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Informal Networks as Catalysts for Innovation: Evidence from Multinational Technology Companies

André Munzinger[1], Cláudio Reis Gonçalo[2],
André Moraes dos Santos[3] , Glauco Oliveira Rodrigues[4], Roberto de Gregori[4],
Sara Segatto[4]

[1] (Doutor, Pelo Programa De Pós Graduação Em Administração, da Universidade do Vale do Itajaí, Brasil, Pesquisador no Instituto Federal Catarinense – IFC e Professor da Administração na Unidavi)
[2] (Doutor, Pelo Programa De Pós Graduação Em Engenharia da Produção, da Universidade Federal de Santa Catarina, Brasil. Professor do Programa de Pós Graduação em Administração da Univali)
[3] (Doutor, Pelo Programa De Pós Graduação Em Administração, da Universidade Nove de Julho, Brasil. Professor do Programa de Pós Graduação em Administração da Univali)
[4] (Pesquisador, Pelo Programa De Pós Graduação Em Administração, da Universidade Federal de Santa Maria, Brasil)

Introdução
Este artigo visa estabelecer uma perspectiva teórico-empírica sobre a inovação e a transferência de conhecimento em organizações globais de tecnologia através do uso de redes informais. Com a implementação das tecnologias da informação e comunicação (TICs) e a difusão de ambientes virtuais de transferência de conhecimento, as empresas intensivas em conhecimento têm novas oportunidades para expandir seus negócios através da inovação em redes informais de cooperação. A pesquisa aborda como essas redes informais promovem a inovação, seja disruptiva ou incremental, e como o conhecimento organizacional é gerado, assimilado e transformado dentro da empresa para obter vantagem competitiva.
Materiais e Métodos
Para o desenvolvimento desta pesquisa, foi adotada uma perspectiva estratégica exploratória de natureza qualitativa, utilizando o estudo de caso múltiplo e a análise de conteúdo (AC) para o tratamento e exploração de dados primários e secundários. Foram realizadas entrevistas semiestruturadas com gestores de duas empresas globais de tecnologia, uma localizada na Alemanha (matriz) e subsidiária no Brasil, e a outra com sede na França e subsidiária também no Brasil. As categorias investigadas incluem conhecimento (aquisição, expansão, armazenamento e transferência), inovação (inovação global e de rede) e redes (interação, conexão global, rede informal e plataforma de interação global). As entrevistas foram complementadas com dados secundários de relatórios anuais e pesquisas existentes.
Resultados
A análise das entrevistas revelou que as redes informais desempenham um papel crucial na promoção da inovação e na resolução de problemas. O uso de plataformas de comunicação integradas e participativas facilita a transferência de conhecimento entre colaboradores globalmente localizados, promovendo a troca de informações, resolução de problemas e geração de novas ideias. A interação em redes informais permite o desenvolvimento de projetos inovadores em equipes multidisciplinares de diferentes países, impulsionando a inovação globalizada. Além disso, o perfil dos líderes das empresas de tecnologia entrevistadas reforça a necessidade de expandir o conhecimento técnico e promover a aprendizagem contínua para assegurar a competitividade das empresas. A transferência horizontal de conhecimento entre unidades e o uso da informalidade na rede de colaboradores contribuem significativamente para o desenvolvimento da inovação.
Palavra-chave*: Knowledge Transfer; Innovation; Informal Networks; Global Technology Companies.*

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I. INTRODUCTION

This article aims to establish a theoretical-empirical perspective on innovation and knowledge transfer in global technology organizations, through the use of informal networks. With the implementation of information and communication technologies (ICTs), and the diffusion of virtual knowledge transfer environments, a new opportunity has opened up for knowledge-intensive companies to expand their business opportunities, through innovation in informal networks of cooperation. This format of innovation, whether disruptive or incremental,

(Christensen, Raynor & Mcdonald, 2015), makes innovation the result of a process that requires resources and transfer of organizational knowledge (Alavi & Leidner, 2001; Bartlett & Ghoshal, 2017).

However, when analyzing aspects of innovation, the value of bringing to light theory, the use of individual knowledge (Crandall & Klein, 1990; Nonaka & Takeushi, 1997; Sudhindra, Ganesh, & Arshinder, 2017) and with greater emphasis on knowledge generated, assimilated and transformed within the organization: organizational knowledge (Cohen & Levinthal, 1990; Todorova & Durisin, 2007 and Zahra & George, 2002). This becomes strategic, a resource that allows organizations to obtain greater competitive advantage (Barney & Hesterly, 2011; Davenport, Prusak & Webber, 2005).

With the possibility of resources and broad and satisfactory knowledge, technology companies have expanded their areas of activity, exploring new markets and seeking to develop original products and services that can serve the markets in which they operate. This multi-integrated form of projects is discussed in internationalization studies (Gupta & Govindarajan, 2000; Szulanski, 1996), understanding multi-territorial organizational knowledge as one of the driving forms of strategic development.

The literature already demonstrates the usefulness of collaboration networks in the flow of information that supports reverse innovation and the localization of innovations in its branches. By promoting innovation through subsidiaries, the organizations investigated develop a network of collaboration and knowledge transfer (Bartlett & Ghoshal, 2017, Costa, Borine & Amatucci, 2013; Roza, 2020 and Tigre, 2006), generated through flows of information that assists in innovative projects and processes and connects the headquarters and subsidiaries in a global space of creation (Batra, Sharma, Dixit & Vohra, 2018; Hansen, 1999; Tsai, 2001). The contribution, through collaborative networks, suggested in the early 2000s (Prahalad & Ramaswamy, 2004; Vargo & Lusch, 2004), integrates the theory with the concept of shared creation and innovation.

However, there are still few studies that analyze the generation of innovations in multinationals based on knowledge flows in a decentralized collaboration, enabling subsidiaries to interact with each other, in order to promote solutions in a more agile and contextualized way. Through a new observation of the phenomenon of creation and its networks, it is possible to expand the usability of the term and add new perspectives for study (Alves, Fernandes & Raposo, 2016; Ramaswamy & Ozcan, 2018). This integrated network also allows individuals to act to share ideas and generate insights, aiming to expand solutions and identify opportunities. The innovation process that occurs between subsidiaries, therefore, is fundamental within the context of this research, as it investigates the development of knowledge transfer and innovation, especially in the use of informal networks in global technology companies, as proposed in research on Munzlinger, Gonçalo and Santos (2023).

Thus, in addition to analyzing the aspects of the networks that make up the phenomenon between the units of global companies, this exploratory research also discusses the structure generated for the transfer of knowledge between headquarters and subsidiaries, in addition to the units themselves, independently, as suggested by future studies by authors Hadengue, Marcellis-Warin and Warin (2017); Sant'Anna, França, Maccari and Da Costa (2019).

II. THEORETICAL FOUNDATION

To reflect on the topic discussed, in this chapter we will be presenting discussions on: a) knowledge and innovation and b) innovation through informal networks.

Specific publications on knowledge transfer began in the literature in the 1980s, with the creation of the International Conference on Knowledge Transfer. Harris and Field (1989) and Nonaka (1988) present this theory as one of the most important variables in the global competition formula, suggesting that governments and companies use knowledge transfer to assist in "fast, intelligent, innovative and informed approaches to solve technological problems" (HARRIS & FIELD, 1989).

As a proposal for Knowlegde Manager (KM) and Knowledge Transfer (KT), the authors Crandall; Klein (1990); Quinn (1992); discussions begin, expanded by Nonaka (1994); Nonaka; Takeuchi (1997) in which a framework is presented with the purpose of understanding the dynamics of knowledge generation, its transformation and subsequent replication.

With the theoretical expansion of the creation of organizational knowledge, 5 constructs were added. Firstly, (1) sharing tacit knowledge; subsequent to (2) creation of concepts; (3) justification of the following concepts; the (4) construction of an archetype and finally the (5) interactive diffusion of knowledge, where the organization appropriates the knowledge generating competitive advantage.

The literature currently points out new aspects for the use of knowledge transfer and management. Recently published articles provide some new parameters on the topic. The dynamics and aspect of the leader in knowledge transfer (Dong-yeol; Seung-hyun, 2018), the knowledge generated at the university with application to entrepreneurship and small businesses (Xiao; Jingdong, 2018), and intra-company cooperation networks in studies between headquarters and subsidiaries (Jasimuddin, Jun & Perdikis, 2019). The studies present a new dimension to knowledge transfer and management, providing new theoretical insights, generating themes for future research.

Innovation and Knowledge

The first prospects in the innovation process are experiments in solving everyday problems. However, it was only at the beginning of the 20th century that the topic began to be debated as an object of study and part of the theory elaborated by Schumpeter (1988), within the capitalist model, differentiating the processes of invention and innovation.

Tidd, Bessant & Pavitt (2015) indicate that innovation requires the promotion of creation and sharing of knowledge, providing unprecedented possibilities through the combination of different information. The recent OECD report on digital transformation in Sweden therefore proposes a different concept that is very pertinent to the context of innovation, which is to: promote the development of new products and processes, organizational methods, markets and any opportunities to improve them (OECD, 2018).

The OECD study analyzed recent developments in the digital economy, considered policies related to digitalization, and made recommendations to increase policy coherence in this area. The report reviewed trends in the use of digital technologies by individuals, businesses and government, examining policies to promote diffusion. Areas covered range from global value chains and innovation, to jobs, skills and work in the digital economy (OECD, 2018).

Thus, the innovation process cannot be analyzed in isolation, there is a need to evaluate the knowledge network present in its development chain, as it is "interactive and social in nature, counting on the contribution of various economic and social agents. social, holders of different types of information and knowledge, inside and outside the company" (CASSIOLATO, LASTRES & MACIEL 2003, p.16).

In this context, Darroch and McNaughton (2002) suggest, as a method to define an innovation, considering the level of behavioral change that the innovation will require from the consumer. These authors prove in their research the relationship between Knowledge Management and Innovation, with the former contributing to both radical and incremental innovations. The logic of development starts from the migration of knowledge, which must be available to be used and, mainly, increased in the organization.

Tigre (2006) observes that when the organization decides to innovate, it makes a management decision and assumes the risks that any change causes. Therefore, the success of both radical and incremental innovation basically depends on the ability of companies to absorb new technologies, procedures and techniques, which, to be effectively adopted, depend on human resources capable of transforming information into knowledge.

The search for knowledge in networks, aids medicine, extends virtual/augmented reality, builds the Internet of people and things, strengthens security, protects the natural environment, assists and facilitates our decisions, activates individuals, equalizes chances, establishes communications and access to data, begins to build a ubiquitous infrastructure, stops being just a branch of technology, grows in the social, cultural, sociological, psychological and artistic space (Zuowei et al. 2016) .

Hajek and Stejskal, (2018) , highlight the strong influence of cooperation in research and development (R&D) in creating spillover effects in sustainable companies. The study contributes with evidence for the origin of knowledge spillovers derived from cooperation between companies and universities and Innovation and Development organizations, as well as testing the influence of internal/external financial support on these effects.

As the authors explain, Christensen; Raynor; Mcdonald (2015), In the case of solutions, disruptive companies create markets by finding a way to turn non-customers into customers. In this context, companies must adopt an effective attitude towards experimenting with business models.

With discovery-driven planning, companies can model uncertainty and update their financial projections as their experiments create new data. This sparks the interest of researchers in understanding how processes and connective networks develop in the company's environment. In the specific context between Headquarters and Subsidiaries, the aim is to specifically understand the origins, creation and development; the reproduction and management of collective constructions, such as routines and capabilities. Therefore, knowledge and informal organizational networks in global technology-based companies are combined, as indicated by studies by Cano-Kollmann et.al. (2016), Del Giudice and Maggioni (2014) and Hacker et al (2019).

Innovation and informal networks

In this topic, we will address issues relating to informal network ties in the innovation process, in which globally located individuals, through informality, come together in the process of creating innovation.

Studies carried out by Kuipers (1999; 2009) define three specific characteristics for informal networks. They are: (a) information network, (b) friendship networks and (c) trust network. These discussions cover the intra-organizational level, as they affect everyone involved in the company. They cover business opportunity relationships, decision-making processes and organizational success, expanding the discussions made by Bachmann (2001), in which he addressed the aspect of the individual in relation to networks of relationships between organizations.

The work developed by Cross, Nohria and Parker (2002) discussed the topic of informal networks empirically in 40 networks from 23 organizations. In the survey produced by the authors, the importance of

informality in relationships within the organization is encouraged, reporting that these, when well used in the company, generate innovative ideas for interconnected problems, producing benefits throughout the company's structure.

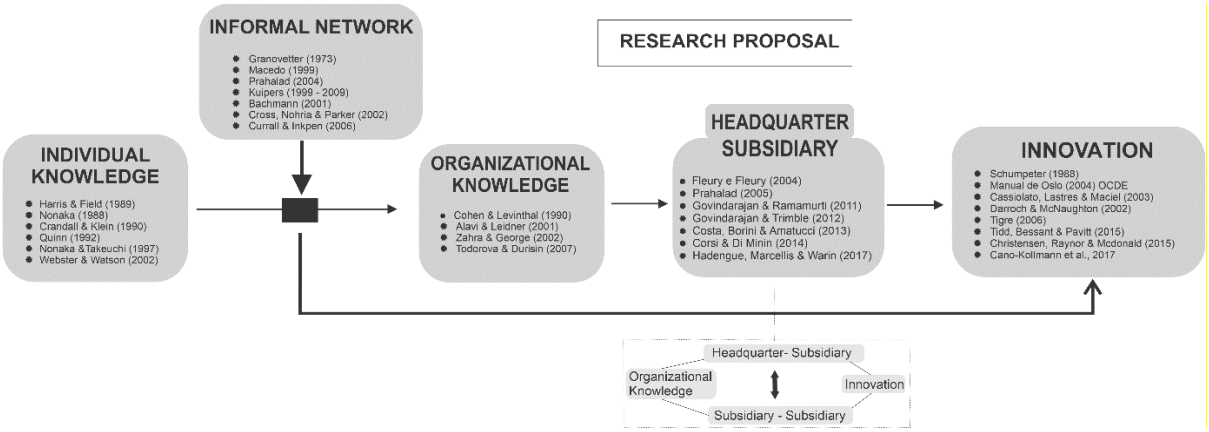
The aspect of professional satisfaction was also evaluated in the research by Cross, Nohria and Parker (2002). In this specific factor, the report demonstrated that informal networks also act in retaining employees, who felt they were participants in the process of developing and creating solutions. According to Fischbach, Gloor and Schoder (2008), using informal networks available in the company, it facilitates the identification of experts at a time when problem solving needs to be effective.

By highlighting the creation of innovation through networks, Lee et al. (2012) and Ramaswamy (2011), begin the discussion of a new process. For them, there is a proposal to evaluate the effects of the network of participants, who seek more effective and real integrations in innovation collaboration. According to the authors, there must be an innovation platform for the convergence of specialized knowledge and ideas, collaboration between organizations, this will be the structure to be focused on creating shared value in products and services. (LEE et al., 2012).

It is worth noting that research into Social Networks and Informal Networks has expanded in recent years. However, despite having a considerable number of high-impact articles, according to authors Arbex and O'Dea (2019), Hesse, Schmidt and Baumgarth, (2020); Huang et al., (2020), there are still gaps that can be addressed in new studies. As this is a new topic in management and business literature, little is discussed about the influence of informal networks on the practice of innovation. Therefore, this research is expressed as relevant, when presenting the subject in the practice of two global technology companies.

Theoretical research framework

Figure 1 – Framework of the theory discussed in the research.



Source: Prepared by the authors (2024).

This exchange of knowledge in networks, between work teams in global companies, is included in this study, transcending the relationship between the headquarters and its subsidiaries (Costa, Borini & Amatucci, 2013). This enables a broad discussion, which permeates the informal connection of these interconnected groups, comprising the generation of innovation and the resolution of problems encountered in the company's day-to-day operations (Mockaitis, Zander & De Cieri, 2018). The theoretical framework in Figure 1 presents the themes listed and the relationship between them, investigated in this research.

Proposal P1, indicated in the Framework, infers the informal organizational network as a bringer of individual and organizational knowledge in the generation of innovation. Through networks, the organization exchanges information and expands its ability to relate to other cultural and business realities, enabling an increase in new knowledge, generating new products and/or services (Hesse, Schmidt and Baumgarth, 2020). The emphasis, in this study, is on the horizontal analysis of informal knowledge interaction, in which all employees, regardless of the unit or country of distribution, participate in the action promoting innovation.

III. METHODOLOGY

For the application and development of this research, we opted for an exploratory strategic perspective, of a qualitative nature, in which the method adopted is the multiple case study and content analysis (CA) in the treatment and exploration of primary and secondary data. (Bardin, 2016). To this end, as a technique, we opted for semi-structured interviews, applied to managers of two global technology companies, the first located in

Germany (headquarters) and in the Brazilian subsidiary, and the second studied, with its headquarters in France, also with the Brazilian subsidiary.

The categories listed in the research were selected from the literature, opting for those intended to deepen the object under study, namely: a) knowledge - acquisition, expansion, storage and transfer; b) innovation – global innovation and network innovation and c) networks – interaction, global connection, informal network and global interaction platform. The aim is also to compare the information obtained in interviews and secondary data, as the cases are of global relevance and, consequently, complex.

To understand the sharing and transfer of knowledge, through informal networks, which is the generator of innovation in technology companies, and individuals as the main responsible for the innovations generated, this was defined as the most effective method to start the investigate the process and make propositions that can explain the results and confront the existing theory, as argued by Richardson (2012).

In the first case, the researcher went to the interviewee in Germany to conduct the interviews, allowing involvement in the participants' experiences and understanding the environment to be investigated. In this process, it was possible to visualize the development of innovations and interactions occurring in the company. In the second case, due to the Coronavirus pandemic, the research took place virtually. In addition to the interviews, secondary data were obtained through annual reports issued by companies and research already carried out, such as the work of Hesse, Schmidt and Baumgarth, (2020).

The multiple case study carried out in two global companies – defended in this research – favors a broad view of the innovation developed, highlighting its character of empirical investigation of contemporary phenomena (EISENHARDT & GRAEBNER, 2007). According to Gibbert et al., (2008) and Yin (2015), case analysis can be carried out when there is sufficient information to prove the assumptions, where all aspects of the investigation are detected.

The companies defined to implement the project were selected after analyzing their structure and the possibility of research at a global level, including the headquarters and the subsidiary. The selection sought to identify the innovative potential of companies, in which innovative characteristics are global, through disruptive and incremental processes developed through networks of actors.

The first organization studied, which will be called Alfa Tech, has units on all continents comprising 20 subsidiaries, in which it has more than 50 thousand employees directly involved in the production of innovations and improvements in technology services in the areas of: telecommunications, health, automotive, aeronautics, security, mobility and several other specificities to serve its 182 thousand customers in more than 5 thousand projects developed annually in its global network.

The second case under study, here called Beta Tech, is a world leader in environmental resource management technology, designs and offers solutions in water, waste and energy management for more than 95 million inhabitants, in the 3,603 cities served in 58 countries on five continents. With more than 300 thousand employees, it directly serves more than 560.5 thousand commercial customers, including 2,389 industrial centers.

The company has a technology and innovation sector, a model that has guaranteed Beta Tech, in the last 6 years, the appropriation of 55 patents registered by Justia Legal Resources in the United States of America. These innovations demonstrate the ability to search for knowledge and innovations in the most diverse countries where the company operates.

The research proposal on informal network analysis in the generation of innovation is also supported by research carried out in a similar way by Allen, James and Gamlen, (2007), when they studied a local company and the interference of the informal network in the product development process and R&D.

IV. DISCUSSION AND RESULTS

Analysis of interviews

To choose the leaders interviewed, within the cases studied, we chose proximity to the object of study. The determining factors for generating information about the development of the project were knowledge transfer protocols and employees working at high management levels, which provides a better understanding of how the processes work. The leaders interviewed from Alfa Tech are listed in Table 1 and from Beta Tech in Table 2.

Table 1 – Profile of Alpha Tech interviewees.

ID	Professional Profile of Interviewed Leaders	Interview Duration	Location
INT. 1	Director of the digital innovation department for 12 years, he has more than 3 thousand direct global employees. Responsible for hiring employees focused on implementing innovation in the company. He currently also holds the role of project manager in the city of Bonn.	01:22:33	Bonn Germany Headquarters
INT. 2	Director of Artificial Intelligence for 5 years, leads a team of more than 100 people in the development of global AI solutions. He has training in the area of Information Technology and gives lectures and workshops in several European countries.	00:42:20	Berlin Germany Headquarters
INT. 3	*Compliance* Manager for over 5 years. He has experience in the area of Information Technology and has worked at the company for over 27 years, having held various positions, such as: innovation manager and process manager, among others. He works at the headquarters in Bonn, Germany, and is currently responsible for developing the ethics system for Artificial Intelligence, which is the model to be implemented in Europe.	00:22:15	Frankfurt Germany Headquarters
INT. 4	Director of the company in Brazil, he has worked at the Blumenau unit for over 10 years. Has experience in managing processes for innovation. He currently coordinates several management groups for the development of solutions in the most diverse areas. He is directly responsible for the unit and the president of the Brazil – Germany Chamber of Commerce, in Santa Catarina.	01:41:10	Blumenau Brazil Subsidiary
INT. 5	Collaborator for 20 years and since 2012 he has been responsible for innovation transfer operations between the group and Startups. He is currently a Senior Manager and is working with the implementation of business development projects with startups in Darmstadt , Germany.	00:13:22	Berlin Germany Business unit
INT. 6	President of the company in Brazil and Argentina for 7 years. He has more than 30 years of experience in the technology sector. He was responsible for local operations and business growth in Latin America.	00:26:32	São Paulo Brazil Subsidiary

Source: Prepared by the authors (2024).

Table 2 – Profile of Beta Tech interviewees

ID	Professional Profile of Interviewed Leaders	Interview Duration	Location
INT. 7	Digital innovation manager at *Alfa Tech* for 6 years. Responsible for projects aimed at implementing innovation in the company. Participates in 12 projects and coordinates more than 100 people. Currently, he is studying a master's degree in Mechanical Engineering and has a degree in Production Engineering.	00:56:48	São Paulo Brazil
INT. 8	Director of Operations for 5 years, leads a team of hundreds of people in several units in Latin America. He has been with the company for 11 years. He has a degree in Environmental Engineering and participates in the innovation project focused on landfills.	00:54:24	São Paulo Sponsor Latin America
INT. 9	IT Director for over 5 years at *Alfa Tech*. He has experience in the area of Information Technology and has worked in the field for over 26 years, having held various positions, such as: innovation manager, IT manager, among others. Currently, it works on the integration of the units' global systems and is linked to the LATAM Zone.	00:56:24	IT Director Latin America
INT. 10	Director of Digital Transformation. He has been in Brazil for over 4 years. Industrial Engineer, has experience in process management and has worked at units in Spain, France and the United States. Currently, he coordinates digital transformation and all segments involved, such as communication, IT and marketing. She is directly responsible for this segment and is hierarchically linked to the company's CEO.	00:37:08	Director Latin and Global America
INT. 11	Contracts and Project Manager for 2 years and was hired to work directly on the link between companies and the innovation sector. She has a degree in Environmental Engineering and a Master's degree in Environmental Sciences and Technologies. He worked for six and a half years at another company in the same segment.	00:43:11	Manager Brazil
INT. 12	Data scientist. Doctor in Administration. Commercial Director of the company for 2 years. Responsible for the company's software innovation and digitalization project. Coordinates 70 employees directly in a specific development unit.	00:48:15	Director Brazil

Source: Prepared by the authors (2024).

After carrying out the interviews and transcriptions, the data was analyzed and complemented using the NVivo software. The total number of cases and coverage presented by the research were 281 and 85% (Alfa Tech) and 314 and 76% (Beta Tech) respectively. The columns represent the coverage of cases in the following areas:

individual knowledge (COB_IND), organizational knowledge (COB_ORG), knowledge transfer (COB_TRSF), informal networks (COB_REDES) and innovation (COB_INOV).

Table 3 – Profile of Beta Tech interviewees.

id	ROOF						
	COB_IND	COB_ORG	CO_TRSF	COB_REDES	COB_INOV	N CASES	COB_TOTAL
ENT. 1	0.0650	0.3037	0.4327	0.0855	0.0748	84	0.9617
ENT. 2	0.0417	0.0335	0.6668	0.0462	0.0977	57	0.8859
ENT. 3	0.0258	0.3960	0.1712	0.0906	0.0680	16	0.7516
ENT. 4	0.1535	0.1996	0.1859	0.0645	0.2190	87	0.8225
ENT. 5	0	0.3242	0.1865	0.0791	0.1882	13	0.7780
ENT. 6	0.0189	0.1817	0.4331	0.0401	0.1840	24	0.8578
ENT. 7	0.0472	0.2052	0.2985	0.0836	0.1668	58	0.8013
ENT. 8	0.0955	0.2341	0.3112	0.0127	0.0968	55	0.7503
ENT. 9	0.1081	0.2387	0.3256	0.0947	0.0402	62	0.8073
ENT. 10	0.0654	0.1277	0.3064	0.0997	0.1014	40	0.7006
ENT. 11	0.0541	0.1421	0.3125	0.0897	0.1127	43	0.7111
ENT. 12	0.0711	0.1727	0.3054	0.0952	0.1484	56	0.7928

Source: Prepared by the authors (2024).

The studies carried out by Camargo and Justo (2005), when analyzing case coverage, define that the considerable value, to be accepted as validation of qualitative research, must have a minimum percentage of 70% to 75%, which was achieved in the present analysis. This makes it possible to affirm that the percentages of use of the answers are sufficient to support this exploratory study.

Regarding the saturation of the interviews, it was verified in the block of 12 interviews that, of the 30 most frequent words in total in the analysis of the interviewees, carried out by NVivo, 27 of them had already been included in the study carried out with 3 of the random research participants, making a total of 90%. In this aspect, the fact that there is 90% equality between the words verified in the set of 3 and 6 interviews, allows us to ensure that data saturation was verified, as recommended by the authors, Bunce and Johnson (2006), Kaufmann (1996) and Minayo (2017).

Individual knowledge emerges as the first set of analysis, which is the generator of organizational knowledge. According to Alvarenga Neto (2008), the creation of knowledge only happens when the organization internalizes its role and provides conditions for people to become empowered. The conversion of individual knowledge into collective knowledge, according to Harris and Field (1989); Nonaka and Takeuchi (2008); Nonaka and Krogh (2009) and Webster and Watson (2002), occurs when there is socialization of experiences, as Roza (2020) and Zahra and George (2002) add in the Absorptive Capacity model.

Thus, the research sought to identify in the leaders interviewed, how the expansion of individual knowledge occurs and what capabilities are necessary to integrate a team in a global technology company. According to the results obtained, technical knowledge can be acquired within the company itself and the company encourages courses and training in the employee's areas of activity. Table 4 presents some anderpts taken from the interviews about the importance of individual knowledge in the company Alfa Tech and Table 5, from the company Beta Tech.

Table 4 – Experpts from interview about individual knowledge at Alfa Tech company.

Theoretical Dimension	**Category**	**Interview.**	**Interview Content**
Individual Knowledge	Acquisition of Knowledge	INT.1	"We can encourage them to take online courses so they can train themselves, that way we can release the power of our employees, they want to have a job for the next ten or fifteen years, twenty years maybe. It's a challenge for all of us, but we need to follow this path."
			(...) "the company's language is English, in theory, as we have a lot of international interaction, especially here at headquarters. Here at headquarters, verbal conversations are around 40% in English and 60% in German."
		INT.2	(...) "have a learning process so that we can all learn from projects that have already been developed in other areas."
		INT.4	(...) "this depends a lot on the vacancy that exists, if it is a Junior he has to have basic knowledge or sometimes he has no knowledge at all because he receives all the training."
		INT.5	"We are also coordinating an academy so that people who have not studied computer science or mathematics can try to get started in the field of AI, at a basic level, but opening up opportunities for people who know how to program."
		INT.6	"This year for example, in years past there was, for example, a requirement to have at least eight, or at least ten, this year there is at least 20 training sessions carried out over the course of a year, 20 training sessions to achieve individual objectives."

			(...) "a higher education degree in the area is a plus, as well as knowing German in addition to English."

Source: Prepared by the authors (2024).

Table 5 – Exerpts from interview about individual knowledge at Beta Tech company.

Theoretical Dimension	Category	Interviewed	Interview Content
Individual Knowledge	Acquisition of Knowledge	INT.7	"I had already worked with an English teacher, and this was my second job opportunity."
			"he has to have a lot of knowledge on the topic we are dealing with".
		INT.8	(...) "that is, a person with a more technical profile, being a civil or environmental engineer."
		INT.9	"the person has some aptitude and has studied or is studying, depending on the level of the position, intern or senior, things related to information technology. So, today the part of network management, information systems, Software Engineering, in short, you have to have some knowledge in this."
			"It's a facility, because Alfa Tech is a multinational company, with languages, they don't want anyone here fluent, an expert in English or Spanish, but I think that for us, for my team, there's no way. I think it's fundamental."
		INT.10	"For me, the most important thing is that you have knowledge of the business and the business challenges."
		INT.11	"I think being an engineer is important."
			"Being fluent at least in English is important. Or who can communicate in English. Why? Because we have relationships with other countries."

Source: Prepared by the authors (2024).

Taking as a basis the absorptive capacity model of Zahra and George (2002) and the definition of organizational learning elaborated by Takahashi (2008), as well as the elements pertinent to the study of knowledge absorption, it is clear in the responses of the leaders interviewed, the importance from individual knowledge to companies.

This reiterates the excerpt from Interviewee 1 regarding the concern with specialization. "We need to build a workforce that remains curious about what skills they have today and what skills they will need in five years, because then I can prepare myself to be employable" (INT.1).

It is possible to see in the interviews that Alfa Tech and Beta Tech constantly seek to enable the expansion of knowledge, aiming to generate new skills and stimulate the competitiveness of companies. Organizational knowledge becomes the object of the next analyses, supported by the studies of Alavi and Leidner (2001); Todorova and Durisin (2007) and Zahra and George (2002).

According to Alavi and Leidner (2001), individual knowledge, when expanded and shared, makes the organization effectively competitive, as the expansion of skills through assimilation and learning enables the generation of new ideas and products, as confirmed by Zahra's studies and George (2002).

In this way, 154 indications of terms referring to the dimension of organizational knowledge and how companies take initiatives to expand and retain this acquired knowledge were identified in the interviews. The interactions between employees and the exchanges of information described help to infer the existence of these processes in the two companies studied.

Table 6 - Excerpts from interviews about organizational knowledge at the company Alfa Tech.

Theoretical Dimension	Categories	Interview.	Interview Content
Organizational Knowledge	Expand Knowledge	INT.1	(...) "we have great knowledge, the best engineers, we have attractive remuneration for them, so looking to the future we definitely need the best scientists and engineers with us, and cooperation, marketing, marketing for employees, everything is very important for us."
			(...) "Interaction is an important approach, that people don't invent things for their bosses or their own ideas, but that we do it together."
	Store Knowledge	INT.4	(...) "an important thing is databases (...) anywhere in the world it is very common to call it Cubase, it is a knowledge database that can be configured for each different project, that is to say can be separated by subject where problems are filed and solutions."
		INT.5	(...) "in this case, exchanging knowledge is very important so that we can know what each person should do, and also to know what can be beneficial to the community, the exchange is important to increase our knowledge."

	Transfer Knowledge	INT.6	"Like every large company, we have repositories, we have YAM, we have cloud storage, patents. We are very open and transparent. Our teams have tools to look for solutions and find practices that have already been done before."

Source: Prepared by the authors (2024).

Table 7 - Excerpts from interviews about organizational knowledge at the company Beta Tech.

Theoretical Dimension	Categories	Interviewed	Interview Content
Organizational Knowledge	Expand Knowledge Store Knowledge Transfer Knowledge	INT.6	"So, we pay for the course and then, sometimes, the training is on site and, sometimes, they go to the institution and do this training. So, he does the training, gets a certificate and everything."
			(...) "Interaction is an important approach, that people don't invent things for their bosses or their own ideas, but that we do it together."
		INT.8	"Mi Campus, because, as it is focused on Latin America, we end up using Spanish more."
		INT.9	"There is an e-learning platform, let's put it that way, and we have a few hours."
			(...) "both corporate courses and specific knowledge courses, how to deal with Google tools or how to make spreadsheets, for example, things like that."

Source: Prepared by the authors (2024).

When evaluating the content of the interviews that deal with the terms "Knowledge", in this set, the individual and organizational aspects were evaluated, making it possible to see that organizations use these aspects to maintain themselves as global leaders. The first, in the technology sector, the second, in waste technology. The next dimension to be specified in the analysis is the concept of this exchange of knowledge between the headquarters and its subsidiaries, the connection, properly speaking, between globally located employees.

Referring to the transfer of knowledge between the headquarters and its subsidiaries, interaction with Brazil was deepened, aiming to specify cooperative projects and joint work networks. Knowledge transfer, in this study, also covers knowledge generated in subsidiaries and at headquarters, according to studies by Costa, Borini and Amatucci (2013), Fleury and Fleury (2004) and Govidarjan and Ramamurti (2011).

The exchange of this knowledge and generalization between subsidiaries and the global company were identified in the interviews, with the work developed through specialized centers and enabling knowledge linked to all units of the company.

The study by Corsi and Di Minin (2014) and Figueira, Luchesi, Silva and Calegario (2017) bring to theory the insertion of "innovativeness" in subsidiaries, and its role in facing the new challenges of technological interaction. From this perspective, of knowledge and innovation between the company's units, the following information was collected:

Table 8 - Excerpts from interviews about knowledge between global units of the company Alfa Tech.

Theoretical Dimension	Categories	Interviewed	Interview Content
Global Knowledge Transfer	Global Knowledge Interaction Global Connection	INT.1	(...) "in this case, the exchange of knowledge is very important so that we can know what each person should do, and also to know what can be beneficial to the community, the exchange is important to increase our knowledge."
		INT.2	(...) "it is very digital because we cannot meet daily in a room in person as people are spread across the planet, but today the digital apparatus we have works very well, e-mail is one of the things, but also using some phone services like Webex, Calling and things like that, it works very well."
		INT.4	"We are a global company, so we will show our strength of competence at a global level and not just at one unit. And today, this relationship, the connection between the units, also makes it easier to establish this way of providing all of our competence, regardless of location and work. There is no longer a department that is responsible for innovation and the rest has nothing to do with innovation, innovation is part of each area of work."
		INT.5	"The teams are connected, regardless of the country they work in. They are encouraged to use this global network to make a better product."
		INT.6	"This sharing is global. Regardless of which unit or office you are in. Alfa *Tech* is global and we can collaborate with anyone from any country. As is the case with offices in several countries. A global company must work globally."

Source: Prepared by the authors (2024).

Table 9 - Excerpts from interviews about knowledge between global units of the company Beta Tech.

Theoretical Dimension	Categories	Interview.	Interview Content
Global Knowledge Transfer	Global Knowledge Interaction Global Connection	INT.7	"We have a methodology that is collaborative, that is there to comment, and I don't have a team, but all the teams help me."
			"There was a very important phase, which was the meeting with the board, meeting with management, understanding the main pain points that we needed to resolve today."
		INT.8	"a very common tool called DDS, which we here call the Daily Security Dialogue, but we don't do it exclusively and solely for security issues, we sometimes end up covering generic terms."
			"We have also participated in some fairs, Fenasan, which is the sanitation fair, so, this has been going on for about two, three years now, and then, we have been following, or looking for partnerships..."
		INT.9	"officially I have biweekly meetings with people from the Latin America region, those responsible for each country, but almost daily I am in contact with the region director."
		INT.11	"In fact, we ended up having very strong interactions with the team of some plant facilitators, others are purchasing teams that manage the contract."

Source: Prepared by the authors (2024).

The elements found in the interviews allow us to infer that companies use the globally located structure as a way of expanding knowledge and transferring it between units, as highlighted by all research participants. This demonstrates that the case under study has information that confirms the strategic vision theorized by Costa, Borini and Amatucci (2015) and Hadengue, Marcellis and Warin (2017), who proposed the influence of subsidiaries on organizational knowledge, which occurs between units. This interaction, in addition to enabling integration, focuses on the development of solutions and innovation.

With the concept of innovation, supported by the studies of Cassiolato, Lastres and Maciel (2003), Christensen, Raynor and Macdonald (2015), Tidd, Bessandt and Pavitt (2015), Tigre (2005), information that could reference to the end, as well as the actions of companies to promote innovation. At first, the discussions refer to the form used. As it is global, it inserts its units into the development process, as can be seen below in Tables 10 and 11.

Table 10 - Excerpts from interviews about innovation between global units of the company Alfa Tech.

Theoretical Dimension	Category	Interviewed	Interview Content
Innovation	Global Innovation Network Innovation	INT.1	"We encourage all subsidiaries to rethink innovation. AI (Artificial Intelligence) is proof of this and so is 5G."
		INT.2	(...) "We also try to combine technology, so we are really doing that, we are trying to nurture innovation, but our team, these 100 collaborators are really nurturing innovation around 5G and AI."
		INT.4	"There is no longer a department that is responsible for innovation and the rest has nothing to do with innovation, innovation is part of each area of work."
		INT.5	"If there is a need in other countries, yes. But when it is something local, without much application in another country, then it is restricted to the subsidiary, but there is always an interest in expanding its use, especially when there are teams from different countries developing it, as everyone who is building it will also want to see it working in their country. country."
		INT.5	"We have many customers and we always need to be innovating, whether in tools, network structure, communication, provision of services or products."
		INT.6	"And when we have an innovation to be carried out, we act in the same way. We set up a team with people from different specialties and located wherever the company operates. In Brazil, Drone and AI projects are some of them."
		ENT.7	"The innovation Department of Technical Development and Performance, where they monitor the performance of each unit to see if it is within the minimum required by the company, as they have the function of developing new technologies, new products, it is almost like R&D that they they call it Research and Development."
		INT.8	"It's like a library. It is a library that contains every document, in my case, that I then enter wherever I am interested within this platform, as it is technical, they go up there, upload all the technical documents, countries, units, procedures, and Then, you can go there and consult."
		INT.10	"(...) any innovation project begins with a detected business need, with an exchange, with: we have to solve this, like *hubgrade* . This can come from management, but it can come from someone who thinks there is an area to improve and speaks to the person in charge and starts an initiative. Effectively, the idea is to have groups, seek help from others, multidisciplinary, who can help you and move forward as a group and as a plan."

Source: Prepared by the authors (2024).

The information obtained through interviews and available documents demonstrates that the innovations present in the company occur connected through teams working together, via collaboration between units and specialist employees. However, the fact that innovations are carried out globally, permeating the link between headquarters and subsidiaries, cannot be refuted as a finding.

In this next analysis, we seek to correlate the teams with the occurrences of knowledge exchange. To integrate this study, the term "networks" was included, identified 45 times in interviews with the company Alfa Tech, with 32 mentions in the company Beta Tech . Likewise, the word YAM ("You And Me") was used as an aid to this understanding, as it refers to the network platform used by the company Alfa Tech, as an "informal collaboration network" and "social network for exchanging information". information". At Beta Tech, the most common terms were: collaborative platform, Digital Box , Whats App and groups.

It should be noted that, like social networks, informal networks emerge as a form of interaction between groups that have similar interests. The difference between the terms is in their applicability. While the former strengthen family and friendship relationships, serving as a form of social mobilization (Freeman, 2006); the second, the theme of this study, are supported by the relationships listed by Krackhardt and Hanson (1997), Macedo (1999) and Kuipers (1999; 2002). Thus, these informal networks are used to exchange information and interconnections within the organization, as reinforced by studies by Hesse, Schmidt and Baumgarth, (2020).

In interviews with both companies, findings were detected that allow us to classify the Collaborative Platform and the You And Me (YAM) digital system as informal networks, due to their characteristics: no hierarchy, participants can interact freely, there is no obligation to participate , free choice of themes and informal relationship between members, (KUIPERS, 2009; MACEDO, 1999; MOCKAITIS, ZANDER & DE CIERI (2018); NIE, LIN, MA & NAKAMORI, 2010), as can be seen in the excerpts below follow:

Table 11 - Excerpts from interviews about informal newtworking and you and me at the company Alfa Tech.

	Categories	**Interviewed**	**Interview Content**
Global Network	Informal Network	INT.1	"With YAM you find a lot of good information that you need, you have a very intelligent way of interacting with experts, if you need an AI expert you look for it and find it, you can make a call with the person or share files. We have more than 120,000 users, more than half of the company's population."
		INT.3	"The YAM portal, is the only media to share these topics, the first step (...) And this is the type of social media created for our collaboration, so we had a lot of context of questions that appeared from other colleagues to ask our team and the direct support of our communications at YAM, so it was a very good medium to further advance the company's projects."
		INT.4	" *You and Me* is a platform where everyone can share information to look for interested parties or partners to work together, to connect. And so that interested people can get involved because there are, of course, spaces that are public, or internal for a certain group of people, collaborators, but there is contact information for the person who publishes, the person who responds, you see who is the person. And also there, all types of information are disseminated in a democratic way."
		INT.5	The teams are connected, regardless of the country they work in. They are encouraged to use this global network to make a better product."
		INT.6	"YAM is an informal solution, like a collaborative one. If you have a problem or want to share ideas, you make an input on YAM and there people who want to collaborate can also post ideas and make comments."
		INT.7	"So there is a specific group for IT tools, to try to bring new ideas." "Internal discussion forums and pages. There are some portals that we always access, the internal global IT portal, where new information is always published on this portal. We always leave it open."
	Global Interaction Platform	INT.8	"Actually, that's what we joke about: if we are a multinational, we have to make this count, if not, I'm just a local company. If we can't exchange expertise, there's no point." "We have this a little more restricted, but, generally, they contact us via email chat, generally it is a more informal contact, or even a call, via *WhatsApp* , we have *WhatsApp groups,* we can exchange this information , talk a little more, in a slightly more informal way, about a project."
		INT.9	"And information travels between countries. This goes from France to the region, the region I mean from Latin America, and from the region to the countries in a very satisfactory way."
		INT.10	(...) "horizontal influence, being able to create work groups where there is no hierarchy, but uniting different profiles from different departments, where everyone has to put their business knowledge and transfer what their needs are and your pain in the business, on a daily basis."
		INT.11	"These groups are multidisciplinary; those who define these requirements (what the business needs) are multidisciplinary; there are different departments within these groups (...)." "So we have these communities where we ask these questions and then we receive contributions from people who sign up to the community, so you sign up based on affinity."
		INT.12	"Projects can start in one unit, in one country, when we say business unit in the country, and then they can become an innovation in the area, and it can also become a global innovation."

Source: Prepared by the authors (2024).

The information also obtained from secondary data makes it possible to understand that the case study of the company analyzed presents a complex model, with several insights to be explored in understanding organizational knowledge.

The use of informal networks, within its own platform, guarantees user interaction, enables the exchange of knowledge, problem solving, in addition to being a driver of new ideas. The documents available in the companies studied confirm the importance of the network, according to the results of the analysis of the interviews and documents, unified in Table 14.

It is possible to see that, in addition to the platform itself, there are groups and interaction through the Whats App application. It can be inferred, therefore, that for companies, the connections and solutions developed are important, and there is no difference through which means this knowledge is shared.

Table 12 – Elements found in secondary data and interviews about informal networks in the two cases studied. Source: Prepared by the authors (2024).

	Categories	Elements
Innovation and Global Network	Knowledge	connect with other network partners to carry out new projects. This dynamic network structure is characterized by an individual arrangement of each network component; It is highly globalized and in all units; Recognition of professional experience; means of possible expansion of experience; we have specialized experience; through training, mobility courses; promote the development of training courses; ease in the English language; *Mi Campus* ; Online courses available on the platform;
	Global Interaction Platform	location of each individual in the network prioritizing *know-who;* Connection via YAM; Talking clearly and about the most important topics within the informality of the network; it is not in fact a static network, but characterized by an intensity of collaborative changes; knowledge among network agents as a preponderant factor in its sustainability; Digital *Box* that serves as a repository; Google tools to manage information; transmission of professional knowledge; share knowledge and transcend traditional boundaries, counting on the collaboration of other units;
	Innovation	undertaking R&D-intensive innovation projects; AI, knowledge is crucial to innovation, Drones project; networks can become ideal for promotion; 5G; cooperation in competitive innovation scenarios increases the importance of skills; networks can become ideal for promotion; thanks to the global network of environmental expertise; *Hubgrade* ;
	Informal Network	resolve complex tasks through this informal system; knowledge that occurs in the network, since innovation processes occur between agents and this same dynamic becomes global; actions carried out within the network, dynamics of horizontal relationships; success of our global network collaboration work; YAM has a clear focus on workforce collaboration; you ask your question in this community, quickly, someone will answer you; information is exchanged through these communities; it is usually a more informal contact, or even a call, via *WhatsApp;* we work with email, *WhatsApp* , virtual meetings; it works in a more informal format within the platform itself;

Discussion of results

The results highlight the importance of informal collaborative networks in promoting innovation in global technology companies. Through a qualitative methodology, including multiple case studies and content analysis, it was possible to identify how cooperation in research and development (R&D) and the exchange of knowledge between work teams are fundamental for creating spillover effects in sustainable companies.

Informal networks play a crucial role in generating innovation and solving problems. The use of integrated and participatory communication platforms facilitates the transfer of knowledge between globally located employees, promoting the exchange of information, problem solving and the generation of new ideas. Interaction in informal networks allows the development of innovative projects in multidisciplinary teams from different countries, boosting globalized innovation. Furthermore, the profile of technology company leaders interviewed reinforces the need to expand technical knowledge and promote continuous learning to ensure companies' competitiveness. The horizontal transfer of knowledge between units and the use of informality in the employee network contribute significantly to the development of innovation.

Although organizational knowledge is not perfect and there are barriers to be overcome, collaboration in organizational development generates innovations that expand knowledge and create competitive advantage. Integration through informal networks allows the creation of innovation horizontally, strengthening the ability of companies to adapt and prosper in a dynamic global environment. The conclusions of this study provide valuable insights for managers and leaders of technology companies, highlighting the importance of fostering informal

networks and promoting a culture of collaboration and knowledge exchange to sustain innovation and competitiveness in the global market.

Pratical study notes promoting continuous learning

Companies should encourage ongoing courses and training for their employees. This can be done through internal training programs and partnerships with educational institutions. The practice of encouraging employees to take online courses and obtain certifications is essential to unlock employees' potential and ensure long-term competitiveness. Integration of Communication Platforms: The implementation of integrated and participatory communication platforms is crucial to facilitate the transfer of knowledge between globally located employees. These platforms must allow real-time interaction and the exchange of information efficiently, promoting problem solving and the generation of new ideas. Promotion of Informal Networks: Informal networks within companies should be encouraged, as they play a fundamental role in innovation and problem solving. Creating environments that encourage spontaneous interaction between employees can generate valuable insights and promote innovation horizontally. Development of Leaders with a Technical and Multicultural Profile:

Selecting leaders with strong technical knowledge and English communication skills is essential, especially in global companies. These leaders must be prepared to deal with cultural and linguistic diversity, facilitating integration and collaboration between the company's different units.

- **Implementation of Knowledge Transfer Protocols:** Establishing clear protocols for the transfer of knowledge between company units is essential. This includes documenting processes, holding workshops and creating knowledge repositories accessible to all employees.
- **Focus on Global and Networked Innovation:** Companies must adopt an approach to innovation that considers both global and local aspects. Innovation projects can start in a specific unit and later be scaled to other units or even to the entire company, promoting globalized innovation.
- **Continuous Assessment and Adaptation:** Continuous assessment of innovation processes and informal networks should be carried out to identify areas for improvement and adapt strategies as necessary. This ensures that the company remains agile and able to respond quickly to market changes.

Contributions to the academic field integration of informal network and innovation

- **Innovation:** The study contributes to the literature by demonstrating how informal collaborative networks can be a significant driver for innovation in global technology companies. The research shows that spontaneous interaction between employees, facilitated by integrated communication platforms, promotes the exchange of knowledge and the generation of new ideas, reinforcing previous theories about the importance of collaboration networks in the flow of information.
- **Qualitative Methodology Applied to Global Companies:** Using a multiple case study and content analysis to investigate global technology companies provides a robust methodological model for future research. The qualitative approach allows for an in-depth understanding of complex phenomena related to knowledge transfer and innovation in a global context.
- **Knowledge Transfer in Global Environments:** The research expands the understanding of knowledge transfer between headquarters and subsidiaries, highlighting the importance of informal networks in facilitating this process. This finding is particularly relevant for studies on knowledge management and innovation in multinational organizations.
- **Profile of Leaders in Technology Companies:** The study identifies the need for leaders with strong technical knowledge and multicultural skills, especially in global companies. This insight contributes to the literature on leadership and management in international contexts, suggesting that the ability to deal with cultural and linguistic diversity is crucial to organizational success.
- **Global and Local Innovation:** The research addresses the duality between global and local innovation, showing how innovative projects can be initiated in a specific unit and scaled to other parts of the organization. This finding contributes to innovation theory, suggesting that innovation can be both a local and a global phenomenon, depending on the structure of informal networks and knowledge transfer.

V. FINAL CONSIDERATIONS

This research made it possible to observe the role of information technology and knowledge flows in informal collaborative networks in the development of innovations in global technology companies. The results highlight the importance of informal collaborative networks in the development of innovations within global technology companies. Through data analysis, it became evident that horizontal relationships play a crucial role in the application of these informal networks, promoting actions aimed at the inactivity of the companies studied. This finding is in line with previous studies that also suggest the relevance of horizontal relationships for innovation.

Data analysis demonstrated that the integrated communication platforms, through voluntary participation, enabled the creation of an informal network that enabled the transfer of knowledge between globally located employees. Through this integrative platform, in addition to exchanging information, developers can suggest improvements, create concepts, manage projects and promote innovation. Individual and organizational knowledge, through this horizontal transfer between units and the use of informality in the employee network, enables the development and increase of innovation. By promoting innovation through subsidiaries, the organization develops a collaboration and knowledge transfer network, interconnecting the headquarters and subsidiaries in a global space for creation.

It is worth mentioning that platforms have their strategic values, as they represent the innovative culture of companies and through them, projects, ideas and new concepts are developed by their employees. The development of innovation is a process and the availability of an online tool to integrate this entire global generation chain, with exchange of ideas and problem solving during the construction cycle, becomes a way of including this interaction format in the innovative process, identified in both cases studied.

At Alfa Tech, examples of innovation are 5G, AI and Drone technology projects and at Beta Tech, Hubgrade and waste interconnection projects were developed by multidisciplinary teams online and from different countries, using tools and platforms informal communication.

When interacting through networks, actors from multinational companies increase another characteristic that could be perceived in this research: globalized innovation. Unlike reverse innovation, (Costa, Borini & Amatucci, 2013; Govindarajan & Ramamurti, 2011; Figueira, Luchesi, Silva & Calegario, 2017;) where the subsidiary shares or sends the knowledge developed to the headquarters and other subsidiaries.

Even though we know that the application of an organizational network to transfer knowledge is not perfect and there are barriers to be overcome (Horak et al., 2020; Trkman & Desouza, 2011), there is evidence in the interviews and documents analyzed that demonstrate that there is collaboration in the development organizational, generating innovations in globally located technology companies, such as the cases under analysis and suggested in the studies by Hesse, Schmidt and Baumgarth, (2020); Mockaitis, Zander and De Cieri, (2018).

This new integration format allows the creation of innovation through informal networks. Innovation is generated when several employees from different units come together to develop solutions in an informal environment. This interaction takes place horizontally, expanding the knowledge of globally located technology companies, enabling the rapid integration of projects and solutions developed, reducing implementation costs and, consequently, generating greater competitive advantage.

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