Critical Success Factors in Management of University-Industry Cooperation Projects: A Case Study in Aerospace and Defense Industry

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Abstract

The University-Industry (U-I) cooperation has been recognized as an essential strategy for innovation between scientific and business society. However, this partnership is not easy to manage; different points of view, objectives, and motivations can drift them apart from its goal. As a result, understand the Critical Success Factors (CSF) involved in cooperation projects might represent a fruitful advantage for both sides. This article proposes a holistic model of five dimensions: organizational context, team leadership, execution & control, team structure, and team processes. Our research carried through a case of study in the Aerospace and Defense (A&D) industry, comparing all of the success factors concerning three variables: cost, schedule, and operability; thus, aim at eight underestimated critical success factors.

Keywords
Critical success factors (CSF), university-industry cooperation (U-I), management of collaborative projects, aerospace and defense (A&D).

1. Introduction
In an environment of globalization, fierce competition drives the modernization of processes, products, services, and notably about commissioning technological innovation strategies in their business (Chan, 2004). Therefore, successful companies, in the long term, evolve in timekeeping a minimum core on R&D investment, which consists of wage payments to highly trained scientists, engineers, and other skilled technology workers who often require a great deal of firm-specific training (Brown, Martinsson, & Petersen, 2012). Even though knowing this type of structure is suffering from a critical shortage of high-skilled workers, cause the return of investment (ROI) is not apparent (Michael Collins, 2018).

To overcome, from this perspective, the collaboration between the universities and industry (U-I) relationship has been consolidated as an effective alternative to create and share knowledge; towards sustaining technological and innovative growth (Soares, Torkomian, Nagano, & Moreira, 2016). In this sense, the connection between U-I and its impacts on innovation processes has been the object of longstanding analysis in various academic communities (Gonçalo e Zanluchi, 2011).

Although it is still an approach not widely practiced and escorted by barriers, generally, related to the management issue due to the dual nature of project control in this context; mixing different organizational cultures which are result in conflicting attitudes imposing a series of barriers to establishing trust between partners (Davenport, Davies, & Grimes, 1998). For example, academia has a more long-term view of their work, and the company has a shorter-term; they also have different goals, focuses, and ways of working (Wallin, Isaksson, Larsson, & Elfström, 2014). Until 2007 (Milosevic and Patanakul, 2005), project management has been present in the literature as practitioner-driven and has relied upon war stories, normative approaches, and lists of factors derived from surveys of project practitioner opinions. Nevertheless, most research on the management of projects often observed a characterization by frameworks unrelated to previous literature and non-rigorous research methods and a lack of empirical research grounded in theory (Scott-Young & Samson, 2008).

For that reason, the International Organization for Standardization effort to develop international standard guidance on Project Management, released in 2012. The ISO 21500 intends to provide generic guidance, explain core principles and what constitutes good practice in project management (Rehacek, 2014). However, the main approach based on a plan-driven methodology has a fixed scope; then, cost and delivery time may fluctuate. Therefore, implying in a cascade approach (i.e., the waterfall model is a breakdown of project activities into linear sequential phases) towards reaching the defined scope. Nevertheless, the method could be different; i.e., value-driven (agile approach), which uses an iterative process (i.e., partial deliveries to the evaluation made at the end of a short time; which encourages customer involvement throughout the project), fixing cost and delivery time, allowing the scope evolution during the project. Consequently, today these two main project management approaches can be mixed and tailored towards reach project success (Bianchi, 2017).

Although, in any conditions, all actors seek a project success; however, success in a project means for a given actor that met certain expectations; consequently, these expectations may differ for each participant (Sanvido Et Al., 1992). Subsequently, the study of project success and critical success factors is considered a meaningful way to improve project delivery effectiveness (Chan, 2004). Furthermore, understand the hard side (the expertise necessary for an individual to do the job successfully, which is achieved through education, training programs, certifications, etc.) of project management. However, the soft side (interpersonal skills, which include communication skills, listening skills, empathy, etc.) can generate minor improvements and render substantial economic benefits for businesses, shareholders, and the economy (Cardoso dos Santos Durão et al., 2017).

Due to its peculiar complexity in terms of the processes and technologies involved, the aerospace and defense (A&D) sector industry seems to encounter difficulties regarding the partnership projects with universities. Indeed, in absolute numbers, spends much less on R&D than other critical sectors[1]; e.g., in terms of innovation intensity (the percentage of sales earmarked for R&D), its spending is also comparatively low as 4.1%, while the other sectors spend an average of 7% (Hauser, Sonnenberg, & Jones, 2018). This difficulty is strongly perceived in the literature, where there is a massive deficiency of studies of this nature. Therefore, using a holistic model, through a case study in an A&D industry, this article aims to identify CSF in collaborative U-I projects and propose recommendations to strengthen relations to facilitate the management of new projects development (NPD) and mitigate barriers in cooperation projects.

2. Success Factors Model

To start a U-I partnership is necessary to specify the type of project. It can characterize according to the degree of technical uncertainty versus the complexity of scope (Shenhar & Wideman, 2002). Today, the predominance of knowledge flows and services from U-I cooperation project, being the ones focused on low degree of uncertainty (routine activities), of slight complexity; e.g., technical consulting, non-routine engineering, and training of personnel (Rapini; Oliveira; Silva, 2016). Nevertheless, in this particular context, U-I cooperation projects should have a high degree of uncertainty and a low to average complexity range. The set of these projects, in general, has a pre-competitive characteristic, i.e., the resulting technologies are not (necessarily) associated with any specific product or immediate request (Araujo, 2012).

Then, to address CSF in U-I partnerships, it is necessary to know and understand the project's success processes (Alias, Zawawi, Yusof, & Aris, 2014). Within the more traditional project management schools, its success relies on a triple set of measures: cost, delivery time, and product performance; i.e., common sense considers a successful project when completed in time, within budget, and carries out what initially proposed. Although the project's success depends on other variables being much more comprehensive than the set of these triple measures, according to Scott-Young et al. 2008, they are only a dependent variable.

From a project management perspective, critical success factors are characteristics, conditions, or variables that can significantly impact project success when properly sustained, maintained, or managed (Milosevic & Patanakul, 2005). In this sense, different studies have tried to identified CSF; and as a result, a lack of consensus among researchers about the criteria for judging project success and the factors that influence such success (Alias et al., 2014; Barnes, Pashby, & Gibbons, 2006; Chan, 2004; Fortune & White, 2006). Nevertheless, in U-I cooperation, companies have different products, goals, cultures, etc., which leads to individuals with different

[1] Analyzed seven manufacturing sectors: Aerospace and Defense (1), Automotive (2), Chemistry and Energy (3), Computing and Electronics (4), Medicine (5), Industry (6), Software and Internet (7) .

behaviors (Albiero Berni, Maffini Gomes, Perlin, Marques Kneipp, & Frizzo, 2015). Therefore it requires a holistic model, based on soft skills (Cardoso dos Santos Durão et al., 2017), capable of measuring the influence of behavior (independent variables) concerning the objective function, which may differ from the university and industry. Thus, no critical success factor is definitive; consequently, the model provides an iterative approach, analyzing past projects and through its outcomes allows improvement in future projects.

It has developed a holistic model for this analysis, based on two models: Scott-Young et al. 2008 and Araújo 2012. The model of Scott-Young et al. 2008, although it has a complete approach, on the themes; including the social psychological, human resources, cognitive and ecological; however, was not successful when it came to research purely in universities, so it was revised and improved exploiting the considerations made by Araújo 2012. This new holistic model identified 26 success factors (independent variables), which is showed in Table 1, presents all assumptions and characteristics of each of the selected factors.

Table 1 – Assumptions and characteristics of success factors.

Success Factors	Assumptions and characteristics of factors
Project choice methodology	- Considerable degree of relevance to development; - High degree of technical uncertainty; - Low to average scope complexity;
Quantity vs Project quality	- Evaluate load and capacity (team); - Degree of impact (project); - Availability of resources (funding agencies);
Project duration	- Split the projects into accomplishable phases within critical periods (Fiscal, Graduate, etc.);
Alignment of project scope	- Differentiate the scope of the project from theses* of the involved; - Establish well-defined boundaries of approach to themes;
Selection of UI partnership	- Considers the researcher's motivation and genuine interest in the project; - Prioritizes long-term partnerships;
Preplanning	- Initial detailing is done collaboratively with well-defined vital deliverables;
Clear project goals	- Keep strategic objectives shared clearly and aligned with the organizational mission/partnership;
Senior management support	- Management supports the team during a difficulty*; - Coordination defines and shares with the project team the necessary authority/responsibility to ensure project success;
Project manager continuity	- There is continuity of the project manager/coordinator; - Always keep a backup manager/coordinator;
Project manager's incentives	- Recognition for achieving intermediate goals;
Motivation	- Engagement of participants in meeting the project objective;
Alignment	- Alignment (and realignment) of the work should involve everyone in the project; - Total and intimate integration between teams;
Planning	- Each step is detailed as the project progresses;
Control type	- Control by coordinators is proactive;
Documentation	- Documentation of project execution progress; - Documentation Standardization;
Milestone and partial deliveries	- Give feedback on partial deliveries; - Highlight the usefulness of each partial delivery to the team;
Cross-functional integration	- Capacity of employees to perform activities beyond the scope in favor of the project;

Autonomous project team structure	- Those involved have the autonomy to develop the activities;
Team experience	- Teams must have the technical qualification at the appropriate level;
Team continuity	- Avoid employee turnover;
Co-location	- The physical proximity of those involved interfere in the team results;
Team communication	- It should be as straightforward as possible and never leave anything implied;
Problem-solving	- Ability of the team to take immediate action to find solutions;
Team potency/efficacy	- Belief that the team believes in their resolution/efficiency potential;
Management tools	- Do not use generic methods for managing a project of specific nature; - Project management tools/methods should be considered unessential;
Intellectual Protection [PI]	- Rules and caution for publication should be clear; - Understand the needs and encourage the publication of results;

Table 1 classifies all of the 26 independent variables into five dimensions (Figure 1): 1. Organizational Context; 2. Team Leadership; 3. Execution and Control; 4. Team Structure, and 5. Team Processes. Also, it is possible to define two phases: a "design phase" and an "ongoing project" phase. All variables within the five dimensions and current phases content different success factors; each one has a direct and positive relationship that influences the success of projects (outcome of the project) directly in terms of cost, schedule, and operability; which represent the sixth dimension (dependent variables), considering the 6. Results (Figure 1).

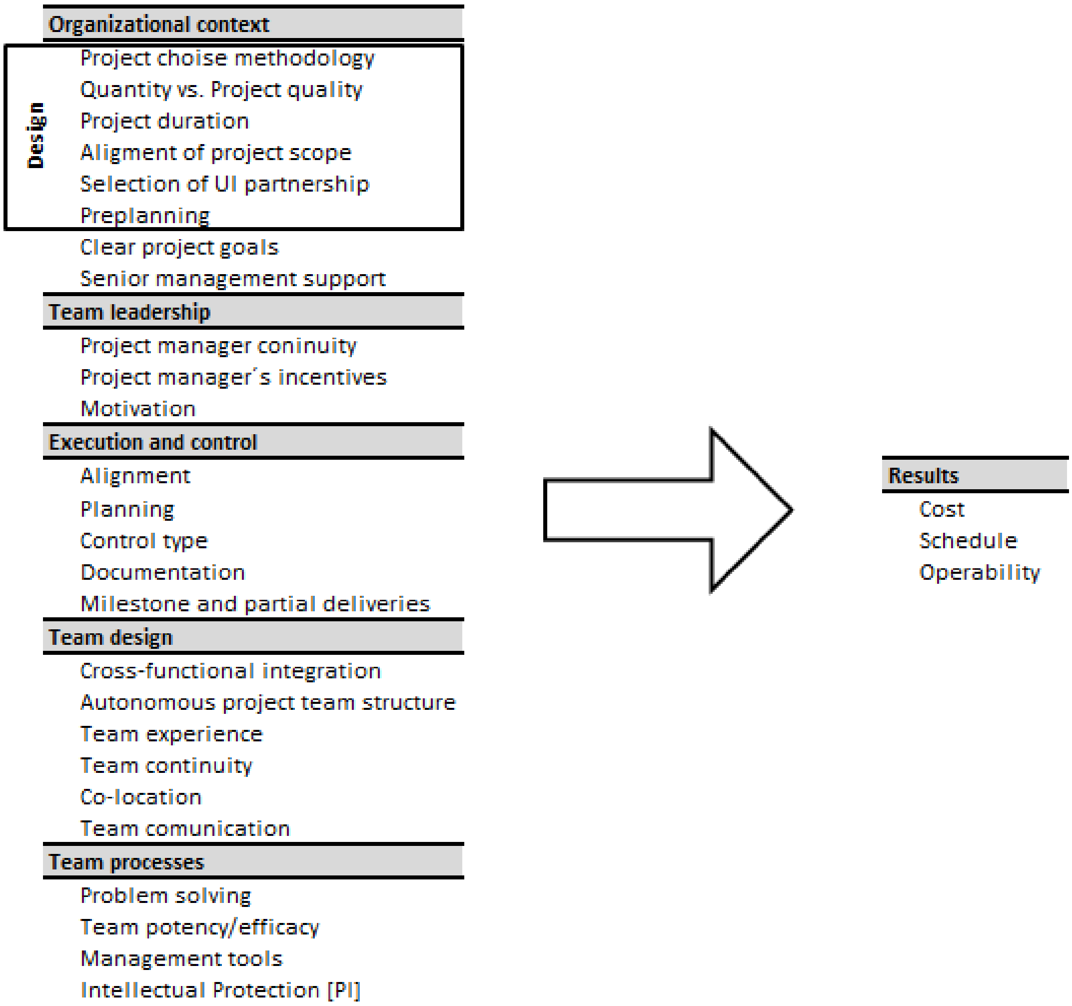

Figure 1 - Framework of the six-dimension holistic model.

3. Case Study

The case study looks back at the past six years of U-I-developed projects in an A&D industry. Its cooperation partners are multiple and usually located in the macro-region of each unit's location; since it has its units scattered throughout the south and southeast of the country. Within the sample, about 10 Engineers on the mission to develop NPD not related to the core business, it was possible to highlight the average experience of four projects per engineer; currently, only about 30% related to U-I collaborations; only 10% were able to produce patents. The first input of the model was made throughout a structured interview, in which the interviewed answer all of the questions about the last successful U-I project. Each question based upon characteristics of Table 1, each of the critical success factors ranked using a Likert scale, with a confidence index close to α = 0.85 (Cronbach's alpha). Table 2 shows the survey results according to the Likert scale (0 - Not Applicable, 1 - Strongly Disagree, 2 - Partially Disagree, 3 - Indifferent, 4 - Partially Agree, and 5 - Strongly Agree).

Table 2 – The most important critical factors for a successful project.

Critical Factors	0	1	2	3	4	5
Project choise methodology	11%	22%	11%	0%	56%	0%
Quantity vs. Project quality	0%	33%	33%	0%	11%	22%
Project duration	0%	11%	0%	11%	33%	44%
Aligment of project scope	0%	33%	22%	11%	22%	11%
Selection of UI partnership	0%	11%	11%	22%	33%	22%
Preplanning	0%	11%	22%	22%	33%	11%
Clear project goals	0%	11%	11%	0%	22%	56%
Senior management support	0%	22%	0%	44%	11%	22%
Project manager coninuity	0%	11%	44%	11%	0%	33%
Project manager´s incentives	11%	44%	33%	0%	11%	0%
Motivation	0%	11%	0%	44%	22%	22%
Alignment	0%	0%	44%	22%	22%	11%
Planning	0%	33%	22%	0%	33%	11%
Control type	11%	11%	22%	22%	22%	11%
Documentation	0%	22%	22%	33%	22%	0%
Milestone and partial deliveries	0%	22%	22%	11%	22%	22%
Cross-functional integration	11%	11%	11%	11%	11%	44%
Autonomous project team structure	0%	11%	0%	11%	56%	22%
Team experience	0%	0%	0%	11%	33%	56%
Team continuity	0%	22%	44%	0%	22%	11%
Co-location	0%	0%	22%	22%	22%	33%
Team comunication	0%	11%	22%	22%	11%	33%
Problem solving	0%	11%	0%	22%	44%	22%
Team potency/efficacy	0%	11%	0%	11%	56%	22%
Management tools	0%	33%	33%	22%	11%	0%
Intellectual Protection [PI]	11%	33%	0%	44%	11%	0%

Regarding Table 2, to be able to establish a parallel to the dependence factor within the independent variable and also between the dependent variables of the sixth dimension; the second set of analysis was performed throughout a partial execution of Value Analysis[2] methodology, resulting in a matrix capable of executing a linear correlation (Gallo, 2012). The analyses consist of building a matrix with all dependable and undependable variables (matrix of 29x29). On a further step, attribute a degree of relevance for each one related to all the others. This index's main advantage allows an objective and significant comparison, even with projects of different scopes, consistently. To build the matrix were relied on the expertise and knowledge of the authors. As a countermeasure to validate, a set of second answers of the interviewed, which for each dimension was chosen the most significant success factor among them, used as a boundary.

In Table 3, the result of the matrix is present in two sections: the first sections, a correlation of success factors versus their degree of relative relevance for each of independent variables, obtained using Value Analysis methodology; the second sections is a linear correlation of each success factor relate to all of the dependent

[2] It is a systematic application of techniques to identify the functions of a product or a component and to provide the desired function at the lowest total cost/effort.

variables (Cost, Schedule and Operability) as an objective to highlight the success factors that most effectively contribute to the goal of the project as a whole. i.e. higher is the percentage, the more essential is the success factor for the dependent variable in the results dimension.

Table 3 – Relevance of critical factors and potential impact on results.

Critical Factors	Relevance	Cost	Schedule	Operability
Project choise methodology	22%		71.6%	98.3%
Quantity vs. Project quality	19%			78.9%
Project duration	10%			81.9%
Aligment of project scope	36%		97.5%	38.0%
Selection of UI partnership	24%	81.3%		
Preplanning	36%		43.3%	
Clear project goals	90%	83.1%		
Senior management support	19%			80.3%
Project manager coninuity	5%	21.8%		38.5%
Project manager´s incentives	2%	47.3%		12.2%
Motivation	32%		16.2%	90.0%
Alignment	86%	85.7%		
Planning	34%	15.3%	18.8%	
Control type	36%	94.4%		
Documentation	49%		93.4%	24.5%
Milestone and partial deliveries	81%	42.5%		17.5%
Cross-functional integration	83%			68.0%
Autonomous project team structure	68%		34.3%	96.6%
Team experience	71%		75.8%	
Team continuity	27%		93.6%	25.2%
Co-location	1%	42.5%		17.5%
Team comunication	99%	24.3%		36.1%
Problem solving	95%		88.6%	13.2%
Team potency/efficacy	54%	94.4%		
Management tools	14%			66.3%
Intellectual Protection [PI]	47%	42.5%		17.5%

4. Results and Discussions

Based on the input data from the interview and the pre-analysis of the independent and dependent variables, it is possible to make two main analyzes: 1. optimize the overall effectiveness of the project as a whole package; 2. optimize by steps, using the outcome-dependent variables. The first analysis showed in Table 4, obtained by crossing the data from Table 2, together with Table 3. The first step is to identify the highest values of relevance among the dependent variables from both sections of Table 3, intending to highlight which success factors with the highest relevance index (Ranking) and how they are perceived and treated as an essential success factor by interviewed; being presented in a percentage scale (ABC).

Table 4 – The 15 most relevant success factors versus the degree of relevance given by the interview.

Critical Factors	ABC	Ranking
Problem solving	67%	1
Clear project goals	78%	2
Alignment	33%	3
Autonomous project team structure	78%	4
Cross-functional integration	56%	5
Team experience	89%	6
Team potency/efficacy	78%	7
Documentation	22%	8
Aligment of project scope	33%	9
Milestone and partial deliveries	44%	10
Control type	33%	11
Motivation	44%	12
Team continuity	33%	13
Team comunication	44%	14
Project choise methodology	56%	15

For the second analysis, the cross-referencing the data from Table 2; how are perceived and treated as an essential success factor by interviewed, together with the second section of Table 3, which allows focusing the optimization within the outcome-dependent variables; respectively in Table 5 (Cost), Table 6 (Schedule) and Table 7 (Operability).

Table 5 – Degree of the relevance of critical factors by cost project optimization.

Critical Factors	ABC	Cost
Control type	33%	94.41%
Team potency/efficacy	78%	94.38%
Alignment	33%	85.68%
Clear project goals	78%	83.08%
Selection of UI partnership	56%	81.27%
Project manager´s incentives	11%	47.28%
Milestone and partial deliveries	44%	42.46%
Co-location	56%	42.46%
Intellectual Protection [PI]	11%	42.46%
Team comunication	44%	24.35%
Project manager coninuity	33%	21.81%
Planning	44%	15.32%

Table 6 – Degree of the relevance of critical factors by schedule project optimization.

Critical Factors	ABC	Schedule
Aligment of project scope	33%	97.51%
Team continuity	33%	93.62%
Documentation	22%	93.37%
Problem solving	67%	88.63%
Team experience	89%	75.80%
Project choise methodology	56%	71.56%
Preplanning	44%	43.30%
Autonomous project team structure	78%	34.33%
Planning	44%	18.75%
Motivation	44%	16.21%
Project duration	78%	0.27%

Table 7 – Degree of the relevance of critical factors by operability project optimization.

Critical Factors	ABC	Operability
Project choise methodology	56%	98.31%
Autonomous project team structure	78%	96.56%
Motivation	44%	90.01%
Project duration	78%	81.91%
Senior management support	33%	80.33%
Quantity vs. Project quality	33%	78.86%
Cross-functional integration	56%	67.99%
Management tools	11%	66.32%
Project manager coninuity	33%	38.47%
Aligment of project scope	33%	38.01%
Team comunication	44%	36.05%
Team continuity	33%	25.16%
Documentation	22%	24.50%
Milestone and partial deliveries	44%	17.54%
Co-location	56%	17.54%
Intellectual Protection [PI]	11%	17.54%
Problem solving	67%	13.16%
Project manager´s incentives	11%	12.20%

The two-analysis based upon the interview answers (ABC) and considering throughout a Pareto 80-20, makes it possible to highlight and focus on which success factors still essential optimization and optimize by the result dimension (related to the dependable variables) of the project. By analyzing purely, the result from Table 4, it is possible to infer that there is already a principle of optimization on existing projects. Hence the top ten most well-ranked success factors were mostly well-rated and evaluated by the interviewers.

A superficial analysis would indicate the continuation of the optimization for the other ranked items, which in turn, at some point, may have some effect. However, this analysis would be how we deal with the trial and error method without focus on specific dependent variables the result dimension optimization. Therefore, stating the analysis from Table 5 (Cost), Table 6 (Schedule), and Table 7 (Operability), it is possible to infer that actions need to take related to project management, the actual management guideline indicated to be ineffective. Therefore, it is possible to boost some dimensions, and exclusively some of the critical factors, that can positively influence the execution of a project; they organize as follows:

1. Organizational Context;
    a. Project scope alignment[3]
    b. Methodology of project choice[3]
    c. Management support/advisor
2. Team Leadership;
    a. Continuity
3. Execution and Control;
    a. Motivation
    b. Documentation
    c. Control type
    d. Alignment

However, if drive only by the three dependable variables, still three factors that will not fit with this analysis[4] (using data from Table 4): cross-functional integration, milestone, and partial deliveries, and team communication. The first notice of these analyses brings up to light two main flaws caused by poor management and controversial decision-making due to organizational culture's influence. Besides, the impact during design project phase is crucial, points out, that might some projects already start on the wrong path; thus, it meets with the perception of the interviewed, which belief of this type of project has low effectiveness (67%) to find an immediate solution.

To reduce all of the negative impacts, a set of best practices should initiate improvements and suggestions to optimize future projects' management. The organizational context should be the first; it influences the other dimensions by working with both sides of the cooperation's primary philosophies and concepts. The methodology of project choice should be based on a vision of the future and aligned with its goals (sense of belonging), should not select projects considered as "shelf" solutions because research institutions work at a different step of the business, which becomes incompatible with the term of lead time.

The duration of projects should be limited to a maximum of two years since it facilitates the achievement for both sides (industry and university), results are straightforward, financial control is more manageable and external factors less impact the project. Limited time does not mean that the partnership must also be short-term, meaning only the project's time. Which is related to the project scope alignment as well as the spillover they may generate. It is essential to differentiate the project's scope from those of theses/dissertations of the researchers involved. The selected topics should create bloom ideas, which researchers (including MSc. and PhD. students) should use in their work, with the appropriate boundaries/limits of each theme's approach well defined. The extraordinary breadth and diversity of themes make it possible to motivate teams. Considering the researcher's motivation and genuine interest in the project is considered a priority versus one based only on the partnership's physical facilities.

As the last topic of the organizational context, management or guidance support is the variable that more influences the concepts of the current administrative philosophies. It is possible to express three activities of more significant impact: Management of the unforeseen, Administrative politics, and sharing responsibility. In general, the team becomes a reflection of its managers. Thus empathy, whether sharing results in success or "crises", and the ability to generate rapid responses throughout unforeseen events become the team's example. Within the policy's scope, its actions are reflected in the ability to delegate responsibilities, impose authority when necessary, and bridge the gap between other sectors related to financial, human resources, and demand for other technological resources. Such topics lead to the next dimension, team leadership. In this way, the management's continuity has a vital role in the length of the schedule and achievement of the goals; the replacement of the same entails a delay in the project. Depending on the project, the figure of a co "chef" aligned with the expectations is necessary to guarantee the control of project execution.

[3] During phase of design of the Project.
[4] Necessary to the development, however, does not add value towards reach the result for the project goal.

It brings us to the next dimension to be analyzed, the execution and control. Alignment plays an essential role with teams and realignment, which should be addressed to all members to minimize the possibility of unforeseen events since each team member has unique experiences and unique contributions to the project. In this case, the alignment depends on the type of control adopted, which should preferably be proactive, allowing a more intimate integration between them. This type of control adopted only makes sense when planning is performed in waves (regardless of the type of project chosen). Although planning in waves, the technical work must always be sizing and planned by the knowledge holder; although obvious, it is crucial to ensure accurate adherence to partial deliveries (documentation) and milestones compliance. To mitigate delivery issues, a web portal is a cheap and straightforward way to do it; it will save much time for the teams and avoid problems related to different versions of documents, reports, plans, etc.

The team structure is the next dimension to be analyzed, which has six variables. Regarding the most critical team experience (the two parts), they must have the technical qualification at the appropriate depth level; knowing what to do next increases problem-solving speed. However, this professional demands certain autonomy for decision-making. In this context, although it seems antagonistic, the same specialist should perform activities in a generalist way in other areas; that is, multitasking. For the project, it represents a gain in performance and dynamism for action. A key point is "communication"; never leave anything implicit, in doubt, be redundant in the project's key issues and critical alignments. The communication also could be affected by the physical allocation of people; either the layout or appropriate location creates a kind of team identity which allows narrowing and facilitating communication; even in some cases, it avoids postponing crucial decisions.

5. Considerations

This article presents and discusses a set of critical success factors and, through a case study in the A&D sector, analyzes the potential for improvement in the execution of technological innovation projects (NPD) in partnership with institutions of research. The application of the suggestions made after the analyses could considerably increase the probability of success of this nature's projects. It should be noted that the case study and its results are restricted to a single company, based on a small sample within a restricted period six-year time. It suggested applying the six-dimensional holistic model in other companies and different sectors to validate their analysis potential demonstrated in this article, thus allowing the development of a guide to "best practices" for these types of projects.

6. Acknowledgements

The authors recognize all involved interviewees and their respective institutions for their collaboration in providing information and support for the project that resulted in this work.

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8. Biographies

Marcel Senaubar Alves, technical in Mechanics from the Technical School Professor Everardo Passos (2005); double degree in Mechanical Engineering from the Federal University of Itajubá (2011) and Ecole Nationale d'Ingénieurs de Metz (2011); Master's degree in Mechanical Engineering from the Federal University of Itajubá (2013) in the domain of energy conversion; and currently pursuing a PhD in Production Engineering from the Federal University of São Carlos (2023), working mainly with Technology and Innovation Management. Work as a manufacturing and process development engineer at EMBRAER, member of integrated product development, emphasizing aerospace structures assembly.

Eduardo Bizeli Tiburtino, technical in data processing from ETEC - Sylvio de Mattos Carvalho (2002); graduated in Production Engineering from University of Araraquara (2007); master's degree in Mechanical Engineering from the University of São Paulo (2012) in the domain of aeronautical structures; and currently pursuing a PhD in Production Engineering from the Federal University of São Carlos (2023), working mainly with Technology and Innovation Management. Work as a manufacturing and process development engineer at EMBRAER, member of integrated product development, emphasizing aerospace structures assembly.

Ana Lúcia Vitale Torkomian, graduated in Production Engineering (1987) from Federal University of São Carlos and master's degree (1992) and doctorate (1997) in Administration, in Science and Technology Management domain, at the University of São Paulo. Since 1993, designed as a professor in the Production Engineering Department at the Federal University of São Carlos (integral dedication since May 2017), working in the area of Technology Management, mainly in the following subjects: university-industry cooperation, entrepreneurship, technology hubs, and parks, technological innovation and intellectual property. She was dedicated to the Production Engineering Department, a member of the UFSCar Innovation Agency's executive board, and coordinator of the southeast region of FORTEC.