

# Exploring the Influence of Leadership on Technology Innovation Project Management in Industry 4.0 in Brazil

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## Abstract

This research's objective is to verify leadership influence on technology innovation projects outcomes performance in industry 4.0, in Brazil. The study was applied to Brazilian Multinational Companies. A conceptual model was drawn and confirmed with specialists. This way, at first, in order to reach such a goal, an exploratory research was developed in light to the literature to gather the variables that make up the conceptual model. Afterwards, these defined variables have been subjected to a selected group of specialists with due knowledge regarding the research object for their evaluation. The data analysis allowed to answer the core question of this research, demonstrating which are the knowledge, skills and attitudes more relevant to a leader to have influence on the technological innovation project management on the industry 4.0. This research started from a gap in the literature and it is hoped that this study can contribute to the art and state of practice, increasing the spectrum of decision making in light of the leadership skills of a technological innovation project in this category of companies.

**Keywords:** Leadership; Technology innovation project management. Industry 4.0 in Brazil

## 1. Introduction

Presently, we see ourselves in the beginnings of a fourth industrial revolution, and with all the technological advancements, we face a reality marked by disruptive changes and also a great diversity of impressive challenge (SCHWAB, 2016). Several academics and uncountable science branched areas have been studying the leadership influence on the organizational sphere (OKE; MUNSHI; WALUMBWA, 2008; BENEVIDES, 2010; KICH et al., 2008), as much as the leadership influence on the project management area (GONÇALVES; MOTA, 2011; CLARKE, 2009; ROY; BERNIER; DANIS, 2010; GEOGHEHAN; DULEWICZ, 2008; SHENHAR, 2004). Despite these facts, very little has been debated regarding how much the leadership can influence on the technology innovation project management process on the Industry 4.0.

This study relevancy is based on the fact that it is still a need to further understand in a more extensive form the gaps existing that regards the sheer velocity and amplitude from innovations on the Industry 4.0 that reach different areas that interact between themselves amplifying each other and fusing together their technologies from the physical, digital and biological worlds. Seeing that these innovations are reshaping the economic, social, cultural and humane contexts, and also that all these changes are extremely difficult to being reversed, the leaders should not ever ponder anymore if there will be or not a rupture in their organizations, but rather to question the when it shall occur and how it will affect his work (SCHWAB, 2016). It becomes evident that there is a necessity for coherent researches that describes the opportunities and challenges of Industry 4.0 to empower the leaders. Mainly the technological innovation project managers, guaranteeing that they will be prepared in the best possible manner to take chance of the new opportunities and overcome the challenges to come.

Therefore, it is intended to fill a gap in the existing literature and does justify itself for the contribution expected to be made to project managers, and consequently organizations as well to take decision better substantiated making while looking for aggregate value and achieve a better market performance. This research has as its prime objective to verify the influence of leadership on managing the technological innovation projects parting from the experience of multiple projects of the Industry 4.0. In order to achieve such objective, a survey has been developed raising information from a selected group of specialists through a questionnaire containing a judgment matrix that then was extracted the corresponding results from the collected data. The primal question of this research is: What are the leadership competences that are considered the most important on project managing for technological innovation on the Industry 4.0? The structure of this article is systematized according to the following requirements: Introduction; Literature review; Research method; Results Analysis; and Conclusions.

## 2. Literature Review

The Industry 4.0 concept, also known as, the Fourth Industrial Revolution, may be described as a shift in business model logic for an increasingly intelligent, interconnected, self-regulating value creation approach that integrates innovative technologies across industries and applies them to their respective product manufacturing and service rendering processes. Among these innovations, the following may be cited: *smart factory*, can be defined as a factory that collect and control real-time product and service data and help people and machines in the execution of their tasks; *big data*, data sets whose size is beyond the typical software capacity; *internet of things*, networked interconnection of everyday objects that are usually equipped with ubiquitous computing; Cyber Physical Systems, complex system consisting of collaborative elements responsible for the integration of computing, communication and physical processes; Cloud computing, this can offer computing and storage power for digitally enhanced production or manufacturing; Artificial intelligence that enables machines to learn from previous situations (WANG; WANG, 2016; KANG, 2016; LIU; XU, 2017; SCHWAB, 2016; HOFMANN; RUSCH, 2017; LIAO et al., 2017).

As industry 4.0 continues to reshape the world, organizations are adapting to the speed of how fast the changes happen and better understanding how they must act today to remain successful in the future (DELOITTE, 2018). In this context, the organizational environment is inevitably experiencing for a systematic and profound change through technological innovations around the world in a never seen before amplitude and velocity in terms of rupture and development (SCHWAB,2016), providing major transformations, with opportunities and challenges that directly affect the profiles of leaders in organizations (BENEVIDES, 2010). Taking this into consideration, business Leaders must be aware of all these changes and adapt to new professional qualification requirements, especially the leader responsible for managing technological innovation projects.

Therefore, for effects in this research, the leadership, ability to influence others to making decisions on a voluntary and routine basis (ROWE, 2002) will be analyzed by the way in which a

leader uses his repertoire of accumulated competences (BERLATO et al 2012) that need to be implemented to achieve a certain goal so to generate results and then adding economic value for the organization as well a social value for the individual (FLEURY; FLEURY, 2000).

In this perspective, the concept of competence here is thought as of a set of three dimensions: knowledge, which basically refers to the knowledge of all that the person has accumulated throughout life; skill, which is related to the productive application of knowledge, that is, the capacity of the person retrieve information stored in your memory and use it in an action; and finally, attitude, which refers to social and affective aspects, as feelings or predispositions of the individual which guide their conduct in relation to others, to work itself, or some specific situation (FLEURY; FLEURY, 2000; CARBONE et al, 2006).

### 3. Research Method

The purpose of the present study is evaluating the influence of leadership in the management of technological innovation projects in industry 4.0. In order to make it, at first, an exploratory research was developed in the light of the literature to survey the variables that make up the conceptual model, serving as a basis to provide greater familiarity with the problem and understanding of the proposed theme. Subsequently, these variables were submitted to experts with knowledge about the research object for their evaluation. The data were collected through a judgment matrix in which the experts gave their opinion on the most important leadership competencies regarding the management of technological innovation projects.

#### 3.1. Conceptual Model

According on the exploratory research mentioned above, developed on the basis of material already elaborated, consisting mainly of scientific articles, theses, dissertations and books; a specific research model has been designed to examine the relationship between the influence of leadership and technology innovation project management, this is, how leadership competencies affect the management of technology innovation projects. The figure 1 illustrates the main constructs included in the current study and will serve to guide the analysis of the results obtained.

**Figure 1:** Conceptual model



Given that the research problem formulated is scientific in nature, that is, it involves variables that can be considered testable, susceptible to observation and manipulation (GIL, 2002); Below are the independent variables and the dependent variables of the present study:

- **Independent variables:** the leadership competencies were adopted, which are expressed when the leader generates a result at work, resulting from the joint application of three dimensions: knowledge, skills and attitudes (FLEURY; FLEURY, 2000; CARBONE et al, 2006).
- **Dependent variables:** the result of the management of technological innovation projects in industry 4.0.

### 3.2. Sample and Data Collection

The object of investigation pertinent to this study is constituted by a significant and rigorously selected sample that contemplates the input of specialists on managing technological innovation projects in industry 4.0. The group of potential respondents was randomly selected from social networks such as LinkedIn and the Lattes platform. To assess the influence of the independent variables under the dependent variables, data were collected through a survey, judgment matrix, containing closed-ended questions and a Likert-type assessment scale (1 - Not important; 2 - Not important; 3 - Null; 4 - Important; 5 - Very important) that were applied to questionnaires that incorporated sections that deal with: Part I - Contact data and general information – example questions: company name, respondent name, others; Part II - Assessing the influence of leadership on technology innovation project management in industry 4.0 – example questions: How important is big data knowledge for technology innovation project management in industry 4.0? others. An open answer question was also used so that the respondents could freely write possible suggestions for the improvement of the research. All leadership knowledge, skills, and attitudes that were used in the judgment matrix are shown in Table 1.

**Table 1:** Leadership Competences

Knowledge	Skills	Attitudes
Project Scope Management (PMI, 2017). Project Schedule Management (PMI, 2017).	Communicating effectively, that is, being able to express yourself clearly and convincingly (IRIGARAY, 2017).	Clarify employee goals, provide guidance on how they can complete tasks, clarify performance standards and expectations, and use positive and negative rewards contingent on performance (IRIGARAY, 2017).
Project Cost Management (PMI, 2017). Project Quality Management (PMI, 2017).	Being persuasive, be able to organize and present ideas in ways that induce others to accept them (IRIGARAY, 2017).	Setting challenging goals, emphasize excellence and demonstrate confidence in the capabilities of those led (IRIGARAY, 2017).
Project Resource Management (PMI, 2017). Project Communications Management (PMI, 2017). Project Risk Management (PMI, 2017).	Having auditory perception, that is, practicing active listening and being able to capture relevant information from oral communications (IRIGARAY, 2017).	To plan, schedule, organize and coordinate work, provide guidance, train, advise, give feedback to assist those in developing their skills, eliminate blockages, provide resources, and transfer power so that they can make actions and decisions (IRIGARAY, 2017).
Project Procurement Management (PMI, 2017). Project Stakeholder Management (PMI, 2017).	Leading the group under your responsibility with integrity and ethics (IRIGARAY, 2017).	Show concern for the welfare and needs of members, be friendly and approachable, and treat them as equals (IRIGARAY, 2017).
People Management (IRIGARAY, 2017). Recruitment, selection, training and retention of talent (IRIGARAY, 2017).	Being able to make a good impression, gain attention and respect, gain confidence and gain personal recognition (IRIGARAY, 2017).	Resolving conflicts and disputes, facilitate communication, encourage exchange of opinions from the minorities, emphasize collaboration and teamwork, encourage close relationships among those led (IRIGARAY, 2017).
Business strategy, mission, vision, values, goals and organizational culture (IRIGARAY, 2017).	Delivering results with excellence, manage time and act strategically (SABBAG, 2017).	
Theories and practices of leadership and motivation; and techniques to persuade and influence people (IRIGARAY, 2017).	Using computational tools to create documents, reports, presentations and spreadsheets (SABBAG, 2017).	Imposing problems rather than solutions on the working group, encourage group members to participate in decision making,
Diversity Management (IRIGARAY, 2017).	Recognizing and define problems, equate solutions, acting	

Knowledge	Skills	Attitudes
IT Governance (CERNEV; LEITE, 2017) E-business (CERNEV; LEITE, 2017)	preventively, transferring and generalizing knowledge (IRIGARAY, 2017).	provide the group with necessary information for analysis and involve informed leaders in the decision making process (IRIGARAY, 2017).
Information Security (CERNEV; LEITE, 2017) Big data (LIU; XU, 2017)	Taking calculated risks, make decisions in contexts with little information and using intuition (SABBAG, 2017).	Presenting the workgroup positively to others, maintain positive relationships with influential others, participate in social functions throughout the organization and ceremonies, and do unconditional favors for others (IRIGARAY, 2017).
Internet of Things (LIU; XU, 2017; SCHWAB, 2016) Analytics (CERNEV; LEITE, 2017)	Being persistent, optimistic, determined and know how to identify and seize opportunities (IRIGARAY, 2017).	
Legal aspects (tax law, labor law, civil code, consumer law and etc.)	Knowing how to communicate in several languages such as English, Spanish, Mandarin and etc (IRIGARAY, 2017).	Establishing a vision, show passion for it and support its achievement, demonstrate self-confidence, communicate high performance expectations and confidence in others' capabilities and give positive feedback (IRIGARAY, 2017).
Politics Economy	Quick learning and ease of dealing with new technologies (IRIGARAY, 2017).	
Accounting	Be motivated to reach your goals (IRIGARAY, 2017).	
Finances Administration Marketing	Using an authentic, respectful and assertive approach to resolving crises with project stakeholders (IRIGARAY, 2017).	
Negotiation and Conflict Resolution (SPINOLA, 2017). Entrepreneurship and innovation Environmental Responsibility	Using negotiation techniques such as win-win based on trust between the parties, which can be achieved from the relationship developed through preliminary conversations (SPINOLA, 2017).	
English language Financial Mathematics International relations	Delegating responsibility, power and authority for that the actions to be taken (IRIGARAY, 2017).	
Compliance Programming language	Strive to create a sense of belonging, empathy and community, both inside and outside the project (IRIGARAY, 2017).	
	Customer orientation (IRIGARAY, 2017).	
	Organizing and optimize the allocation of scarce resources efficiently and effectively (IRIGARAY, 2017).	

#### 4. Results Analysis

The questionnaires were sent via email or private message on the LinkedIn web platform between November 27, 2019 and December 3, 2019 and were completed using the Google Forms tool. From 75 questionnaires sent, 21.33% returned answered. A significant sample is evidenced, considering that it is an exploratory study. Once returned the questionnaires answered the data was organized in a spreadsheet. To better understand the data, the knowledge gathered was grouped into four groups: Group 1 - Project Management; Group 2 - Leadership; Group 3 - Innovation and Information Technology; and Group 4 - General Knowledge. The skills raised were grouped into two groups: Group 1 - Techniques; and Group 2 - Social. Attitudes were organized into only one group. The

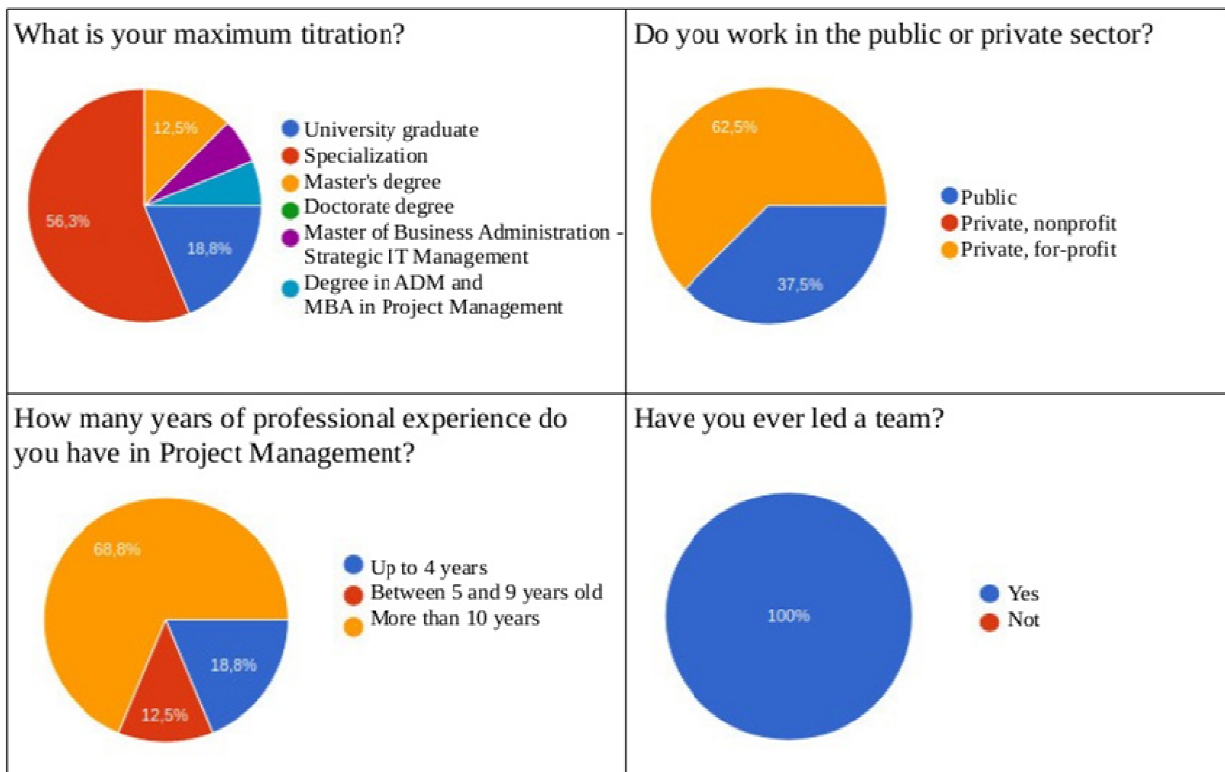
arithmetic mean was used for the descriptive analysis of the answers regarding the degree of importance of knowledge, skills and attitudes according to the perception of the participating experts. Basically, summed the values of all the individual answers and was divided by the total number of respondents, 16 people. Table 2 shows a summary with one item considered most important for the respondents in each studied dimension of competence here in this research.

**Table 2:** The three most important items in each competency dimension

	16 expert answers																Mean
<b>Knowledge:</b> People management (IRIGARAY, 2017).	5	4	5	5	5	5	3	5	5	5	5	4	4	5	5	5	4,68
<b>Skills:</b> Leading the group under your responsibility with integrity and ethics (IRIGARAY, 2017).	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4,93
<b>Attitudes:</b> To plan, schedule, organize and coordinate work, provide guidance, train, advise, give feedback to assist those in developing their skills, eliminate blockages, provide resources, and transfer power so that they can make actions and decisions (IRIGARAY, 2017).	5	5	5	5	5	5	5	5	5	5	4	5	4	5	2	5	4,68

As shown in Figure 2, the population profiles of this study revealed a marked presence of professionals with a maximum degree of specialization, 56.3%, with the majority currently working in the private sector, for profit, 62.5%, and over 10 years of professional experience in Project Management, 68.8%; highlighting the fact that all respondents have already led a team, 100%.

**Figure 2:** General Information – Results



The result showed that the most important expertise in Group 1 - Project Management is “Project Quality Management” first, followed by a draw between “Project Resource Management” and “Project Communications Management”. The least important knowledge in this group was “Project Schedule Management”.

- **In Group 2** – Leadership: the knowledge considered most important is “People Management”. The knowledge considered less important in this group was the “Theories and practices of leadership and motivation; and techniques to persuade and influence people”.
- **In Group 3** - Innovation and Information Technology, the knowledge considered most important is “Information Security”. The knowledge considered less important in this group was "E-business".
- **In Group 4** - General Knowledge, the knowledge considered most important is “Negotiation and Conflict Resolution”, followed by “Environmental Responsibility”. The knowledge considered less important in this group was “Financial Mathematics”.

The result showed that the skills considered most important in Group 1 – Techniques are, firstly, “To lead the group under your responsibility with integrity and ethics”, followed by “To recognize and define problems, equate solutions, acting preventively, transferring and generalizing knowledge. ” The least important knowledge in this group was “To use computational tools to create documents, reports, presentations and spreadsheets”.

In Group 2 - Social, the skill considered most important is “To Communicate effectively, that is, being able to express yourself clearly and convincingly,” followed by “To have auditory perception, that is, practicing active listening and being able to capture relevant information from oral communications”. The least important was "To take calculated risks, make decisions in contexts with little information and using intuition."

Regarding attitudes, the result demonstrated that the most important would be “To plan, schedule, organize and coordinate work, provide guidance, train, advise, give feedback to assist those in developing their skills, eliminate blockages, provide resources, and transfer power so they can make actions and decisions”. The less important attitude would be to “To impose problems rather than solutions on the working group, encourage group members to participate in decision making, provide the group with necessary information for analysis and involve informed leaders in the decision making process”.

## 5. Conclusions

One of Schwab's (2016) major concerns is that leaders are often driven by traditional linear thinking, caring too much about immediate issues, and failing to think strategically about the diffusion of innovations and the mitigation of disruptions that shape the future. Given this, coherent researches describing the opportunities and challenges of industry 4.0 is still needed to empower leaders, especially technology innovation project managers, to ensure that they are best prepared to take advantage of these new opportunities and overcome the challenges. The data analysis allowed answering the core question of this research: which leadership competencies (divided into three dimensions: knowledge, skills and attitudes) are considered the most important in the management of technological innovation projects in industry 4.0. It is to be concluded that for a leader to influence the management of technological innovation projects in industry 4.0 the most important knowledge is “People Management”, the most important skill considered is “To lead the group under its responsibility with integrity and ethics” and the most important attitude considered is “To plan, schedule, organize and coordinate work, provide guidance, train, advise, give feedback to assist those in developing their skills, eliminate blockages, provide resources, and transfer power so that they can take action and decisions”.

As restrictions of this research, it is possible to cite the data gathering related to the perception that people suffer about themselves, which may result in distorted data. There is difference between what people do or feel and what they say about it. Besides providing a static view of the studied phenomenon, it does not indicate its tendencies to variation, much less the possible structural changes (GIL, 2002). The purpose of this study was to contribute to the basement of future constructive discussions and to the planning of professional development of leadership competencies, in accordance with the requirements arising from megatrends brought about by industry 4.0 advances, providing clear guidance to project managers and organizations on how to be prepared to succeed with technological innovations.

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