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CHALLENGES OF INTERACTION BETWEEN SUPPLIERS AND OEMS IN THE NEW PRODUCT DEVELOPMENT FOR COMPANIES IN BRAZIL

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Abstract. *The objective of this paper is to identify ways to mitigate challenges related to the interaction between the project teams of Original Equipment Manufacturer (OEM) companies, mainly automotive manufacturers and suppliers in Brazil. The study takes place in the New Product Development (NPD) phase when there is early involvement of key suppliers from the project planning phase working with Research and Development (R&D) project management. The importance of the research is due to the presentation of ways to mitigate the interaction challenges by preparing a guide or framework to support planning for project managers (PM). The work is a data collection from literature of OEM and suppliers experience during NPD activities about challenges and ways to mitigate them. The expected outcome is innovation through the proposed compendium of Challenges and Mitigation Process that will assist PMs in future endeavors by anticipating challenges and improving the planning of project activities. This paper contributes to improve project outputs, risk management and final product quality mainly helping OEMs and suppliers in Brazil.*

Keywords: *OEM, automotive industry, new product development, multiple case study, R&D project management.*

1. INTRODUCTION

New product development (NPD) activities are becoming the central focus of companies that wish to stay ahead in a globally competitive market (Flankegard, Granlund, Johansson, 2021; Dal Forno et al., 2013; Zhang, Wang, Gao, 2017). The successful transfer of this developed product to manufacturing is also a decisive factor for the gradual increase in production (Wlazlak et al., 2018). In addition to these factors, one adds the demands related to environmental regulations that increasingly request the use of new technologies for product development (Magnusson, Berggren, 2001).

Besides the core activity context, there is also that of the constant growth of OEMs, especially automotive industries, evidenced by the increase in the volume of products produced and, with that, the parts for their production (Wójtowicz, Rachwal, 2014) and the technology has been the engine for OEMs during this last decade and the technology embedded in vehicles is increasing, helping the driver through real-time information, which passes from the sensors to the control units, so there is the need to work together with key suppliers of automotive parts (Silva et al., 2018), which demands increasingly faster releases and NPD with a focus on meeting legal requirements and on customer (Zhang, Wang, Gao, 2017). Thus, there is a need for external collaborations for organization during the NPD (Melander, Lakemond, 2015) and sharing information during this phase has a positive and direct effect (Zhang, Wang, Gao, 2017).

Collaboration for the development of new products is a current challenge between manufacturers and suppliers and, in a globalized environment with rapid technological advancement, it is difficult for manufacturing companies to keep all technological experience in-house, but a good governance management is essential for positive results on NPD, a good management of interaction between organizations teams is a good practice to be followed (Melander, Lakemond, 2015).

Another key item is technological uncertainty, that is, when a product is new and has a high risk of development (cost and time), this element suggests an approach beyond production or lean development, requiring control elements such as tests initials, intense horizontal communication, and challenging objectives (Magnusson, Berggren, 2001).

In cases of radical innovations, it is necessary to develop new knowledge, that is, that new technologies are used for the NPD, and it may be that the manufacturer, especially automotive vehicle assemblers, does not have this entire framework of knowledge, being necessary the collaboration of external suppliers, being necessary, including, a more adequate way of management (Magnusson, Berggren, 2001). Manufacturing companies should focus on learning ventures, using suppliers in a partnership system to increase the quality of their products and the excellence of their developments (Morgan and Liker, 2020).

In a scenario like described above, there are challenges that need to be faced by the teams of the manufacturer and suppliers in relation to the 4 known dimensions that are People, Processes, Tools/Technology and Interaction, which involves all the 3 previous ones between the two teams that are working on NPD (Flankegard, Granlund, Johansson, 2021). Supplier involvement has been used in NPD, but there is no concrete evidence, that is, there is not overwhelming evidence to support the positive effects of early supplier involvement in this phase of the project and, therefore, there is a field of study in this regard (Suurmond, Wynstra, Dul, 2020).

Under these circumstances, the objective of this paper is to identify ways to mitigate challenges related to the interaction between project teams of Original Equipment Manufacturer (OEM) companies, mainly automotive manufacturers and suppliers in Brazil by Systematic Literature Review about NPD challenges mitigation.

This article is structured as follows: Section 2 provides a literature review on the interaction challenges in NPD activities. Section 3 research methods. Section 4 main results. Section 5 conclusion and recommendation. Section 6 for acknowledgements. Section 7 for references and. Section 8 for responsibility notice.

2. LITERATURE REVIEW

In New Product Development (NPD) project there are challenges in the "manufacturer and supplier" cooperation about four main dimensions, these are: People, Processes, Technologies/Tools and Interaction (Figure 1).

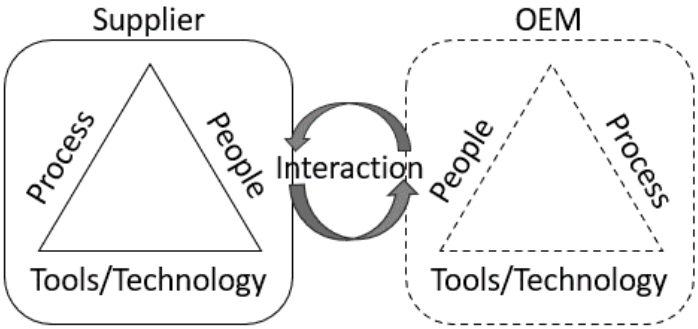

Figure 1. Interaction between the dimensions for new product development.
Source: Adapted from Flankegard, Granlund, Johansson,. (2021)

The challenges found add up to 24 and were listed in 4 groups using the concept of the dimensions reported and in 8 subgroups for a clearer visualization of the results listed as follows: Interaction (asymmetric relationships and customer entry points), People (cross-functional collaboration and project manager), Processes (process model definition and process model anchoring) and Tools/Technology (design tools and management of products requirements) (Flankegard, Granlund, Johansson, 2021). Table 1 shows the challenges during NPD.

Table 1. Challenges experienced by suppliers during customers' new product development.

Dimension	Challenge Type	Challenge
Interaction	Asymmetrical relationships	Customer defines business terms
		Customer exploits supplier knowledge
		Customer postpones activities
	Customer entry points	Limited access to contact persons at customers
		Contact people not clearly defined
		Communication across competencies
		Contradicting information from customer representatives

People	Cross functional collaboration	Function-oriented priorities
		Insufficient dialogue between design and manufacturing functions
		Unclear agreement between sales and design on what to consider as standard components
		Understanding of different functions roles and responsibilities
	Project management	Insufficient project planning
		Unclear project responsibilities
		Poor exchange of project information
Process	Process model definition	Absence of a product development process model
		Too rigid and detailed product development process model
		Absence of clear process stage interfaces
	Process model anchoring	Unawareness of the product development process model
		Poor product development process model compliance
Tools/technology	Design tools	Limited understanding and use of relevant design tools
		Inappropriate design tools
	Management of product requirements	Product requirements that are incomplete or changing
		Product requirements that are too detailed and extensive
		Product requirements that allow multiple interpretations

Source: Adapted from Flankegard, Granlund, Johansson,. (2021)

Another point is to develop suppliers aimed at reducing suppliers' issues and increasing their production capacities. An important factor of this development is the early supplier involvement, that can improve suppliers' capabilities causing a long-term relationship with customers, but even has some challenges as dependency on reliable and technically competent suppliers to satisfy completely the objective, lack of motivation from the staff of the company, problems relating to the ownership of the jointly developed design/product, fear of leaking proprietary information, poor communication and perceived higher cost in involving their suppliers earlier. These challenges should be mitigated, due to early involvement can improve the company's innovation, knowledge, and expertise, as well as quality improvement, reliability, costs reduction and competitive advantage among other as Figure 2 (Chavhan, Mahjan, Sarang, 2018).

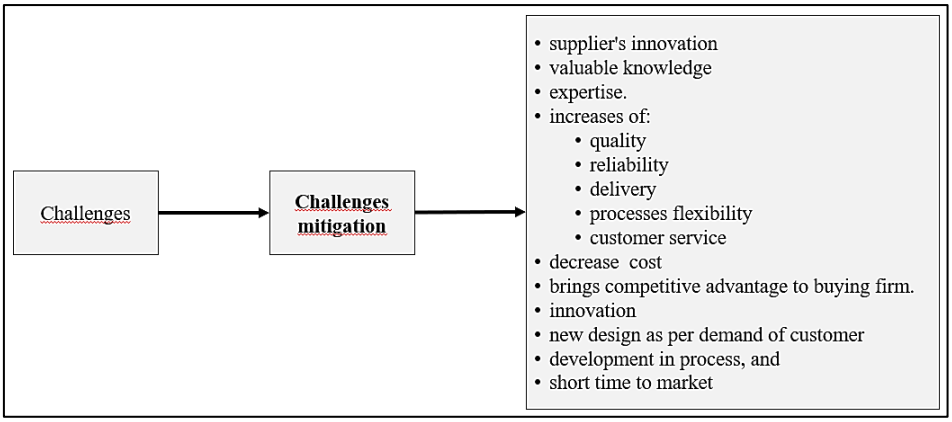

Figure 2. Challenges mitigation benefits.
Source: Adapted from Chavhan, Mahjan, Sarang, (2018)

During the NPD phase, inter-organizational collaboration is a key factor for the success of the activities, speaking only of the product itself, but when you add the need to purchase services from the supplier, the intensity of the relationship increases, and new challenges are added. So, some factors can impact the collaboration between companies

and can considered as challenges to be mitigated. The most important are trust, commitment, shared vision and values, shared language, information and knowledge sharing, shared goals and interests, social network, coordination, communication quality and interdependency among others as shown in Figure 3 (Harrat, Belkadi, Bernard, 2020).

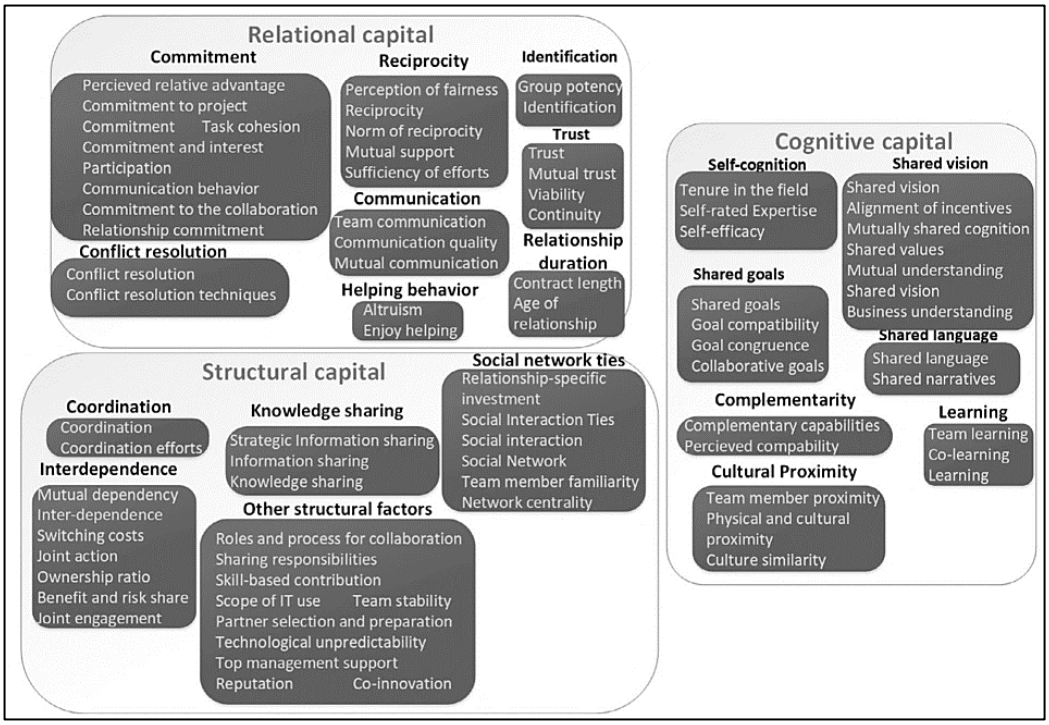

Figure 3. Classification of collaboration factors
Source: Adapted Harrat, Belkadi, Bernard, 2020

New product development activities are complex and with a great gain of knowledge, which is extremely necessary to solve problems, so external collaboration is of utmost importance for manufacturing companies, and with this comes the challenges resulting from the work between teams from different companies. Integrating teams and sharing information are the big challenges for companies looking to excel with NPD (Rauniar et al., 2019).

Working with a good coordination of activities, i.e. a governance plan, is paramount in NPD activities, even more so if there is external collaboration, which is necessary for the development of high uncertainty products. To this end, it is important to highlight some important factors that are considered as challenges and that must be mitigated, or fulfilled correctly, these are: face-to-face meetings on a project level, standardized work model, quality assurance document provided to the suppliers, internal integration at the OEM and the role of the supplier's quality assurance (SQA) sector, readiness of the component specifications, and timing of supplier integration and selection. Table 2 shows the factors and when they are necessary (Wlazlak et al., 2018).

Table 2. Critical factors for the integration of the suppliers.

Factor	When
Face-to-face meeting on a project level	Beginning of the OEM industrialization
Standardized work model	Non-stage specific (suppliers' workflow
Quality assurance document provided to the suppliers	At the beginning of the collaboration with the supplier
Internal integration at the OEM and the role of SQA	Non-stage specific (OEM's NPD process)
Readiness of the component specifications	Before first release to the suppliers
Timing of supplier integration and selection	Before the full technical specifications are completed and released with project order

Source: Adapted from Wlazlak et al., (2018)

Corroborating with what has been verified so far, another existing challenge in the NPD is the prioritization of testing activities, because during the project the demands of customers arise where the technical and environmental requirements already exist. The project specialists must map these requirements so that there are no unnecessary tests increasing the NPD cost as well as using resources in activities that are not relevant for a given moment (Liu, Tahera, 2023).

Increased deployments of an NPD feature can generate systemic mismatch, leading to organizational errors manifested in product recalls. The main sources of mismatch found were one related to internal routines that span organizational subsystems and another related to external routines established with suppliers. Thus, it is important that companies that have their teams involved in NPD employ ways to mitigate these challenges providing an accumulation of knowledge and less error prone (Geleilate, Fainshmidt, Zollo, 2021).

The greater the direct links with the suppliers, the greater the innovative performance of a company will be. For this it is necessary that the manufacturer exchanges important information about products and processes with its suppliers, in this way it will have access to their knowledge, increasing its information framework and product development practices. The challenge lies in achieving a safe exchange of information where all parties can benefit (Kim, Narayanan, Narasimhan, 2020).

Creating and sharing knowledge influences the development and performance of manufacturing companies and suppliers and improves the ability of organizations to create solutions to problems. But the challenge lies in understanding how to share knowledge, because data security is also of utmost importance. Productive and valuable knowledge-sharing is built on three main pillars: voluntarism, reciprocity, and trust (Morris, Madzudzi, Garcia-Perez, 2020).

Successful projects usually have common factors, such as sufficient project resources, fast internal communication, and good communication with customers. The project should be as efficient as possible, a robust, repeatable, and constant development environment is necessary. Overall, newness is recognized as a critical issue in projects, so can be described as a challenge, which needs to be investigated more deeply (Beste, Welo, Ringen, 2019).

According to literature, challenges in NPD will happen but manufacturers and suppliers should use them to improve their projects process constantly facing as a lesson learned and opportunity to improve their knowledge (Figure 4). Companies should focus their efforts on mitigation and keep this as an project historic to use on future projects.

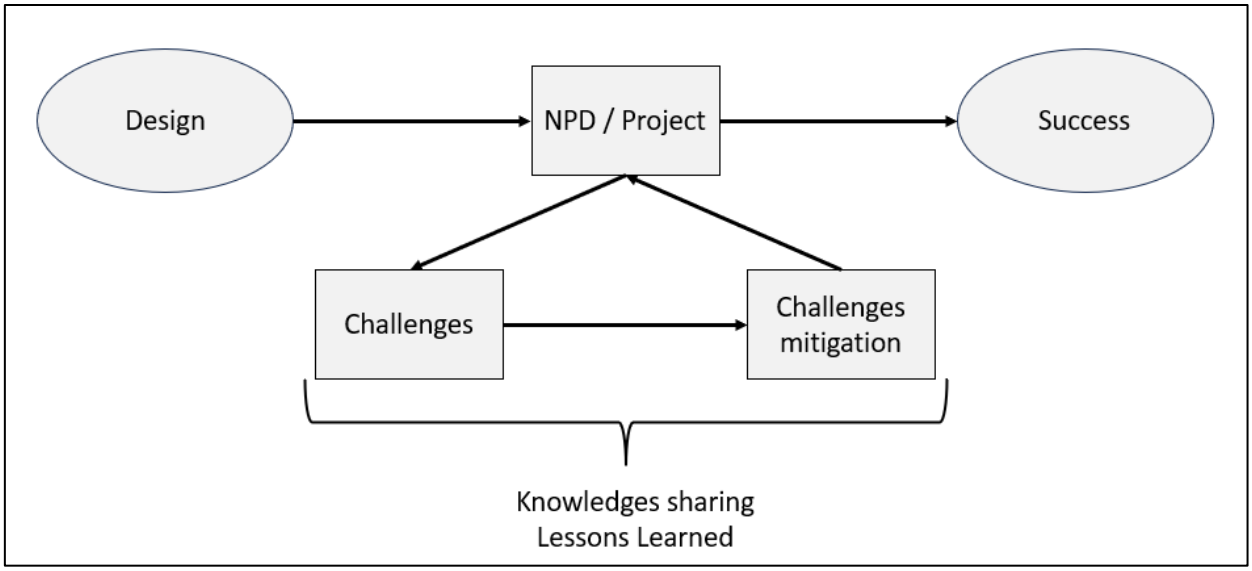

Figure 4. Knowledges and lessons learned as project historic.
Source: by Author

3. RESEACH METHODS

The research methodology was literature review to get the overall context of the article and systematic literature review for the definition and ways to mitigate NPD challenges. Was used as a search source the "Science Direct" platform using the string "challenges" AND "new product development" AND "supplier" AND "OEM" AND "automotive industry" as illustrated below (Figure 5). The Parsifal platform was used to organize the articles, facilitate the evaluation of research questions, exclusion criteria, and approval/rejection of the bibliographies analyzed.

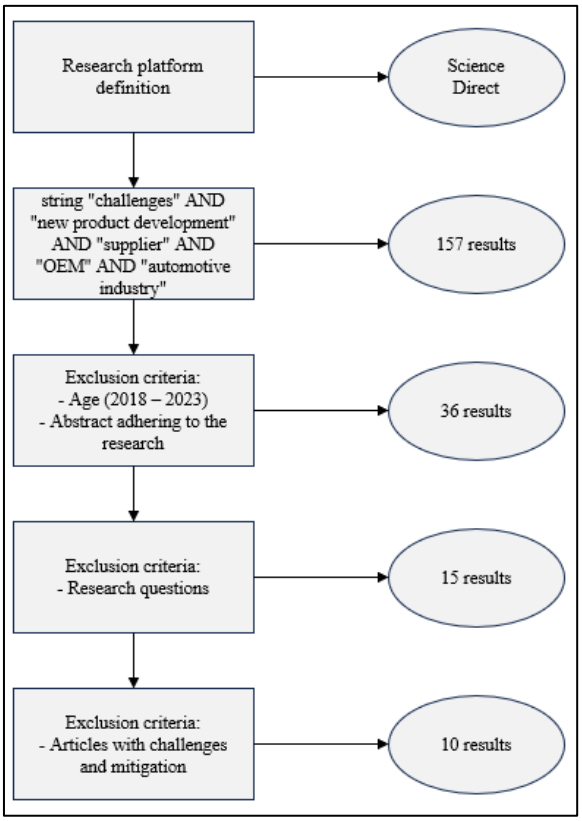

Figure 5. Literature Systematic Review.
Source: by Author

The approved papers were those that had the description of the studied challenges, the proof of these challenges in the NPD phase, and most importantly, had the approved mitigation proposal. In this way it was possible to collect the data to facilitate the presentation of the results.

4. MAIN RESULTS

To facilitate the visualization of the results, a table was assembled to verify the challenges faced during the NPD, followed by their form of mitigation, enabling those responsible for planning the project a tool to be used in future work that requires the participation of multidisciplinary teams, including external collaboration (Table 3).

Table 3. Challenges *vs* Mitigation Process.

Challenges	Mitigation Processes	References
Customer defines business terms	Be customer-centric	Flankegard, Granlund, Johansson (2021);
Customer exploits supplier knowledge	Provide value, via unique resource competences	Geleilate, Fainshmidt, Zollo (2021);
Customer postpones activities	Establish interaction based on relationship-driven strategies	Kim, Narayanan, Narasimhan (2020);
Limited access to contact persons at customers	Establish trust via long-term relationships	Morris, Madzudzi, Garcia-Perez (2020);
Contact people not clearly defined	Ensure frequent information sharing with customers	Beste, Welo, Ringen, (2019)
Communication across competencies	Identify and list contact persons at customers	
Contradicting information from customer representatives	Ensure trust via documented processes	
Function-oriented priorities	Define a checklist of essential information from customers	

Insufficient dialogue between design and manufacturing functions	Establish cross-functional teams with individuals representing different competencies and organizational units	
Unclear agreement between sales and design on what to consider as standard components	Balance cross-functional integration with functional expertise	
Understanding of different functions roles and responsibilities	Ensure team members understand the product development process	
Insufficient project planning	Use frequent project meetings	
Unclear project responsibilities	Establish function-based phone numbers	
Poor exchange of project information	Clarify roles and responsibilities of project managers and team members	
Absence of a product development process model	Establish documented and visual product development process model with explicit descriptions of how work is to be done	
Too rigid and detailed product development process model	Apply integration mechanisms to ensure smooth process stage interfaces transitions	
Absence of clear process stage interfaces	Apply agile project practices	
Unawareness of the product development process model	Apply processes adjusted to type of projects	
Poor product development process model compliance	Ensure internal education and auditing of adherence to the product development model and performance of process	
Limited understanding and use of relevant design tools	Use project management software and techniques	
Inappropriate design tools	Identify appropriate support tools and techniques that are deemed relevant for specific projects	
Product requirements that are incomplete or changing	Apply planning techniques such as Gannt charts or PERT, contract books, risk assessment techniques, etc.	
Product requirements that are too detailed and extensive	Use visual planning and design review meetings	
Product requirements that allow multiple interpretations	Define project team member lists	
	Ensure project documentation is easily accessible	
	Use Dfx and quality management tools	
	Constant dialogue with the customers and rapid communication of changed requirements	
Dependency on reliable and technically competent suppliers to satisfy completely the objective	Good and well defined selection criteria for assess technical capabilities of the suppliers, reliability in delivering goods on time and in the promised quality	Chavhan, Mahjan, Sarang (2018); Geleilate, Fainshmidt, Zollo (2021);
Lack of motivation from the staff of the company	Profit-sharing, creating a motivating and competitive environment to encourage their people to put in their best efforts	Kim, Narayanan, Narasimhan, (2020);
Problems relating to the ownership of the jointly developed design/product	Reaching an agreement in advance	Morris, Madzudzi, Garcia-Perez, (2020);
Fear of leaking proprietary information	Making use of non-disclosure agreements	Beste, Welo, Ringen (2019)
Poor communication	Establish proper means of communication	
Perceived higher cost in involving their suppliers earlier	Investing in their suppliers will eventually benefit them in the form of better technologies and greater security in the procurement of good quality materials	

Lack of: Trust Commitment Shared vision and values Shared language Information and knowledge sharing Shared goals and interests Social network Coordination Communication Quality and interdependency among others	High level of trust for partner satisfaction Commitment effort will balance short-term problems with long- term goal achievement Sharing common vision in a virtual community will help members to see the meaning of their knowledge Shared language facilitates access to people, organizations and enhances the effectiveness of information exchange and assistance sharing confidential information means goodwill intentions and can be trusted, avoiding misunderstanding Shared goals to common objective, increase knowledge exchange and reducing conflicts provide information channels that reduce the time and effort required to gather information Coordination means 'to keep the group alive' and promotes productivity to the group as well as collaborating quality Communication to increase collaboration, trust, synergy and commitment, reduce time and costs Interdependency to improve the resources	Harrat, Belkadi, Bernard (2020); Geleilate, Fainshmidt, Zollo (2021); Kim, Narayanan, Narasimhan (2020); Morris, Madzudzi, Garcia-Perez (2020); Beste, Welo, Ringen, (2019)
Integrating teams Sharing information	Knowledge integration for successful project (support for problems solution) Focus on a project mission and create a sense of mission Mutual trust and mutual influence for open communication	Rauniar et al., 2019; Geleilate, Fainshmidt, Zollo (2021); Kim, Narayanan, Narasimhan (2020); Morris, Madzudzi, Garcia-Perez (2020); Beste, Welo, Ringen, (2019)
Lack of activities coordination/good governance	Face-to-face meeting on a project level Standardized work model Quality assurance document provided to the suppliers Internal integration at the OEM and the role of SQA Readiness of the component specifications Timing of supplier integration and selection	Wlazlak et al., 2018; Geleilate, Fainshmidt, Zollo (2021);
Different requirements	Prioritization of testing activities Map of requirements Risk Management	Liu, Tahera, 2023

Source: by Author

After RSL were identified forty-four main challenges and all of them with mitigation management ways capable to provide to both teams (OEM and supplier) possibility to define a reliable guide for future projects. The literature

contributes with NPD teams defining best practices to avoid mistakes during the planning and after activities start, but the information should be demonstrated clearly to all responsible helping all teams to define a good project plan.

5. CONCLUSION AND RECOMMENDATIONS

The aim of this work is to identify ways to mitigate challenges related to the interaction between project teams of Original Equipment Manufacturer (OEM) companies, mainly automotive manufacturers and suppliers through literature review about NPD challenges mitigation. Mitigation strategies must be treated with full attention for two main reasons, (a) to avoid errors during the current project activities of new product development and (b) as an opportunity for future projects where there is the participation of multidisciplinary teams, especially during the planning phase of the activities. The mitigation procedures collected from literature review do not involve a high investment, being necessary a good communication and information exchange between the teams of the companies participating in the project, as well as the commitment of the Top Management of the Companies, so following them is, without a doubt, a good management practice from which companies can benefit during and after the NPD project.

In academic perspective this work contributes to researchers interested in the subject with a clear and objective review, with focus on listing, not only the works related to the subject, but also organizing the ideas and mitigation proposals for a group of challenges. Another contribution is the identification of good project management practices in the planning phase with cost reduction, resources increase and project total time decrease.

For corporations, the article contributes with important information on how to plan activities on which cross-functional teams of manufacturers and suppliers will work. It confirms the need for planning taking in consideration not only risk management, but also ways of mitigating NPD challenges. Those challenges can be dealt in advance by using design plan practice as a tool. The development of new products involves a set of activities that must be consensual in a macro plan for the project managers' follow-up. These events must be planned and have an adherence to the form of coordination and may even change the governance structure that has an impact on both teams of OEM and suppliers. A well-defined plan is the one of the most important aspects for successful projects, and the planning of activities with a methodology for mitigating risks and challenges should also be employed in the project design phase.

This work shows good adherence with many project management methodologies (e.g., agile, traditional and hybrid), and can become an important tool in the hands of project managers to: (a) reallocate resources, (b) reduce the costs of activities and tests, (c) increase the engagement of cross-functional teams, (d) improve the communication and the exchange of information and knowledge, (e) improve activity deadlines and (f) increase the final product quality. The use of the results to improve the way of planning, communicating, reporting, and defining objectives for the program is highlighted, as communication is one of the points to be observed according to this article.

The ideas highlighted in this paper could be used by many companies in Brazil that have in their business the development of new products and services for the market. Project manager could use some mitigation methodologies in conjunction with his ability to plan activities and this plan should be officially reported, making it visible to the whole team and reevaluating, whenever necessary, the forms of mitigation, to confirm that they are effective, thus ensuring that the results are fitting the plan.

Some limitations of this work are the need to examine other databases and the expansion of the studies to other sectors of the industry, not automotive only. As a proposal for future work, research questions could be formulated for a series of interviews with specialists in the industry (from NPD teams), forming a panel with feedback and, out of that, create a list of ways to mitigate the challenges in NPD interface between suppliers and OEM in Brazil.

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7. RESPONSIBILITY NOTICE

The authors are the only responsible for the printed material included in this paper.