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Article

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Article

Driving Innovation Initiatives in a Multinational Company Subsidiary: A Case Study and Conceptual Framework for Further Application

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Abstract: This study aims at identifying factors that facilitate the development of the capacity to generate innovations in a subsidiary of a multinational company. Based on the understanding that innovation management deals with the establishment of organizational routines and the investigation of environmental factors that affect the success of the innovation process, the purpose of this work is to contribute toward identifying these factors. For this, a single case study was carried out in a Brazilian subsidiary of a German multinational company, having as incorporated objects the two Business Units of the subsidiary. The results include 20 potential factors to drive the innovation process in the subsidiary company organized as a tree-like structure with three categories: reasons to innovate, spontaneous factors and induced factors. The structure serves as a conceptual framework to address future research, as well as to help subsidiaries' managers to leverage innovative potential. The study opens room for further implementation of open innovation in the company, as the innovation process is now more stable and robust. Excellent alternatives for open innovation projects are available in the local market and can now be implemented by the company.

Keywords: innovation management; innovation process; innovation capacity; multinational companies



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1. Introduction

The association between globalization and technological development imposes a competitive scenario that forces companies to streamline their innovation processes [1,2]. Simultaneously, companies should continuously strive to reduce costs, mainly those related to their industrial machinery and manufacturing operation [3]. Regarding multinational companies (MNC) and innovation based on research and development (R&D), there is an incomplete understanding of how subsidiaries create capabilities to innovate when MNCs move activities from headquarters to emergent markets [4]. This is the case for R&D activities transferred by MNCs to foreign subsidiaries [5–7]. In the 1980s, competitive advantage was provided by a headquarters whose main role was to transfer technology to foreign subsidiaries [8]. Nowadays, subsidiaries abroad autonomously develop R&D activities focused on local objectives [2].

Related studies have focused on the moving process from headquarters to subsidiaries [7,9–17]. Recent research indicates that the generation of competitive advantages also occurs through capacities developed abroad [7,18–20], not only in MNC headquarters [21]. Furthermore, an important source of competitive advantage for MNCs is the capacity of foreign subsidiaries to generate innovations relying on drivers and resources available in the geographical region of the subsidiary [14].

This study relies on two assumptions, (i) innovation capacity requires the organizational potential to innovate [4,22] and (ii) innovation is a path-dependent process based

on proven capabilities, not only in the headquarters but also in subsidiaries [23]. Both assumptions demand the identification of facilitating factors whose presence or absence may boost or hinder the innovation process [18,24], pointing to a research gap to be bridged. To do this, the study needs to answer a research question: How can facilitating factors help build the necessary capacity to support innovation in MNCs' subsidiaries? The purpose of the study is to identify facilitating factors that boost the innovation capacity of an MNC subsidiary. The main finding is the definition of a conceptual model to support managers of MNC subsidiaries in further innovation processes. The main implication is that now the company can look forward to open innovation initiatives relying on local, skilled innovation agents, available for joint implementations. Open innovation can have a significant impact on the competitiveness of manufacturing companies and can quickly boost profits of manufacturing companies based on technology [3], such as in the studied company. Open innovation initiatives may convey the development of innovative support products, such as APPs or software licenses.

The rest of the article includes the literature review, methodology, results and conclusion.

2. Subsidiary Innovation Capacity

Innovation is a strategic concern aiming to increase the existing market share, enter new markets, or generate some type of competitive advantage. Relying on innovation, companies can increase the efficiency of manufacturing processes [3], increase customer satisfaction, improve reputation and achieve a sustainable competitive advantage [25]. An important aspect that differentiates innovation from a single new idea or invention is the need for implementation and the contribution to the overall performance [26,27]. Innovation is an evolutionary process to turn an idea into practical use and organizational changes [28]. Innovation relates to a new or improved product, process, or a combination of both that is significantly different from previously adopted solutions, both in the product and in the production process [27].

MNCs usually embrace a network of globally dispersed subsidiaries [23] that control multiple stocks of resources owned by the parent company [10]. The MNC's ability to explore resources and capabilities beyond borders is critically dependent on its ability to transfer knowledge [29]. A subsidiary is an operating unit located outside the birthplace that carries out activities under the control of the headquarters [12]. The scope of activities of the subsidiaries characterizes the concept of mandate [2]. Subsidiaries may arise through a green-field operation, acquisition of an existing company, or joint venture [30]. Certain subsidiaries develop, over time, new roles and competencies (resources and capabilities) that increase their importance and strategic relevance for MNCs, which includes innovation strategy [21,31].

Innovation requires material resources, collaborative structure and problem-solving skills [32]. Innovation capacity can be tough as a continuous search is required for improvement in capabilities and resources to take advantage of opportunities [33] and neutralize threats in the industry [34]. Resources are firm-specific assets, such as patents, brands, reputation, installed base and human assets that boost production [35,36]. Capabilities are the abilities to deploy resources that influence skilled capacities necessary for innovation [37], based not only on individual skills but also on collective learning, equipment and facilities [38]. Subsidiaries can develop distinctive capabilities by combining the host-country resources with locally available resources and capabilities [39]. Once developed, these distinct capabilities may eventually contribute to the innovative capacity of the MNC headquarters [40,41].

2.1. Antecedents to Innovation Capacity: Facilitating Factors

Multiple antecedent factors, the drivers, may shape the innovation process [42]. The success of the innovation process depends on establishing organizational routines and identifying facilitating factors [43]. Facilitating factors encompass several environmental and contextual-specific factors that positively influence the innovation process [44]. The lit-

erature refers to such factors by multiple names, such as determinants, catalysts, drivers, or stimuli. Figure 1 (adapted from [22]) represents how facilitating factors relate to innovation.

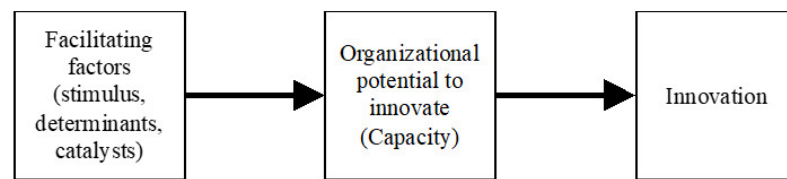


Figure 1. Facilitating factors.

Multiple facilitating factors may have a dynamic and relational behavior [22] acting as a barrier or a driver, depending on the type of mutual influence among them and on the performance of the innovation process [44]. Based on a survey of 194 business managers in Australia, [22] found a strong relationship between drivers, the capacity for innovation and innovation performance, as well as non-direct effects on the capacity for innovation. The study identifies a positive relationship between facilitating factors, the drivers, capacity for innovation and innovation performance.

2.2. Structural and Behavioral Contexts

Subsidiaries must at the same time comply with local regulations, serve local markets and generate value for headquarters [45]. Subsidiaries must move in the local as well as in the MNC structural and behavioral context. Structural contexts encompass forces that influence the business process, such as organizational structures, control systems, indicators and evaluation performance systems. Behavioral contexts encompass individual behavior, collaboration, training and learning, as well as guiding beliefs developed over time [12]. The scope of this study includes only internal contexts and dependent factors; external factors are not investigated.

Factors that facilitate innovation depend on behavioral and structural contexts [23]. In the structural context of MNC, three intertwined and complementary factors usually stand out: miniature replication, multiple embeddedness and combinative capabilities [45]. Miniature replications apply when subsidiaries try to replicate headquarters [46]. Multiple embeddedness captures respectively the closeness and intensity of relationships and information exchange, as well as the extent to which internal and external resources are interconnected [45]. Under such factors, eventually, subsidiaries may develop specific capacities over time, moving from applying external innovation to driving innovation. In such cases, resulting innovation may also be useful in headquarters [47,48]. Multiple embeddedness also includes universities, suppliers, customers, institutions and other subsidiaries, establishing a large number of stable and profitable local connections [18], which favor open innovation initiatives [3].

The third factor is combinative capabilities, the capacity to integrate and recombine knowledge [23]. The tacit nature of the knowledge ensures the recombination of innovation results with acquired knowledge from subsidiaries, headquarters and external sources [49], such as that observed in open innovation initiatives. Cooperation within the MNC network and with local agents is essential to provide the knowledge necessary for innovations. Knowledge transfers may occur exclusively within the MNC network and between the network and external, local agents that help find specific solutions to specific problems. Joint learning, cooperation between units, cooperation with external agents and new knowledge can enable the subsidiary to increase profits for the MNC [45].

Behavioral contexts encompass autonomy, entrepreneurship and strategy. Autonomy relates to the degree to which subsidiaries can decide regardless of headquarters [13]. The role of subsidiaries in final decisions may vary according to an eventually conquered autonomy, which is positively related to the subsidiary's ability to innovate. Greater autonomy provides subsidiaries with better adaptation to local market requirements [50]. Entrepreneurship is the capacity of subsidiaries required to promote innovation indepen-

dently of headquarters. Particularly, subsidiaries demonstrate their entrepreneurship in business development initiatives [31]. A business development initiative is a proactive and deliberate search for new business opportunities by the subsidiary to expand its scope of responsibility in line with the headquarters strategy [12]. Subsidiary initiatives are expected to be proactive, autonomous and risk-taking, stemming from outside the home country, within a foreign subsidiary and under the leadership of the subsidiary's actors. New knowledge can emerge due to a proactive initiative in searching for opportunities [51]. Eventually, this knowledge can be used to innovate, even by headquarters [52].

2.3. Leadership

The subsidiary's leadership stands out as an essential factor for innovation [18,48], which should rely on a culture focused on innovation [26]. Leadership may require ascending, horizontal and descending strategic positioning. Ascending strategies include searching for new responsibilities required, increasing the importance for headquarters and usually conveying more resources to subsidiaries. Horizontal strategies include interaction and cooperation among subsidiaries with similar importance and also with external agents [2,53]. Horizontal activities may also increase the importance of the subsidiary and convey access to critical resources eventually idle in other subsidiaries, owing to multiple insertions or embeddedness [54]. Descending strategies include the exploration and eventual development of abilities limited to the subsidiary [2]. Such strategies may limit the scope of activities of the subsidiary to a local market, which may, eventually, in the long term, develop a strong competitive capacity based on niches. Nonetheless, it is not unusual that headquarters limits investment in innovations to subsidiaries that compete by niches [45].

2.4. Influence of Different Contexts

The relationship between headquarter and the subsidiary may produce managerial factors that facilitate the emergence of the capacity to innovate [4]. Subsidiaries can increase their influence and autonomy when they succeed in producing profits and finding solutions to problems that interest headquarters [10,55]. The such relationship shows dynamic and relational aspects of multiple factors that facilitate innovation [44]. A usual implication is an increment in the subsidiary's capabilities due to the interaction with different knowledge resources and the absorption of the knowledge from headquarters and other companies of the MNC network [21,48].

A recent review study [48] encompassing 72 articles identified 15 facilitating factors, organized into three constructs: local environment (LE), subsidiary traits (ST) and headquarters strategy (HS). LE refers mainly to the possibility of knowledge acquisition by the subsidiary from the headquarters' business environment. The key factors are local insertion, local market and local resources. ST refers to the characteristics and capabilities that allow the subsidiary to acquire, assimilate and combine knowledge and learning from the local environment. The factors retrieved from the literature were subsidiary leadership, availability of resources, dynamic knowledge capabilities, self-determination, teamwork, credibility and intra and intercommunication. HS refers to the headquarters' influence on the subsidiary's innovative capacity. The role of the subsidiary relies on the headquarters' strategy, which usually includes investment in innovation and performance control. The related factors are the investment in research and development, headquarters involvement, decentralization (or degree of autonomy), expatriate resources and mandate. Some simplifications help to facilitate the identification of factors:

- The local insertion and local resources are considered within the multiple insertion factor;
- The self-determination factor is understood as an initiative;
- The credibility factor is inserted in the relationship with the headquarter;
- Instead, the decentralization factor is considered as the autonomy factor.

The teamwork factor is the ability to cooperate and communicate between subsidiaries [13]. Culture clashes within a globalized company can also be lessened when

the cultural distance is small [56]. Broad communication channels facilitate the flow of knowledge since subsidiaries have formal and informal communication channels and mechanisms that facilitate the transfer and sharing of knowledge among them [15]. In an MNC network, the higher the density of internal communication, the larger the number of well-succeed innovations. Similarly, the subsidiaries that most adopted innovations received from the headquarters were those in which the local managers maintained more intense communication with the headquarters’ managers. [50].

Communication patterns reflect the nature and extent of organizational integration and this integration is an essential determinant of innovation. High integration among business partners results from a high degree of organizational socialization [50]. Socialization relates to the ability to facilitate relationships of trust, create a shared vision and minimize differences in preferences and interests between members of the network, using mechanisms for exchanging information that meets cost requirements and benefits [19]. Periodic meetings such as visiting trips and managers’ temporary transfers between headquarters and subsidiaries, integrated projects, task forces and joint committees are examples of mechanisms for organizational socialization, [19,50]. The intensive use of socialization mechanisms can increase the headquarters’ confidence in the subsidiary competencies [19], reinforcing the importance of socialization and communication as relevant factors in the innovation processes of complex organizations [5,55].

Finally, the subsidiary’s mandate is a factor that can influence the capacity for innovation. The mandate is the strategic positioning that defines and identifies the role, goals and scope of the subsidiary’s operation [4,48]. Subsidiaries with knowledge creation mandates present a rate of innovation higher than subsidiaries with knowledge exploration mandates. The headquarter investment policy is also a factor with a strong relationship with the subsidiary’s innovation capacity.

2.5. Conceptual Research Framework

This research aims to identify factors present in the context of an MNC subsidiary that can have a positive influence on the capacity to innovate, i.e., facilitating factors. Figure 2 shows the factors retrieved from the literature organized in a conceptual framework proposition.

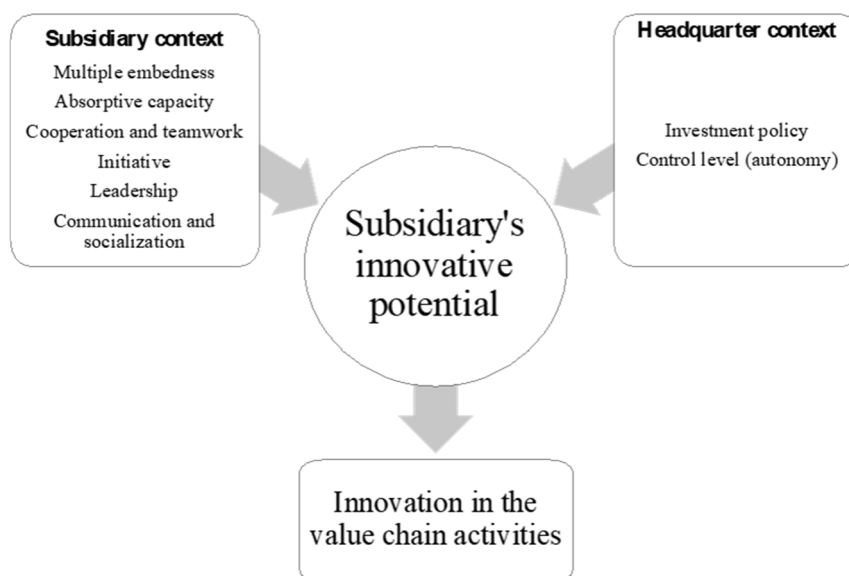


Figure 2. Conceptual framework.

The framework presents the factors within two contexts, the subsidiary and the headquarters, encompassing respectively their idiosyncratic factors. The framework also shows the influence of these factors on the capacity to generate fruitful innovation [22]. The framework was used to stimulate the respondents to report their perceptions of the

relevance of the proposed factors on the generation capacity of the subsidiary to innovate. The research does not limit itself to the factors previously selected. Eventually, new factors may arise during the empirical stage of the study.

3. The Case

The research relies on the case study strategy. Case studies are especially relevant when the research question approaches a contemporary, complex situation or phenomenon and is especially useful to answer questions beginning with how or why [57]. The current study has a qualitative, descriptive approach that embraces a single unit with multiple subsidiaries, i.e., a single case study with embedded objects.

The research method is a single case study. The focus of interest includes only one of the subsidiaries of the multinational company and only local markets. The single case-based research strategy examines a single phenomenon in depth and it is not possible, necessary, or desirable to separate it from the environment. The case can be exploratory if it raises hypotheses for future studies; descriptive, looking for and testing associations between variables defined in farms; or explanatory, in which plausible explanations for the described associations are presented. Cases can contribute to future theory in five ways: (i) they offer in-depth descriptions of objects for other studies; (ii) interpret regularities as evidence of more general postulates, not yet verified; (iii) investigate a situation in search of a hypothesis; (iv) make a plausible probing of an existing hypothesis; and (v) the crucial case supports or refutes a plausible hypothesis already probed. The objectives are the exploration, generation and testing of hypotheses [57]. The present case is descriptive. It is not explanatory, since it does not provide explanations for the behavior of variables. The contribution is of the third type and a hypothesis for further, wider studies, has been found.

3.1. The Company

The study focuses on a subsidiary of the German Group Stihl GmbH, established in 1975 in the city of São Leopoldo, Brazil. The company is an exemplary case of growth and longevity in the local scenario. The Stihl Group sells portable motorized tools for the forestry, agricultural, professional gardening, cleaning and conservation and civil and domestic construction markets. Headquartered in Waiblingen, Germany, the company is recognized worldwide, aiming to ensure a high standard of quality of products and services. To serve the global market, currently, the company has more than 12,000 employees worldwide and seven production units in Germany, Brazil, the United States, Austria, Switzerland, China and the Philippines. Despite being a family business already in the third generation, the Group's current management does not have family members, who withdrew from the business. The family is involved in all strategic decisions through its Board of Directors. The Brazilian subsidiary, which has more than 2300 employees, is installed in an industrial site with more than 87,000 m² of built area, 51% occupied by production areas and 24% by logistics and warehousing facilities. Besides, the company operates the largest R&D center out of Germany's headquarters, totaling approximately 3500 m² of built area. The company offers to the local market and Latin America a wide range of portable motorized tools found in more than 3000 points of sale throughout Brazil and distribution centers in Argentina and Colombia. Products are sold exclusively by authorized distributors, who offer information on use, safety, maintenance, operation and warranty, based on technical delivery procedures. The company invests in partnership with its resellers' network, conducting regular training in five Qualification Centers distributed in Brazil. The Brazilian subsidiary has a robust strategic role since the cylinder business supplies more than 85% of key components for the entire group.

The subsidiary encompasses two business units. The Power Tools unit produces the group portfolio for the Brazilian and Latin American markets. Internal manufacture of key components ensures intellectual property. The unit has vertical manufacturing, subdivided into areas by technical competence, the so-called mini-factories. The priority is to reduce production, material and component costs. The component ensures low emissions of

polluting gases and increased power. The company continuously develops new products, manufacturing technologies and materials. Product replacement occurs every 2.5 years. R&D receives 4% of the global revenue. The main competitive differential is cutting-edge technology development to meet the stringent requirements of professional users of products of the Stihl group. The study has delimitations as it focuses only on activities related to the product, process, production and internal logistics development. Activities related to brand management, design, distribution, marketing, sales and after-sales are outside the current scope.

3.2. Interviews

Data were gathered from documents (website data, reporting information, etc.), field observations and interviews with managers and directors involved with innovation activities, i.e., elite informants [58]. Elite informants are important when research aims to construct or test theories in strategic management, as they allow for assessing how top management influences policies, processes and actions throughout the organization. The interviews involved the Brazilian subsidiary president, the vice president of operations and the directors responsible for the two business units selected for the interviews. Managers of logistics and planning, product engineering and process engineering for each business unit were also selected. The Brazilian subsidiary's process engineering is responsible for developing the production means (machines, tools and devices) and manufacturing processes within each business unit. As the researcher is the manager responsible for the process engineering of the Cylinder unit, it was decided to interview one of the area supervisors following the same criteria used in selecting the other interviewees. Production managers from each business unit, tooling and maintenance managers were also selected. The interviewees' list also included the human resources manager and the supervisor of the subsidiary's area of continuous improvement, totaling 14 local interviews. In addition, two employees of the headquarters in Germany that play relevant roles and have a significant influence on the Brazilian subsidiary answered a questionnaire by email. Their responses served to verify the alignment of perceptions of the headquarter and local interviewees regarding the subsidiary's innovation capacity. Table 1 profiles the respondents.

Table 1. Respondents' profile.

Respondent	Job Position	Site	Age	Experience (Years)	Scholar Degree
1	Director	Subsidiary	45	19	Engineer
2	Supervisor	Subsidiary	39	9	MSc Engineer
3	Manager	Subsidiary	41	8	MSc Engineer
4	Director	Subsidiary	40	13	MSc Engineer
5	Manager	Subsidiary	47	10	Engineer
6	Manager	Subsidiary	52	30	MSc Engineer
7	Director	Subsidiary	57	32	MSc Engineer
8	Manager	Subsidiary	37	16	Engineer
9	Manager	Subsidiary	61	36	Engineer
10	Director	Subsidiary	55	12	BSc Accounting
11	Manager	Subsidiary	41	10	Engineer
12	Manager	Subsidiary	46	10	MSc Engineer
13	Supervisor	Subsidiary	42	13	Engineer
14	Manager	Subsidiary	39	10	Engineer
15	Manager	Headquarter	39	12	Engineer
16	Specialist	Headquarter	61	34	Engineer

3.3. Data Collection and Analysis

The interviews used a script based on the proposed conceptual model. Fourteen interviews were carried out at the subsidiary and two in the headquarters between February and March 2020. The interviews were digitally recorded and lasted about 60 min. The interviews were initiated, requesting the formalization of the interviewee's acceptance

through a consent form. Next, the interviewee’s general and demographic information was collected. As a preparatory step for the interview, the research objective was recalled and the relevant concepts were introduced to the interviewees. A two-fold strategy was adopted. Firstly, the concept of facilitating factors was introduced and an open question was posed, generating spontaneous responses without the researcher’s influence. Finally, the answers were stimulated by the researcher. The proposed framework was used to encourage respondents to report their perceptions regarding the relevance of the factors. Triangulation helps to assess the convergence of the collected data, achieved by multiple interviews, not only to explore concordances but also to identify divergences and contradictory points of view. Besides, there was a triangulation between data and the theoretical basis, documents collected in the company and empirical observations.

The data were analyzed using the content analysis technique [59], supported by the ATLAS.ti Cloud® software, available at <https://atlasti.com/cloud/> (accessed on 16 September 2022). The audio files were transcribed and analyzed and the data is coded and categorized. The result is a tree-like structure that organizes the influent factors. Tree-like structures are especially useful in strategic studies as they facilitate further improvements, mainly when such improvements employ multi-attribute methods to assign importance to the factors [60]. This is true in the current case as different factors may impact different intensities in the final result, the innovation performance. Table 2 shows the tree-like hierarchical structure of categories extracted from the interviews.

Table 2. Tree-like structure of driving factors and categories.

Top Term	Main Topic	Category
Innovations drives	Reasons to innovate	Competitiveness
		Cost reduction
		Survival
	Facilitating factors: Spontaneous	Quality
		Product Complexity
		Differentiation
	Facilitating factors: Stimulated	Strategic importance
		Skilled people/Knowledge
		Culture
		Available resources
		Long-term relationship
		Type of Company
		Leadership
		Investment policy
		Initiative
		Communication and Socialization
		Autonomy
		Cooperation and teamwork
		Absorption capacity
		Networking

4. Discussion

4.1. Innovation Drives

According to most respondents, the main reasons that lead the subsidiary to seek innovation are the search for competitiveness, cost reduction and the survival of the Brazilian plant. According to [25] and regarding competitiveness, corporate strategies encompass innovation for multiple reasons, such as to increase productivity in manufacturing processes, to increase market share, to build a positive reputation with customers and, as a result, to gain a sustainable competitive advantage.

Cost is an important competitive criterion. As identified in the study, innovation may boost cost reduction. The difference between them is the focus of the reduction due to the inherent characteristics of each unit. While the Cylinder unit aims to reduce fixed

costs, the Power Tools unit aims to reduce raw materials and components' costs [61]. Therefore, it is true that different business units have different competitive strategies, adopting different competitive criteria. The strategy in operations relates to the definition of which competitive criteria the company must compete in [62]. Competitive criteria are quality, reliability, flexibility and cost. The Cylinders' business unit criteria are quality, reliability (delivery) and cost (internal). In the Power Tools unit, the perceived criteria were cost (raw material and components) and flexibility (production). These are the criteria responsible for driving innovation in the subsidiary [61].

4.2. Facilitating Factors

The case helps to improve the conceptual framework according to Figure 3.

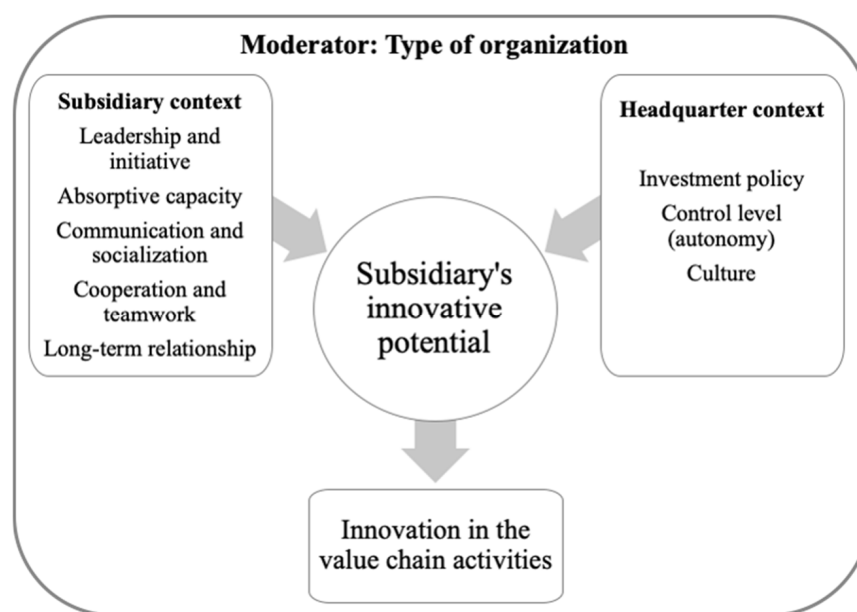


Figure 3. A revised conceptual framework.

From the original conceptual model, it was possible to validate some factors from the theory as well as to identify a factor not supported by the literature consulted on factors that facilitate innovation. In the context of the subsidiary, leadership is the main factor and, in addition, directly linked to the initiative factor. The interviewees understand leadership as having several roles in the company's innovative process, such as: promoting a culture of innovation and an appropriate environment for teamwork, initiative and motivation to search for problem-solving through innovation [63].

In the improved framework, the long-term relationship factor, verified in the context of the subsidiary, was not found in the literature. However, there is a relationship between this factor and Total Quality Management (TQM) [64]. According to [65], TQM can have a positive and significant relationship with innovation. The Toyota system is a classic example of these aspects of TQM. The long-term relationship between the company and its employees is the starting point for the implementation of Toyota's culture, as employees are considered part of the company's assets. Therefore, the labor force is not a generic or interchangeable good, but a strategic asset [64]. That long-term relationship contributes to individuals' aggregate absorptive capacity would lead to positive innovation outcomes especially when their activities are highly coordinated [66]. The factor of a long-term relationship with the Organization relates to the generation of knowledge for the subsidiary studied. This aspect allows different professionals to mature through a long-term journey concerning the technical knowledge needed for innovations. The Organization's knowledge asset, necessary for innovation, can significantly relate to the interaction of the facilitating factor's

long-term relationship with the subsidiary education and continuing professional training practices over time. This interaction is a differential in the company's innovative potential.

In the headquarters context, the culture factor was included since it was noticed during the interviews that this factor permeates the MNC and is related to the company's family aspect. Family members visit the subsidiary annually to check the improvements and innovations carried out with a particular interest in the manufacturing processes. It seems possible to affirm that there is a high level of agreement among the interviewees regarding the positive influence of the Stihl family members on the subsidiary, not only in terms of a technical culture but also in strengthening the employees' identity with the company. This fact is mainly referred to, as Mr. Hans Peter Stihl, son of the company's founder in Germany and, currently, Honorary President of the Stihl group, [67] understands culture as one of the determinants of innovation, since it can reinforce and inhibit behaviors in favor of innovation. The author adds that the basis of an innovative organization is its organizational culture since the necessary skills and attitudes are in the company's employees. When large international corporations begin operating in a country with different social norms, they must conform to the expectations of the local population, demonstrate social responsibility in the new country and gain social acceptance. The difficulty in achieving social acceptance is a consequence of the difference in culture between the home country and the host country [68].

The network insertion factor did not obtain sufficient mention to validate its relevance to the subsidiary. Respondents related this factor mainly to universities and research institutes and, although there are already some partnerships in this sense, they do not perceive direct results from innovations arising from these partnerships.

Facilitating factors may be subject to certain moderating factors. The existence of four main moderators is as follows: (i) type of organization; (ii) type of innovation; (iii) adoption stage; and (iv) scope of innovation. In this sense, the author understands that each moderator would imply different factors that facilitate innovation. Thus, cited as an example, goods and services companies, public and private, would demonstrate different factors related to the generation of innovations when considering the organization's moderating variable type [69]. As this study encompasses a family business, such an aspect may have influenced the relevance of some facilitating factors and/or the reduction of the effect or non-existence of others. Therefore, the type of company factor was included in the new framework as influencing the subsidiary and parent company's behavioral context. The behavioral context, which is inherent to each company, would be the set of values and beliefs of the organization that shapes the behavior and, for this reason, it would have an influence on which factors would facilitate the generation of the innovative capacity of the company. In the case of the researched subsidiary, it is possible to state that different business units from a given subsidiary, with different competitive criteria to serve its internal and external customers, may present similar facilitating factors for the generation when inserted in the same behavioral context of innovative potential [23].

5. Final Remarks

The main contribution of this study is the proposition of a tree-like structure framework of factors that can drive internal potential and capacities to boost innovation. The framework organizes twenty potential factors into three categories, reasons to innovate, spontaneous factors and induced factors. The resulting conceptual framework can help both in academic studies and in industry, particularly in innovation strategies formulated by MNC subsidiaries. The main limitation of the study relates to the research strategy, the case study. Although the study has reached a conceptual framework, this framework should be verified in similar cases to enrich the factors and eventually distribute importance among the constructs. Such goals are forwarded to further, complementary research.

This study contributes to the academic development related to studies on innovation, particularly those related to innovation in MNC subsidiaries. The factors discussed and analyzed in this work are relevant to facilitate the journey toward the necessary capacity

for innovation. Another contribution to the academy is to bring up aspects that can contribute to research that deals with the relationship between TQM and the capacity for innovation [69,70]. The identified factor related to the longer-term employment relationship established between the employees and the company has a relevant influence on the retention and development of the subsidiary's knowledge. Despite not finding theoretical grounds in the literature consulted on factors that facilitate innovation, there is a grounding in the TQM literature [69].

It is worth highlighting the contribution of managers of MNC subsidiaries who can, based on the findings of this research, seek improvements in their companies' innovative potential. A particularly relevant fact for these managers is the understanding of the importance of an explicit and formally established innovation system. This is because the absence of such a system can result in isolated innovation activities not aligned with the company's strategy, causing waste in the use of resources developed over time and available in the company. Another essential contributing aspect, also anchored in TQM, refers to the practice established in the subsidiary of subsidized education and continuing professional training for its employees. This aspect, together with a long-term relationship between the company and employees, can be a relevant differential in an MNC subsidiary's innovative potential.

In the current case, results validate and reinforce management practices anchored in the proposed framework to enhance the Brazilian subsidiary's innovative capacity. Together with the current production system at the Brazilian plant, implementing an innovation management system is necessary to use the subsidiary's resources and capabilities. Finally, anchored in the framework, it is possible to conclude that leadership that promotes initiative, driven by the competitive strategy, along with the development and retention of knowledge and a corporate culture focused on innovation, are the potential ingredients to generate the necessary conditions for innovation in the context of a subsidiary. It is also worth highlighting the influence of the headquarter on this potential in the sense of having an investment policy aimed at R&D, determining an adequate level of autonomy for the subsidiary and valuing and promoting the corporate culture focused on innovation and continuous improvements.

As a final implication, the study opens room for implementing open innovation initiatives in the company [71]. Local stakeholders offer consolidated opportunities in key strategic innovative drivers, such as renewable energy [72], industrial symbiosis [73], energy-exchanging networking [74], sustainable and cleaner production [75] and virtual-supported product development [76]. Such initiatives supported by local open innovation agents may deal with resource and environmental externalities [77] which, besides complying with local regulations, can support the main customer of the company, the forestry industry.

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References

1. Cheah, S.; Ho, Y.; Li, S. Search strategy, innovation and financial performance of firms in process industries. *Technovation* **2021**, *105*, 102257. [\[CrossRef\]](#)
2. Gilmore, E.; Andersson, U.; Memar, N. How subsidiaries influence innovation in the MNE value chain. *Transnatl. Corp.* **2018**, *25*, 73–100. [\[CrossRef\]](#)
3. Gauss, L.; Lacerda, D.P.; Sellitto, M.A. Module-based machinery design: A method to support the design of modular machine families for reconfigurable manufacturing systems. *Int. J. Adv. Manuf. Technol.* **2019**, *102*, 3911–3936. [\[CrossRef\]](#)
4. Figueiredo, P.; Larsen, H.; Hansen, U. The role of interactive learning in innovation capability building in multinational subsidiaries: A micro-level study of biotechnology in Brazil. *Res. Policy* **2020**, *49*, 103995. [\[CrossRef\]](#)
5. Lô, A.; Geiger, M. Managing internal embeddedness in multinational corporations' R&D subsidiaries: An evolutionary perspective on the automotive industry in Silicon Valley. *Technovation* **2022**, *113*, 102422.
6. Contractor, F.; Kumar, V.; Kundu, S.; Pedersen, T. Reconceptualizing the firm in a world of outsourcing and offshoring: The organizational and geographical relocation of high-value company functions. *J. Manag. Stud.* **2010**, *47*, 1417–1433. [\[CrossRef\]](#)
7. Lim, C.; Hemmert, M.; Kim, S. MNE subsidiary evolution from sales to innovation: Looking inside the black box. *Int. Bus. Rev.* **2017**, *26*, 145–155. [\[CrossRef\]](#)
8. Birkinshaw, J.; Hood, N. Multinational subsidiary evolution: Capability and charter change in foreign-owned subsidiary companies. *Acad. Manag. Rev.* **1998**, *23*, 773–795. [\[CrossRef\]](#)
9. Garg, G.; Sewak, M.; Sharma, A. Learning from Older Siblings: Impact on Subsidiary Performance. *Int. Bus. Rev.* **2022**, *31*, 101957. [\[CrossRef\]](#)
10. Ambos, T.; Andersson, U.; Birkinshaw, J. What are the consequences of initiative-taking in multinational subsidiaries? *J. Int. Bus. Stud.* **2010**, *41*, 1099–1118. [\[CrossRef\]](#)
11. Andersson, U.; Forsgren, M. In Search of Centre of Excellence: Network Embeddedness and Subsidiary Roles in Multinational Corporations. *Manag. Int. Rev.* **2000**, *40*, 329–350.
12. Birkinshaw, J. Entrepreneurship in multinational corporations: The characteristics of subsidiary initiatives. *Strateg. Manag. J.* **1997**, *18*, 207–229. [\[CrossRef\]](#)
13. Boehe, D. The roles of Brazilian subsidiaries in the innovation strategy of foreign multinational companies. *Admin. J.* **2007**, *42*, 5–18.
14. Frost, T.; Birkinshaw, J.; Ensign, P. Centers of excellence in multinational corporations. *Strateg. Manag. J.* **2002**, *23*, 997–1018. [\[CrossRef\]](#)
15. Gupta, A.; Govindarajan, V. Knowledge flows and the structure of control within multinational corporations. *Acad. Manag. Rev.* **1991**, *16*, 768–792. [\[CrossRef\]](#)
16. Roth, K.; Morrison, A. Implementing global strategy: Characteristics of global subsidiary mandates. *J. Int. Bus. Stud.* **1992**, *23*, 715–735. [\[CrossRef\]](#)
17. Figueiredo, P. The role of dual embeddedness in the innovative performance of MNE subsidiaries: Evidence from Brazil. *J. Manag. Stud.* **2011**, *48*, 417–440. [\[CrossRef\]](#)
18. Hansen, U.; Larsen, T.; Bhasin, S.; Burgers, R.; Larsen, H. Innovation capability building in subsidiaries of multinational companies in emerging economies: Insights from the wind turbine industry. *J. Clean. Prod.* **2020**, *244*, 118746. [\[CrossRef\]](#)
19. Borini, F.; Oliveira, M., Jr.; Silveira, F.; Concer, R. The reverse transfer of innovation of foreign subsidiaries of Brazilian multinationals. *Eur. Manag. J.* **2012**, *30*, 219–231. [\[CrossRef\]](#)
20. Dias, A.; Salerno, M. Decentralization of Research, Development and Engineering activities of transnational companies: An investigation from the perspective of automotive subsidiaries. *Gest. Prod.* **2009**, *16*, 187–199. [\[CrossRef\]](#)
21. Liu, T.; Li, X. How Do MNCs Conduct Local Technological Innovation in a Host Country? An Examination from Subsidiaries' Perspective. *J. Int. Manag.* **2022**, *28*, 100951. [\[CrossRef\]](#)
22. Prajogo, D.; Ahmed, P. Relationships between innovation stimulus, innovation capacity, and innovation performance. *R D Manag.* **2006**, *36*, 499–515. [\[CrossRef\]](#)
23. Reilly, M.; Scott, P. Subsidiary driven innovation within shifting MNC structures: Identifying new challenges and research directions. *Technovation* **2014**, *34*, 190–202. [\[CrossRef\]](#)
24. Murphree, M.; Petersen, B.; Warrian, P.; Gosine, R. Scope and scale of technology challenge and MNE subsidiary knowledge sourcing in host countries. *Technovation* **2022**, *116*, 102485. [\[CrossRef\]](#)
25. Gunday, G.; Ulusoy, G.; Kilic, K.; Alpkan, L. Effects of innovation types on firm performance. *Int. J. Prod. Econ.* **2011**, *133*, 662–676. [\[CrossRef\]](#)
26. Read, A. Determinants of successful organizational innovation: A review of current research. *J. Manag. Prac.* **2000**, *3*, 95–119.
27. OECD Publishing. *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation*; OECD: Paris, France, 2018.
28. Damanpour, F.; Aravind, D. Managerial innovation: Conceptions, processes and antecedents. *Manag. Organ. Rev.* **2012**, *8*, 423–454. [\[CrossRef\]](#)
29. Gölgeci, I.; Ferraris, A.; Arslan, A.; Tarba, S. European MNE subsidiaries' embeddedness and innovation performance: Moderating role of external search depth and breadth. *J. Bus. Res.* **2019**, *102*, 97–108. [\[CrossRef\]](#)
30. Cavanagh, A.; Freeman, S. The development of subsidiary roles in the motor vehicle manufacturing industry. *Int. Bus. Rev.* **2012**, *21*, 602–617. [\[CrossRef\]](#)

31. Birkinshaw, J. The determinants and consequences of subsidiary initiative in multinational corporations. *Entrep. Theory Pract.* **1999**, *24*, 9–36. [CrossRef]
32. Laforet, S. A framework of organizational innovation and outcomes in SMEs. *Int. J. Entrepr. Behav. Res.* **2011**, *17*, 380–408. [CrossRef]
33. Tarraço, E.; Bernardes, R.; Borini, F.; Rossetto, D. Innovation capabilities for global R&D projects in subsidiaries. *Eur. J. Innov. Manag.* **2019**, *22*, 639–659.
34. Pierre, A.; Fernandez, A. Going deeper into SMEs' innovation capacity: An empirical exploration of innovation capacity factors. *J. Innov. Econ.* **2018**, *1*, 139–181. [CrossRef]
35. Forsman, H. Innovation capacity and innovation development in small enterprises. A comparison between the manufacturing and service sectors. *Res. Policy* **2011**, *40*, 739–750. [CrossRef]
36. Besanko, D.; Dranove, D.; Shanley, M.; Schaefer, S. *Economy of Strategy*; John Wiley & Sons: Hoboken, NJ, USA, 2009.
37. Papanastassiou, M.; Pearce, R.; Zanfei, A. Changing perspectives on the internationalization of R&D and innovation by multinational enterprises: A review of the literature. *J. Int. Bus. Stud.* **2020**, *51*, 623–664.
38. Petricevic, O.; Teece, D. The structural reshaping of globalization: Implications for strategic sectors, profiting from innovation, and the multinational enterprise. *J. Int. Bus. Stud.* **2019**, *50*, 1487–1512. [CrossRef]
39. Teece, D. Dynamic capabilities: Routines versus entrepreneurial action. *J. Manag. Stud.* **2012**, *49*, 1395–1401. [CrossRef]
40. Sheng, M.; Hartmann, N. Impact of subsidiaries' cross-border knowledge tacitness shared and social capital on MNCs' explorative and exploitative innovation capability. *J. Int. Manag.* **2019**, *25*, 100705. [CrossRef]
41. Collinson, S.; Wang, R. The evolution of innovation capability in multinational enterprise subsidiaries: Dual network embeddedness and the divergence of subsidiary specialization in Taiwan. *Res. Policy* **2012**, *41*, 1501–1518. [CrossRef]
42. Salerno, M.; Gomes, L.; Silva, D.; Bagno, R.; Freitas, S. Innovation processes: Which process for which project? *Technovation* **2015**, *35*, 59–70. [CrossRef]
43. Souza, J.; Faria, M. Innovation process in the organizational context: An analysis of facilitators and hindlers. *Braz. Bus. Rev.* **2013**, *10*, 113–136.
44. Hadjimanolis, A. The barriers approach to innovation. In *The International Handbook on Innovation*; Elsevier: Amsterdam, The Netherlands, 2003.
45. Phookan, H.; Sharma, R. Subsidiary power, cultural intelligence and interpersonal knowledge transfer between subsidiaries within the multinational enterprise. *J. Int. Manag.* **2021**, *27*, 100859. [CrossRef]
46. White, R.; Poynter, T. Strategies for foreign-owned subsidiaries in Canada. *Bus. Q.* **1984**, *49*, 59–69.
47. Andrews, D.; Fainshmidt, S.; Gaur, A.; Parente, R. Configuring knowledge connectivity and strategy conditions for foreign subsidiary innovation. *Long Range Plann.* **2022**, *55*, 102089. [CrossRef]
48. Betaraya, D.; Nasim, S.; Mukhopadhyay, J. Subsidiary innovation in a developing economy: Towards a comprehensive model and directions for future research. *FIIB Bus. Rev.* **2018**, *7*, 109–125. [CrossRef]
49. Kogut, B.; Zander, U. Knowledge of the firm, combinative capabilities, and the replication of technology. *Organ. Sci.* **1992**, *3*, 383–397. [CrossRef]
50. Ghoshal, S.; Bartlett, C. Creation, adoption and diffusion of innovations by subsidiaries of multinational corporations. *J. Int. Bus. Stud.* **1988**, *19*, 365–388. [CrossRef]
51. Schmid, S.; Dzedek, L.; Lehrer, M. From rocking the boat to wagging the dog: A literature review of subsidiary initiative research and integrative framework. *J. Int. Manag.* **2014**, *20*, 201–218. [CrossRef]
52. Michailova, S.; Zhan, W. Dynamic capabilities and innovation in MNC subsidiaries. *J. World Bus.* **2015**, *50*, 576–583. [CrossRef]
53. Memar, N.; Andersson, U.; Gillmore, E. What Happens when Subsidiaries Go through a Change? Impact of Gaining an R&D Mandate on Subsidiary Managers Activities and Subsidiary Innovation. In *Megatrends in International Business*; Batas, S., Kuivalainen, O., Sinkovics, R.R., Eds.; Palgrave Macmillan: Cham, Switzerland, 2022.
54. Andersson, U.; Forsgren, M.; Holm, U. The strategic impact of external networks: Subsidiary performance and competence development in the multinational corporation. *Strateg. Manag. J.* **2002**, *23*, 979–996. [CrossRef]
55. Davy, E.; Hansen, U.; Nygaard, I. Dual embeddedness? Innovation capabilities, multinational subsidiaries, and solar power development in South Africa. *Energy Res. Soc. Sci.* **2021**, *78*, 102145. [CrossRef]
56. Singh, D.; Pattnaik, C.; Lee, J.; Gaur, A. Subsidiary staffing, cultural friction, and subsidiary performance: Evidence from Korean subsidiaries in 63 countries. *Hum. Resour. Manag.* **2019**, *58*, 219–234. [CrossRef]
57. Eisenhardt, K. Building theories from case study research. *Acad. Manag. Rev.* **1989**, *14*, 532–550. [CrossRef]
58. Aguinis, H.; Solarino, A. Transparency and replicability in qualitative research: The case of interviews with elite informants. *Strateg. Manag. J.* **2019**, *40*, 1291–1315. [CrossRef]
59. Krippendorff, K. *Content Analysis: An Introduction to Its Methodology*; Sage Publications: Thousand Oaks, CA, USA, 2018.
60. Nara, E.; Sordi, D.; Schaefer, J.; Schreiber, J.; Baierle, I.; Sellitto, M.; Furtado, J.C. Prioritization of OHS key performance indicators that affecting business competitiveness—A demonstration based on MAUT and Neural Networks. *Safety Sci.* **2019**, *118*, 826–834. [CrossRef]
61. Lewis, M.; Slack, N. *Operations Strategy*; Pearson Education: London, UK, 2014.
62. Skinner, W. Manufacturing-missing link in corporate strategy. *Harv. Bus. Rev.* **1969**, 136–145. Available online: <https://peppers.feb.unesp.br/vagner/files/2009/03/skinner-69-hbr.pdf> (accessed on 16 September 2022).

63. Denti, L.; Hemlin, S. Leadership and innovation in organizations: A systematic review of factors that mediate or moderate the relationship. *Int. J. Innov. Manag.* **2012**, *16*, 1240007. [[CrossRef](#)]
64. Liker, J.; Hoseus, M. *Toyota Culture: The Heart and Soul of the Toyota Way*; McGraw-Hill: New York, NY, USA, 2007.
65. Prajogo, D.; Sohal, A. The relationship between TQM practices, quality performance, and innovation performance. *Int. J. Qual. Reliab. Manag.* **2003**, *20*, 901–918. [[CrossRef](#)]
66. Yildiz, H.; Murtic, A.; Klostfen, M.; Zander, U.; Richtner, A. Individual and contextual determinants of innovation performance: A micro-foundations perspective. *Technovation* **2021**, *99*, 102130. [[CrossRef](#)]
67. Machado, D.; Gomes, G.; Trentin, G.; Silva, A. Culture of innovation: Elements of culture that facilitate the creation of an innovative environment. *J. Innov. Manag.* **2013**, *10*, 164–182.
68. Kim, C.; Choi, S.; Zhang, L. Determinants of Staff Localization in Headquarters-Subsidiary-Subsidiary Relationships. *Sustainability* **2021**, *14*, 249. [[CrossRef](#)]
69. Damanpour, F. Organizational innovation: A meta-analysis of effects of determinants and moderators. *Acad. Manag. J.* **1991**, *34*, 555–590.
70. Perdomo-Ortiz, J.; González-Benito, J.; Galende, J. Total quality management as a forerunner of business innovation capability. *Technovation* **2006**, *26*, 1170–1185. [[CrossRef](#)]
71. Chesbrough, H.; Brunswicker, S. A fad or a phenomenon? The adoption of open innovation practices in large firms. *J. Res. Technol. Manag.* **2014**, *57*, 16–25.
72. Borchardt, M.; Poltosi, L.A.; Sellitto, M.A.; Pereira, G.M. Adopting ecodesign practices: Case study of a mid-sized automotive supplier. *Environ. Qual. Manag.* **2009**, *19*, 7–22. [[CrossRef](#)]
73. Adami, V.S.; Júnior, J.A.V.A.; Sellitto, M.A. Regional industrial policy in the wind energy sector: The case of the State of Rio Grande do Sul, Brazil. *Energy Policy* **2017**, *111*, 18–27. [[CrossRef](#)]
74. Sellitto, M.A.; Murakami, F.K.; Butturi, M.A.; Marinelli, S.; Kadel, N., Jr.; Rimini, B. Barriers, drivers, and relationships in industrial symbiosis of a network of Brazilian manufacturing companies. *Sustain. Prod. Consum.* **2021**, *26*, 443–454. [[CrossRef](#)]
75. Sellitto, M.A.; Murakami, F.K. Industrial symbiosis: A case study involving a steelmaking, a cement manufacturing, and a zinc smelting plant. *Chem. Eng. Trans.* **2018**, *70*, 211–216.
76. Trujillo-Gallego, M.; Sarache, W.; Sellitto, M.A. Identification of practices that facilitate manufacturing companies' environmental collaboration and their influence on sustainable production. *Sustain. Prod. Consum.* **2021**, *27*, 1372–1391. [[CrossRef](#)]
77. Anjos, F.V.; Rocha, L.O.; Silva, D.D.; Pacheco, R. Virtual and augmented reality application in production engineering teaching-learning processes. *Production* **2020**, *30*, e20190088. [[CrossRef](#)]