as a basis for future research.

The contribution to society is made by offering conditions for the analysis of industry sectors, and the elaboration of strategies and policies to encourage OI, enabling the sustainability or increase of financial results, and consequently the generation of employment and income, in addition to the collection of taxes and their respective reversal to society through the government.

The results of editions of PINTEC, professionals from companies and support institutions have shown the importance and need to preserve efforts in favor of innovation, but the conditions of companies, markets and institutional environment have not been very favorable, and the The industry awaits a virtuous cycle of technological development and innovations that will fuel its competitiveness, growth and financial results (IEDI, 2020).

It is highlighted, as limitations of the study, that the results refer to industry sectors, not being advised to use it for other business sectors. It is also noteworthy that the analysis was not carried out considering the size of the companies, leaving this suggestion for future studies. Another limiting aspect refers to the detailing of the data within the types of OI performed, because when the IBGE carried out the data collection, the respondent was only asked if he

performed a certain type of OI, and no information is collected on which element or instrument of OI on TG, TGA, OT and or RE on has been implemented.

Based on the results of this research, it is suggested for future studies to carry out in-depth research that seeks to identify the reasons for performing OI in companies, specifically what leads the company to perform a certain type of OI, what were the results obtained with its implementation, its reflections in the financial and productive scope, among others.

Among the types of OI, it is specifically suggested to observe some related activities, for example, the analysis of the performance of labor productivity, cost reduction, quality of services provided, teamwork, cooperation between workers, cooperation between companies, government and institutions teaching and research, leadership styles, mental well-being, environmental sustainability, job satisfaction, management tools for planning and control, actions with the local community, layout in the workplace, changes in the organization chart structure, safety in the workplace work (health, illness, accidents).

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