

## Supplier development practices and their challenges: a roadmap proposal

### Práticas de desenvolvimento de fornecedores e seus desafios: proposta de um roadmap

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#### **ABSTRACT**

Original Equipment Manufacturers (OEMs), when focusing on their core business, outsource non-essential processes to their supplier base, a strategy that makes them dependent on their suppliers' performance. The purpose of this paper is to propose a practical roadmap based on the post-relevant supplier development practices, barriers to be avoided by the managers, and critical success factors identified by the literature reviewed and in five Brazilian companies in the automotive segment. Although supplier development (SD) is widely acknowledged, there is no roadmap to guide the organizational managers when applying it. The roadmap aims to direct managers' activities when developing their suppliers to obtain better results. The method used was a qualitative research and its strategy was a multiple case study with an exploratory character. Data collection was obtained through a semi-structured interview. The research identified 17 relevant practices of supplier development. These practices of supplier development identified by the literature reviewed, coupled with the manager's speech, have enabled the researcher to figure out an empirical roadmap to assist organizational managers in planning and conducting development actions on

their supplier base in a structured manner. The results obtained by the managers' speech indicated that OEMs want creative and innovative solutions from their suppliers to be applied to the new generations of their vehicles, far beyond the products or services usually delivered until now. Another important result for the successful supplier development was the top team's commitment to implement the changes resulting from development practices combined with a preventive rather than corrective posture.

**Keywords:** Supplier development practices, supplier development roadmap, barriers, critical success factors, industry 4.0 and case study

## RESUMO

Os fabricantes de equipamentos originais (OEMs), ao se concentrarem em seus negócios principais, terceirizam processos não essenciais para sua base de fornecedores, uma estratégia que os torna dependentes do desempenho de seus fornecedores. O objetivo deste artigo é propor um roteiro prático baseado nas práticas relevantes de desenvolvimento de fornecedores, barreiras a serem evitadas pelos gestores e fatores críticos de sucesso identificados na literatura revisada e em cinco empresas brasileiras do segmento automotivo. Embora o desenvolvimento de fornecedores (DF) seja amplamente conhecido, não há um roteiro para orientar os gerentes organizacionais na hora de aplicá-lo. O roadmap visa direcionar as atividades dos gestores no desenvolvimento de seus fornecedores para a obtenção de melhores resultados. O método utilizado foi a pesquisa qualitativa e sua estratégia foi o estudo de casos múltiplos de caráter exploratório. A coleta de dados foi obtida por meio de entrevistas semiestruturadas. A pesquisa identificou 17 práticas relevantes de desenvolvimento de fornecedores. Essas práticas de desenvolvimento de fornecedores identificadas pela literatura revisada, somadas ao discurso dos gestores, permitiram ao pesquisador traçar um roteiro empírico para auxiliar os gestores organizacionais no planejamento e na condução de ações de desenvolvimento de sua base de fornecedores de forma estruturada. Os resultados obtidos pela fala dos gestores indicaram que as OEMs querem soluções criativas e inovadoras de seus fornecedores para serem aplicadas nas novas gerações de seus veículos, muito além dos produtos ou serviços normalmente entregues até agora. Outro resultado importante para o desenvolvimento bem-sucedido dos fornecedores foi o compromisso da equipe de topo em implementar as mudanças resultantes das práticas de desenvolvimento, que devem ser combinadas com uma postura preventiva ao invés de corretiva.

**Palavras-chave:** Práticas de desenvolvimento de fornecedores, roadmap para o desenvolvimento de fornecedores, barreiras, fatores críticos de sucesso, Indústria 4.0 e estudos de caso.

## 1 INTRODUCTION

Manufacturing companies need highest flexibility and speed in their production processes, to keep up with demands of the markets in which they operate, and in this way systematically reduce the so-called "time to market". The challenges to be tackled include internal process optimization of these companies and linking them to the external value chain's processes of their entire supplier base. Sharma and Yu (2013) understand that the highest hierarchical levels of the organizational structure of OEMs must focus on the companies' core competencies, in order to improve their performance, and in doing so some suppliers restrict this strategic intention, as they do not have adequate quality and supply requirements' levels intended by OEMs. Indeed, it is difficult to find suppliers already developed to match up all the OEM's requirements at the same time (Noshad and Awasthi, 2016), therefore the sought integration between the internal processes of manufacturing companies and their supplier processes depends very often on how

OEMs develop their supplier base. In this way, the development of the supplier base by OEM's takes on a relevant role for companies that operate in increasingly competitive environments. The effects of intensive use of technologies provided by the industrial internet of things (IIoT) allied with the industry 4.0 (I4.0) resulted in a significant impact on the world economy which point out an intensive collaboration among all members of the OEMs supply chain network. This approach is reinforced by the strategic orientation of companies with the aim of meeting their customers' needs and with a consolidation of a society supported by the use of the internet of things associated with I4.0. The dissemination of cutting-edge technologies coupled with productive machines promotes the interconnection of the entire organization's value chain almost in real time and this context reflects the importance of developing the supplier base performance according to Ayres et. al (2018). This research's primary motivation was to identify the OEMs supplier's development (SD) relevant practices, their critical success factors, and barriers. At the same time, propose a practical roadmap that could support the company's managers to develop their suppliers' base consistently.

## **2 LITERATURE REVIEW**

The literature review on the SD built up the concept evolution, moving from actions imposed by OEMs in the recent past to projects carried out together with suppliers, in order to obtain challenging and long-term results with suppliers considered strategic for the buyer firms. Following the previous line of reasoning, Ivanov, Tsipoulanidis and Schoenberger (2019) emphasize that the development of suppliers aims to improve the supplier's skills and introduce improvements in their processes, such as, for example, jointly implement actions to solve common problems or establish transformations that should be applied, in order to obtain continuous improvement of the supplier's performance. Sharma and Yu (2013) reveal that, as the assembly companies outsource their non-essential processes, they have the expectation that their suppliers will deliver innovative higher quality products in the exact quantity and at the right time and, in addition, at a competitive cost. This approach was already pointed out by Krause, Scannell and Calantone (2000), as they emphasize that the purchasing companies, by prioritizing their core competencies, outsource a significant portion of their products and services, making them more dependent on the performance of their supplier's base. This highlights the importance of having a limited number of strategic suppliers capable of working in an integrated manner to develop new and innovative products closely with the assembly companies to ensure long-term organizational competitiveness and high profitability. The strategic movements conducted by OEM's aims to receive from their supplier's higher quality products, supported by multidisciplinary teams committed to achieving challenges' results banded together and aligned with common goals to deliver not only products and services but also creative and innovative solutions to assembly companies. Krause and Ellram (1997) highlight the importance of maintaining a network of capable suppliers, one of the most crucial purchasing department functions. The

same authors emphasize that the concept of SD does not express which practices of the supplier's development process should be used by OEMs in their development. Urbaniak (2015) understands that the SD depends on the establishment of a high relationship degree of trust between purchasing companies and their suppliers. The above author understands that the trust established between the organizational stakeholders' relationships generates mutual benefits, such as the improvement of the delivery quality of the products and services, the drastic reduction of the purchasing cycles, which ramps up the effectiveness of the purchase processes and the communication, and of the new product development cycles. This approach is in line with Benton, Prahinski and Ying (2020), as they find that practices such as incentives, competitive pressure, and direct involvement of OEMs did not show statistical robustness to improve supplier performance without, however, establishing a high-level and longer-term relationship with their suppliers. This finding is important as the assembly companies systematically improve their supplier base without obtaining consistent and lasting results. In the new scenario that unfolds with the challenges and opportunities created by I4.0, companies are considered as sources of value creation, no longer occurring in a linear way as in mass production companies, but as a result of a network called "value web" which reinforces the importance of SD by OEMs (Kuruczleki et al., 2016). Nagati and Rebolledo (2013) agree with the lines of reasoning set out, as they understand that supplier development actions are now considered to have a more strategic nature and directed towards results of longer deadlines. Thus, in order to compete in the highest competitive markets, the OEMs must ensure that their suppliers' chain performance and developed capabilities are equal to or greater than the supply chain's performance and capabilities of their competitors (Lambert and Schwieterman, 2012). The literature review showed a significant transformation of SD over time from one antagonistic stance to another by providing joint solutions with complementary objectives, multidirectional information flow, and a longer-term relationship with shared knowledge among organizations. Hence the importance of segmenting the supplier base for strategic suppliers' choice to form lasting partnerships with them. OEMs have become dependent on their suppliers' performance, which implies new skills from both parties and trustworthy relationships between the involved organizations based on mutual trust and the transfer of knowledge between them. The considerations made point out that the cooperation between OEMs and their suppliers becomes a critical success factor for developing the supplier base of the purchasing companies. The absence of an empirical roadmap in the literature examined that would serve as a navigation tool for the managers of the purchasing companies to develop their supplier base was a driving force for this paper to come into being.

### **3 METHODOLOGICAL ASPECTS, INVESTIGATIVE PROCEDURES AND METHOD FOR DESIGNING THE EMPIRICAL ROADMAP**

The researcher used qualitative approach as a research method and as a research strategy the multiple case study, with an exploratory character, conducted in five Brazilian automotive companies,

which according to Saunders, Lewis and Thornhill (2000) allows considering the various aspects related to the subject under study. Inductive research process was used in this investigative project to build up theories based on information obtained from data collected empirically. The case study is then configured, as appropriate, to be carried out in field research, in such a way that it is processed while it occurs, without the direct interference of the researcher. The main objective of the case study is to understand the event under analysis at the time of its realization and generate comprehensive theories about the phenomena observed in the field. The investigative research corresponds to a qualitative research methodology, whose nature is exploratory, related to a research strategy based on a multiple case study. The research process was designed to identify the SD concept's evolution and the relevant SD practices used by purchasing companies to develop their suppliers, allowing them to achieve challenging goals and propose an empirical roadmap to help managers consistently to build their supplier base.

### 3.1 INVESTIGATIVE PROCEDURES ASPECTS

The four automotive companies chosen for this investigative work are global organizations headquartered in Europe and the United States. The fifth company is a Brazilian multinational supplier that performs at tier one, two, and three in the spare parts industry. The criteria for choosing automotive companies were based on the researcher's easy contact with these companies' managers. The five companies selected belong to the automotive segment, with 4 of them are assemblers belonging to American and European schools. Two of those companies operate in the heavy vehicle segment, and the other two in the passenger car market. The last company is a multinational company of Brazilian origin and supplier of all the OEMs analyzed. It was included in the survey to suggest two of the assembly companies for presenting relevant lean manufacturing practices. The companies participating in this investigative project are among the largest enterprises in Brazil. Meetings with the organizational managers have been recorded. The interviews were transcribed and analyzed using NVivo software, which helped the authors consolidate and categorize the data. In total, the researcher interviewed eleven managers of the five companies. The hierarchical position of eight managers corresponds to the managerial or tactical level, and three of them belong to the strategic hierarchic level. The data collected through the interviews carried out was consolidated using the content analysis proposed by Bardin (1977). This approach aims to categorize the data obtained and thus enable its grouping to facilitate the conclusions to be reached. Qualitative research generates a considerable amount of data, and the NVivo software aims to assist researchers in recovering and grouping them into categories (Edlund and McDougall, 2020). However, the use of the NVivo system took time to be mastered and understood, but with its use and practice of its essential functions, its advantage in processing large amounts of data became evident (Ozkan, 2004).

### 3.2 METHOD FOR DESIGNING THE EMPIRICAL ROADMAP

The method carried out by the researcher to outline the empirical roadmap is represented by Figure 1.

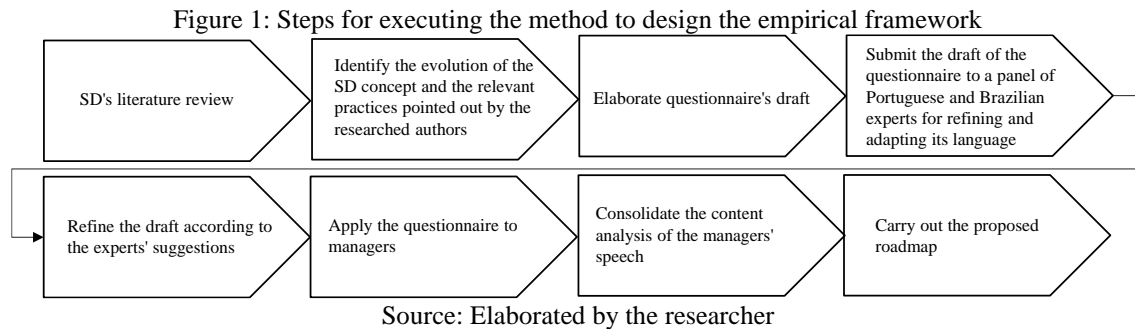


Figure 1 represents the steps to obtain the empirical roadmap and highlights that this paper aims to propose an empirical roadmap and not a roadmapping, which means the organizational actions for the roadmap's implementation based on multifunctional workshops. Therefore, the applied method aims to explain that the literature review served to demonstrate the evolution of the concept of supplier development and identify the relevant SD practices indicated by the researched authors. Via this approach, the researchers' concern was to establish a link between the questions made with the authors researched by the literature review and build a bridge between the managers' answers and the theoretical concepts about SD, as we can see in Table 1. As exemplified by Table 1, all of the questionnaire questions used for semi-structured interviews with organizational managers were initially based on a previous literature review supported by the academics identified in it.

Table1: Survey question's example for interviews

Examples of questions numbers	Interviews questions	Authors
Q1	Explain if the company has a formal procedure for identifying suppliers considered strategic.	Kraljic (1983); Larson and Halldorsson (2004); Nagati and Rebolledo (2013); Rezaei; Wang and Tavasszy (2015) and Sharma and Yu (2013)
Q12	How does the extensive use of digitization of production processes impact your organization's current and future supply-based practices?	Prause and Weigand (2016) and Rüssman et al. (2015)
Q15	According to your company, what are the critical success factors for the development of your suppliers?	Trent and Monczka (1999); Krause and Ellram (1997); Wagner (2010); Shrimali (2010); Dalvi and Kant (2015); Handfield et al. (2000) and Sanders; Elangeswaran and Wulfsberg (2016)
Q27	Would you like to add some considerations that were not addressed during this interview?	Open question

Source: Elaborated by the researcher



This questionnaire was then submitted to a panel of Portuguese and Brazilian experts to refine and adjust it in a language for better understanding by the organizational managers. The criteria used to select the experts were their professional and academic experiences concerning the construct being analyzed. These experts' professional experience was taken into consideration, which greatly validates the questions applied during the interviews with the organizational managers. The experts' suggestions were analyzed and incorporated into the former questionnaire's questions and thus troubleshoot the interviews to be conducted with the company's managers chosen for this purpose. The interviews were conducted through 27 – questionnaire questions, the last one being an open question as we can see in Table 1. After applying the questionnaire and the consolidation of the managers' speech content, 17 sets of SD practices used by companies in the automotive segment were identified, summarized, and employed to design the proposed empirical roadmap (see appendix I attached - Figure 4).

#### 4 RESEARCH ANALYSIS AND RESULTS

The data collected through the interviews carried out was consolidated using the content analysis proposed by Bardin (1997). This approach aims to categorize the data obtained and thus enable its grouping to facilitate the conclusions to be reached. The analysis carried out covered all the speeches of each one of the managers and all the companies, which allowed to identify ten groupings of elements of SD processes directly related to the questions present in the questionnaire. However, only some manager's speeches for each of the identified SD groups will be made available in this paper due to space restrictions. These groupings are presented in Table 2. This approach should be considered an illustration of the researcher's procedure. In the managers' speech transcription, the researcher was not concerned about correcting any grammatical errors, as the speech's translation was “*ipsis literis*”.

Table 2: Grouping of supplier development practices

SD practices	Organizational managers' speech	Researcher's considerations
Related to segmentation and limited number of suppliers	[...] Ok ... well ... we work with a matrix, which is widely used in the market ... that classifies the group of parts from suppliers into four quadrants [...]	The segmentation process for choosing strategic suppliers used by this company is based on the matrix of Kraljic (1983). Of all the analyzed universe, only one presented the strategic planning to identify its strategic suppliers. According to their managers, the other companies also do it, but the procedure does not have the same strategy.
Related to principles, values and mutual trust	[...] actually, this work of ... has been done for ... about a year and a little bit within the group in the world ... and talking about vision ... about ... or something that worth ... it's gone, isn't it? ... we're going to that ... to that moment when you need to answer an intrinsic question ... Why am I here? ... What is the purpose of the working group's existence ... even my individuality within that group? ... is the translation of the Group's World purpose, and that we have four pillars, right? [...]	All organizations analyzed in some way work with organizational principles, values, and mutual trust between stakeholders. The managers' statements' organizational values could be identified so that they seek to establish the links between the values present in them and that of their suppliers. This implies the importance of establishing a fruitful relationship between the buying companies and their suppliers' agents to develop a long-term relationship anchored in organizational values

SD practices	Organizational managers' speech	Researcher's considerations
Related to motivations for SD	<p>[...] but ... we work with those who cause us most of the problems ... we don't necessarily work with the strategic ones ... we work with suppliers ... who have a low performance ... whether or not strategic ... if the strategy is causing problems [...]</p>	<p>and principles (Benton; Prahinski and Ying (2020). In general, the main driver for suppliers' development is the low performance or the qualitative level of the products, delivery, or price. The analyzed organizations still have a corrective approach when prioritizing short-term actions to develop their suppliers, whether or not strategic.</p>
Related to suppliers' performance improvement	<p>[...] and obviously visits with multifunctional teams ... inside the suppliers to make the evaluations [...] [...] already have the certifications in force today, for example, IATF 16949 ... the certification of ... environmental too ... ISO 14001 ... and also a logistics standard, which is MMOG - Material Management Operations Guidelines [...]</p>	<p>The managers' discourse generated a series of elements of the supplier development processes related to improvements in the qualitative level of the products and their production processes, which are generally conducted by multifunctional teams over time. In general, all OEMs require ISO / IATF 16949 standards, MMOG, which establishes delivery and logistics conditions for companies, and ISO 14000 environmental. Considered by OEMs as an essential addition is whether suppliers use the OEE (Overall Equipment Effectiveness) that measures the overall efficiency of manufacturing equipment to measure the results resulting from TPM (Total Productive Maintenance).</p>
Related to critical success factors	<p>[...] but try to go to the root cause of why they, overnight, in a few months, were good suppliers ... and started to have a questionable reputation ... and our conclusion was that there was no involvement of top leadership on the shop floor ... and that companies where leaders ... top leaders ... are present on the shop floor, are active in audits, participate in meetings, run daily quality meetings, are present, delegate matters ... these companies, even with the high turnover of labor, usually perform better ... That was the great root cause that we came to [...]</p>	<p>During the interviews with the managers, it became clear that the way the top team is committed to changes, how they are communicated and informed, how feedback is carried out, how organizations structure their teams for the development of their suppliers, and the degree of autonomy delegated to them, play a fundamental role in the success of the actions being undertaken at suppliers.</p>
Related to technologies/I4.0	<p>[...] we talk about CEP ... I don't need to do this anymore ... I won't need to ... because I need to keep plotting ... analyze the graph's trend ... then the machine itself generates the data, and it corrects itself so that I don't have it there ... I eliminate this variation ... or, however, I signal before getting out of control ... so this is even expected [...] [...] virtual collaboration ... so, bringing it to my area ... there will be ... a lot ... of ... collaboration with the supplier ... a broader reality ... so, not necessarily, I need to be on the supplier's website ... but I need to see what's going on ... so, he will show me ... through ... over the Google Glasses he has and what I have here. ... I can see what is happening [...]</p>	<p>The intensive use of new technologies leveraged by IIoT in order to promote essential improvements in the performance of the suppliers' qualitative level is perceived by all companies analyzed as a differential to be explored.</p>
Related to organizational structure	<p>[...] Interesting ... these connections you mentioned ... I work a lot with the quality SQA ... he sits next to the buyer ... the layout itself favored [...] [...] one of the heads of the green arrow ... he is not with his team in front of him ... in the department layout everything is on a par ... SQA with a buyer ... so it is all together .. there ... he does not do anything alone [...]</p>	<p>Larson and Halldorsson (2004) reinforce the importance of the evolution of the purchasing function towards a strategic profile to develop the supplier base. This change requires an evolution of confrontational behavior, still present in the negotiations in the current context between OEMs and their suppliers, for another one of partnership, based on trust and more extended negotiation deadlines.</p>



SD practices	Organizational managers' speech	Researcher's considerations
Related to barriers	<p>[...] obviously, in large suppliers ... suppliers ... global ... it is much more difficult for you to insert these ... this way of working ... because they also already have theirs historically, huh? We have much more ... like this ... possibilities of success, precisely with suppliers ... of medium and small companies [...]</p> <p>[...] as it can be understood with the increased use of technology and due to the pillars of Industry 4.0, comp[...] Do you know what is the differential that we have been using for about two years? Today we have a commitment to our matrix to work globally ... so ... today ... developing a part at the company here in Brazil ... can give you the opportunity to supply this part globally. . and then ... you bring the guy to your side [...]any have a greater possibility of exchanging and making data made available via the cloud more intensive, which could represent a threat to the security of important data of these companies [...]</p> <p>[...] we are now dealing with high technology ... it is pure technology ... You even get it from the small and multinational companies that are working with us ... and then you have to bring in experts from all over the world .. to do know-how transfer here ... because the base is not able to absorb this type of technology ... This for me is also a significant barrier [...]</p>	<p>It comes through the speech of the managers of two companies that a barrier to the development of global suppliers is the fact that they already have structured quality management programs and, thus, become reticent to the development practices provided by OEMs. Another barrier pointed out was the lack of confidence in making essential data from production processes available in the cloud and the Another important barrier mentioned emphasizing the lack of knowledge of supplier companies using advanced technologies.</p>
Related to supplier's mobilization	<p>[...] Do you know what is the differential that we have been using for about two years? Today we have a commitment to our matrix to work globally ... so ... today ... developing a part at company B here in Brazil ... can give you the opportunity to supply this part globally. . and then ... you get the guy on board [...]</p>	<p>Three of the researched companies have award programs to recognize the suppliers who have made a difference in achieving the established goals.</p>
Related to future managers' competencies	<p>[...] I think the main competence is behavioral ... actually, right? I always tell our team ... that our team can't stop learning ... that's the key point, right? In each internal effort we have discussed the issue of generating knowledge modules and these knowledge modules are very useful for everything we have been doing ... mainly to shorten the time to market for everything we have as deliverable ... so, this is the big effort ... there is a lot of this behavioral issue ... and openness to new knowledge [...]</p>	<p>When asked about future competencies, the managers addressed behavioral ones. Namely, they need to develop their flexibility, understanding, adapting to rapid changes, getting to know the design thinking approach, and working with the clients' needs. Face and respond quickly to the challenges imposed by new technologies, have innovative thinking, and behave like the process owner, and change from a corrective to a preventive approach.</p>

Source: Elaborated by the researcher

In addition to the grouping of elements of supplier development process indicated, seven more sets of SD elements were identified by the managers' speeches, which directly are not associated with questionnaire questions: supplier's conditions, new product development, innovation, investment in suppliers, patents, proximity to OEMs and outsourcing non-essential competencies from OEMs to suppliers. As seen in the literature review, the SD concept's construction does not make explicit which practices should be adopted to develop their supplier base (Krause and Ellram, 1997). However, the

literature review associated with content analysis of the manager's speeches revealed 17 grouping practices of SD that are applied by purchasing companies to develop their suppliers, which could be understood as the relevant practices used by those companies, which is an integrated way promoted the development of their supplier base. It should be noted that the grouping carried out is only an approach to facilitate the understanding of the wide range of data obtained by qualitative research and that only the intense integration of SD practices produces what can be designated as a "*cross-fertilization*" to create unique and competitive advantages for purchasing companies and their suppliers. The approach taken to group the supplier development practices obtained as described in the previous paragraphs is in line with Sánchez-Rodríguez (2009), which argues that organizations that combine and uniquely integrate their resources, aligning them with their strategic objectives, create competitive advantages not easy to be copied by its competitors. Essential considerations can be deduced from the consolidation of data obtained by the managers' statements, as indicated:

- The strategic decision on the part of the OEMs does not prioritize in a structured way the supplier's choice of strategic suppliers for the business model of these companies. The researcher understands that this segmentation to choose their strategic supplier is important to ensure the purchasing companies' performance (Berger and Lazard, 2018). For this reason, the importance of identifying strategic suppliers for the business of the purchasing companies, as the SD requires time, dedication, effort, and high cost for OEMs, and therefore it does not apply it to the entire supplier base.
- The analyzed purchasing companies realized the importance of working with organizational principles and values with their suppliers. They play a leading role, when properly applied, to engage, obtain commitment and align OEM's efforts through the supply chain in such a way to obtain mutual trust and thereby sustain long-term partnerships.
- It was found that the primary motivation for SD is due to the low qualitative level of the products offered by the supply base. This attitude reveals the corrective behavior still present in the relationships between OEMs and their suppliers. The researcher understands that this nature's actions generate costs and do not add the expected value, as they serve to bring about the correction of a situation that should not be present. Therefore, special attention should be given to the paradigm shift from corrective to preventive. However, according to Benton; Prahinski and Ying (2020), the SD mechanisms only guarantee the commitment of the supplier base if an exceptional relationship is established between OEMs and their suppliers.
- SD enshrined practices in use are periodic audits on suppliers, required certifications, practices related to OEE, and lean manufacturing, such as just in time (JIT) and just in sequence (JIS) in conjunction with the established improvement actions jointly to improve organizational performance. In addition, the purchased companies use the common practice of competitive

pressure on suppliers when making the same product available to a group of suppliers. This practice produces an illusory advantage in minimizing the risk of supply in the event of a problem with the supplier. However, the current situation entails further stringent requirements in long-term partnership work with suppliers to be sustained.

- Regarding the critical success factors, the managers of the companies studied identified the commitment of the top team of suppliers as essential for the implementation and maintenance of the improvement processes resulting from SD
- practices. The leadership skills of the top team are reflected in the two-way communication and feedback processes that contribute to long-term improvement actions. Likewise, multidisciplinary teams with complementary and non-competing strategic objectives between areas and companies are essential for the deployment and implementation of good practices throughout the supply chain.
- With the advent of the new industrial revolution called industry 4.0, the supplier development practices applied until then will face challenges that are not yet fully visible, but the paradigm shift from correction to prevention must be an obstacle to be overcome.
- The OEMs and suppliers' organizational structure also plays a vital role in the SD, as it gives the purchasing function the responsibility to participate in an engaging way to develop its supplier's base.
- The main barrier pointed out by the purchasing companies is the resistance on the part of the global suppliers to accept the development practices suggested by the purchasing companies. This resistance is associated with the guidelines imposed by the headquarters of these companies abroad since they already have established practices for their internal use, which are hard to change. This behavior opens space for the development of small and medium-sized local companies. Another significant barrier pointed out was the unpreparedness of suppliers concerning the use of new technologies. The researcher understands that OEMs will have to face this challenge and develop their suppliers in the widespread use of these new technologies to follow them in their strategic movements.
- A significant aspect was the understanding of how assembly companies mobilize their suppliers through new business offers based on the results obtained and how they are recognized through annual awards.
- Practices related to training and education have a special meaning, as purchasing companies have always focused on training suppliers in technical tools aimed at improving organizational results. Due attention was not paid to the education of the top team in developing new skills, such as leadership, multidisciplinary teams, design, and management of organizational change projects. This is a gap that needs to be adequately addressed by OEMs in developing their supplier base.

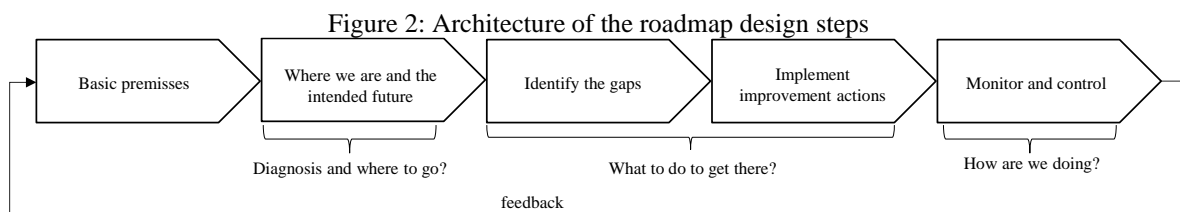
The practices indicated below were identified by the managers' statements but not directly linked to the questionnaire's questions and which have specific influences on the SD.

- When developing their tier-one suppliers, automakers expect them to build their sub-suppliers, replicating relevant standards practices, and OEM's requirements across the value chain.
- Practices related to the development of new products and innovation bring with them the OEMs intention to receive from their suppliers not only products and services but also integrated solutions to solve and eliminate the organizational problems.
- The organizations analyzed do not have the widespread practice of passing on their financial resources to suppliers. However, investment in human resources is common practice with the allocation of multifunctional teams, internalized for a certain period in suppliers.
- In the analyzed Brazilian companies, it was found that it is not common practice to develop patents based on the improvements implemented in the supplier's processes, unlike what occurs in the headquarters of these companies. As mentioned by the Brazilian multinational company manager, supplier of all the OEMs analyzed, there is no interest in this company to patent the innovative solutions developed by them in their production processes. The reason is the high investment to register these patents in Brazil. However, these patents do not ensure total protection abroad, motivated by a partnership's lack between the Brazilian government and overseas regulatory agents. This gap represents a substantial investment that the company is not willing to pay.
- In order to reduce logistical costs and have greater flexibility in decision-making, some purchasing companies have developed condominiums for suppliers to reduce the physical distance between them.
- The manager of one of the analyzed companies emphasized the process of outsourcing business considered to be non-core, highlighting the importance of developing competent strategic suppliers committed to the purchasing company's business model. This positioning reflects the growing dependence of purchasing companies on their supply base.

These considerations are in line with Sillanpää; Shahzad and Sillanpää (2015) when they understand that SD is an integrated and collaborative process between the parties involved to achieve challenging goals with intense generation and knowledge exchange. The future challenge is to carry out actions to integrate the practices for greater synergy between them. The proposed roadmap is intended to bring together various SD practices in an organized structure to help managers build a base of highly competent suppliers that assist OEMs in deploying the best practices throughout the supply chain.

## 5 PROPOSED ROADMAP

Kamtsiou et al. (2006) conceptualize the roadmap to diagnose the present situation and outline current and emerging trends to project the intended future. The same authors reinforce that the roadmap does not predict the future, but rather, it is a collaboratively designed strategic planning tool. It is, therefore, a useful tool to outline strategies and the subsequent decision-making, which, when implemented, guide companies towards the intended future. Amer and Daim (2010) complement the ideas of Kamtsiou et al. (2006) by pointing out that roadmaps at the industry level are used to identify the vision, everyday needs, assess the barriers and risks faced by these companies in their competitive environments. Analyzing the roadmap's role from the scholars above mentioned implies facing the future, not any lot, but, rather, the one intended by organizations. Due to the considerations made, this approach has a proactive character, with a marked characteristic of learning and value creation (Kamtsiou et al., 2006). The roadmap's architecture is supported by the steps established by Kamtsiou et al. (2006) and is depicted in Figure 2.

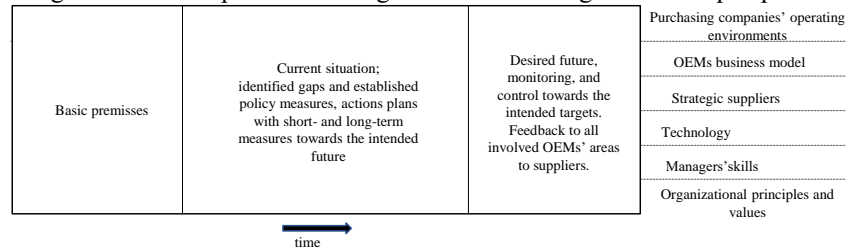


Source: As Kamtsiou et al. (2006) modified by the researcher

Thus, the roadmap when answering questions resulting from the diagnosis of the current situation and identifying gaps for obtaining the intended future and establishing policy measures, action plans with short- and long-term measures becomes a powerful tool for organizational managers. The emphasis given to the roadmap, constructed in this way, is directed towards its essentially practical application and helps organizational managers develop their supplier base. Roadmaps have various forms and purposes, and this paper considers their use from a strategic and multi-organizational perspective (Phaal; Farruk and Probert, 2004). The strategic perspective is related to the search for an intended future and multi-organizational state since the actions taken to obtain the intended future impact the purchasing companies' business level and their strategic suppliers (Phaal; Farruk and Probert, 2004). According to Phaal; Farruk and Probert (2004), this type of perspective seeks to capture the operating environments of the purchasing companies and their business models, threats, and opportunities for a specific segment of strategic suppliers, technology, managerial skills, and the principles and organizational values over time. Thus, the generic conception of a roadmap is the time-based chart, which covers layers of perspectives inherent to the specific purposes for which it was designed (Phaal; Farruk and Probert, 2004). In this paper, the researcher's understanding of the generic multi-organizational roadmap design has the following configuration with its perspective's layers, as illustrated in Figure 3.



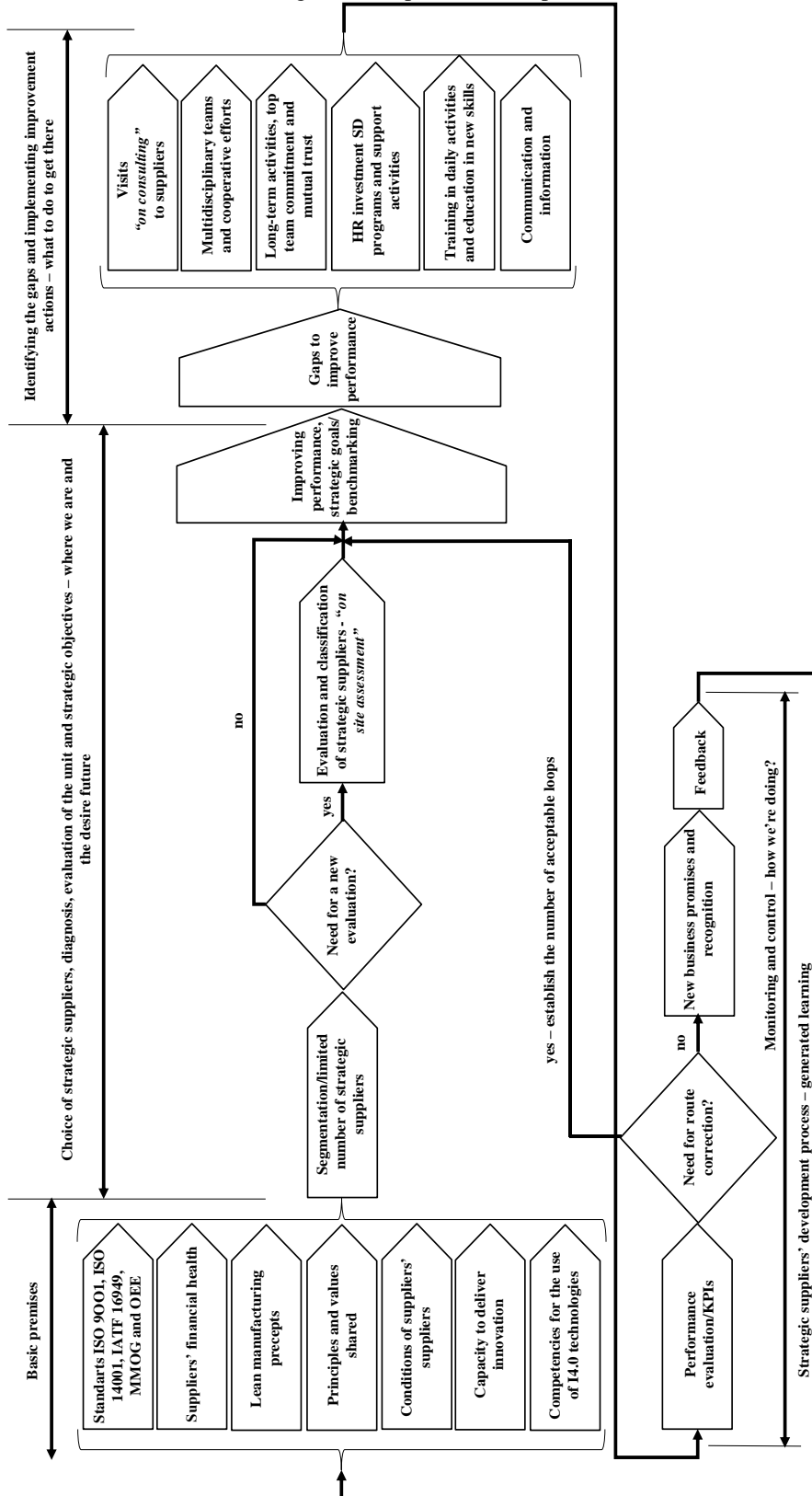
Figure 3: Roadmap’s basic configuration as multiorganizational perspective



Source: As Amer and Daim (2010) modified by the researcher

The SD concepts obtained from the literature review, managers' speeches consolidation to identify the best SD practices, the steps for the architecture, and the basic configuration of the roadmaps according to figures 2 and 3, respectively, served as foundations for the roadmap proposed by the researcher depicted in Figure 4 (see appendix I attached). The proposed roadmap brings together the various SD practices in a structured set to assist managers in building a base of highly competitive strategic suppliers and helping assemblers in deploying these practices along the supply chain. Therefore, the proposed roadmap is intended mainly to assist organizational managers, serving as a practical guide to assist them in developing their supplier base. Based on the considerations made, the proposed roadmap intends to contribute to the literature too, promoting the consolidation of relevant supplier development practices to be applied by the OEMs in a structured way, generating knowledge shared over time. This approach is essential from a practical perspective since these companies' multidisciplinary teams deal with conflicts, complexities, and uncertainties when performing their functions. The proposed roadmap ( see Figure 4) aims to reduce these kinds of barriers to improve supplier performance in a structured way because the managers' speech revealed that these practices are usually disconnected from each other, and the roadmap proposes integrating them.

Figure 4: Proposed roadmap



Source: Elaborated by the researcher

Therefore, the empirical roadmap proposed was designed to represent an integrated image that depicts the steps to be followed by purchasing companies to develop their strategic suppliers. It aims to aggregate the concepts and practices identified from the literature review, the content's analysis of the managers' speech, and the researcher's critical view concerning the SD process. It is a consensus of academics and managers that the development of suppliers provide a significant improvement in the organizational performance of OEMs (Dalvi and Kant, 2015) and this statement reinforces the importance of a roadmap to be used by them in training the suppliers' task force and educate their top team managers. When developing their strategic suppliers, assembly companies intend that they should be the main vectors to disseminate the relevant practices and requirements through the entire production chain. These considerations are reinforced by Rezaei; Wang and Tavasszy (2015) which highlights the strategic importance of purchasing companies in developing their suppliers in order to assume differentiated positions in relation to their competitors. The proposed roadmap depicted in Figure 4 consists of five stages.

- The first refers to the basic premises, and this approach is in line with the initial stage represented by the first column in Figure 3. It is fine-tuned with the three perspectives indicated by the same Figure: strategic suppliers, technology, and organizational principles and values. It was identified by the managers' statement that the standards noted in the roadmap in Figure 4 are common requirements to all companies. However, there is still a gap between OEMs concerning lean manufacturing's precepts, suppliers' suppliers' conditions, suppliers' capacity to deliver innovative solutions, and the necessary skills to use cutting-edge technologies associated with I4.0. Similarly, the OEMs expect financial health from their suppliers and the alignment with shared organizational principles and values. Special attention should be given to choose suppliers that can deliver innovative solutions to OEMs and use cutting-edge technologies related to industry 4.0.
- The next step confirms whether OEMs' choice concerning the selected strategic suppliers is adequate and whether there is a need to carry out a new, more detailed assessment at the supplier's unit. This decision is made through meetings with various OEMs departments according to the organizational manager's speeches. This step confirms the choice of strategic suppliers, and the diagnosis of the current situation is made, based on which strategic objectives are set together with the benchmarks for each organizational area. These considerations are aligned with the central column from Figure 3 and the associated perspectives indicated in the same Figure: purchasing companies' operating environment, OEMs business model and strategic suppliers. The researcher realized that the establishment of short-term targets by the OEMs revealed subtleties inherent to each analyzed company, identified by the managers' statements. The researcher's understanding is that this approach induces corrective and short-term actions, which do not add value but generate costs.

- In the third stage, the supplier development practices and their implementation are carried out. This stage also corresponds to the central column in Figure 3. The OEMs focus on training employees in the relevant supplier's development practices rather than educating the suppliers' top team for new skills. According to the content analysis of the managers' speech, one of the significant obstacles to the development of suppliers is not related to the technical aspects of the training but rather to the lack of the top team's commitment of suppliers to design, operationalize and implement the necessary changes. This means that the supplier development teams also need to change their approach so far and be trained for new skills, such as mobilizing and engaging the suppliers' top team for these new challenges. This step is in line with the managers' skills perspective in Figure 3. Particular attention to multidisciplinary teams, cooperative efforts, long-term activities, mutual trust, intensive communication and education for changing the organizational leaders' behavior from corrective to preventive posture, and their commitment to driving and implementing changes arising from the challenges imposed by relevant SD practices. This stage corresponds to the actions and implementations that the managers must conduct to obtain the intended future ahead.
- The fourth stage corresponds to the monitoring, control, and evaluation of strategic suppliers' performance to achieve the intended goals and the intended future. Formal recognition of those who made a difference in meeting the established goals is a practice for obtaining a commitment to new business for suppliers who have completed the agreed-upon objectives. The fourth stage corresponds to the third column in Figure 3 and satisfies the following perspectives: purchasing companies' operating environment, OEMs business model, and strategic suppliers.
- The fifth and final stage identifies whether the supplier development process is aligned with the strategic supplier choices initially made and whether learning is generated at each step of the process cycle. Feedback is given to the process as a whole since the OEMs areas involved and suppliers to assess the development of their manufacturing processes. It is the stage that informs us how we are doing about the development of strategic suppliers. This possibility, considered by the researcher, allows managers to correct the supplier's development cycle, ensuring the dynamics of the proposed roadmap. The results obtained are evaluated, and this step also corresponds to the last column of Figure 3 associated with the following perspectives; purchasing companies' operating environment, OEMs business model, and strategic suppliers.

## 6 CONCLUSIONS AND FUTURE RESEARCH

The analysis of the data obtained through the interviews carried out in this investigative work allows us to outline that the assembly companies are avid for partners who offer innovative solutions to their problems. They no longer admit suppliers that simply deliver their products or services only demanded by the OEM's, they seek partners who preferably deliver integrated solutions to be incorporated in their next-

generation products. These considerations show that supplier development practices are expected to change at imaginable levels and mainly by the widespread use of the internet in manufacturing environments, promoted by industry 4.0. One of the most important changes is that suppliers should deliver preventive solutions to the purchasing companies' problems, in all aspects, and this represents a fundamental change from a corrective and widely disseminated paradigm in the supply chain due to the focus given by carmakers to develop their suppliers. The research carried out showed also the resistance reported by OEMs on global suppliers to accept the proposals for continuous improvements suggested by them. This resistance reflects two dimensions: the conflicting strategic between OEMs and global suppliers; and the still unilateral positions of purchasing companies in their dealings with these suppliers. In some moments, the OEMs contact their headquarters abroad to bridge the global suppliers' headquarters to solve quality problems. However, these restrictions open a unique window of opportunity, in the Brazilian context, for purchasing companies to develop the most sensitive links in their supply chains, which are small and medium-sized companies. The researcher understands that companies that know how to take advantage of this period to train their suppliers in day-to-day practices to obtain significant results and at the same time promote the commitment to the formation of the top team of these suppliers to develop current and reinforced competences after that period. The education of the superior team of suppliers, as the researcher understands it, aims to achieve the following objectives:

- Obtain engagement for the definitive solution of existing problems;
- Mobilize teams to achieve the stipulated objectives, recognizing those who made a difference;
- Obtain alignment between the purchasing company's organizational principles and values with their strategic suppliers, highlighting the importance of aligning them with the purchasing companies' business model and establishing a relevant long-term partnership;
- Make the tier one suppliers as a vector to permeate good practices throughout the entire supply chain;
- Use this development process as a learning experience to break through the organizational boundaries.

These considerations reinforce the need to using a proposed roadmap, as depicted by Figure 4 to be used by the managers of the purchasing companies, to guide them towards to obtaining a highly capable supplier base. It is emphasized that the proposed roadmap needs to be validated in practice by the purchasing companies' managers. Therefore, this is a limitation of the work presented, which requires further analysis.



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