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JÉSSICA KARINE PROCHNOW

Internal Stakeholders' Analysis of Industry 4.0 Working Network within a Multinational Automotive Supplier

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Thesis submitted as a requirement to obtain a bachelor's degree in the Graduate Course of Automotive Engineering of the Joinville Technological Center of the Federal University of Santa Catarina.

Advisor: Prof. Dr. Janaína Renata Garcia

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Jéssica Karine Prochnow

INTERNAL STAKEHOLDERS' ANALYSIS OF INDUSTRY 4.0 WORKING NETWORK WITHIN A MULTINATIONAL AUTOMOTIVE SUPPLIER

This monography has been judged and approved as a partial requirement for obtaining the Bachelor of Automotive Engineering degree at the Federal University of Santa Catarina, Technological Center of Joinville.

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Prof. Dr. Modesto Hurtado Ferrer
Course Coordinator

Examining Board:

Prof. Dr. Janaína Renata Garcia
Advisor

Prof. Dr. Marcos Alves Rabelo
Member

Prof. Dr. Elisete Santos da Silva Zagheni
Member

I dedicate this work to my dear parents for providing me the opportunity to study and for teaching me the important values in life.

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RESUMO

Devido aos avanços tecnológicos em digitalização e conectividade nos processos de fabricação, empresas multinacionais têm enfrentado desafios impostos pela Indústria 4.0 para melhorar sua produtividade. O presente trabalho tem como principal objetivo abordar um estudo de caso envolvendo a análise de stakeholders internos de um departamento responsável por gerenciar projetos para Indústria 4.0 de uma fornecedora automotiva multinacional. A partir do levantamento de dados e pesquisas, busca-se desenvolver análises qualitativas de poder e influência dos stakeholders internos, as quais baseiam-se nos principais interesses dos stakeholders nos projetos gerenciados pelo departamento em questão. Para o melhor entendimento da participação dos stakeholders identificados no desenvolvimento do projetos estratégicos, estes são divididos inicialmente em categorias relacionadas ao níveis organizacional e de projeto. Além disso, com base na classificação de stakeholders obtida, propõem-se um conceito de comunicação de forma a atender as expectativas dos stakeholders, uma vez que representam, de acordo com graus de poder e influência, fatores fundamentais no desenvolvimento de um projeto.

Palavras-chave: Stakeholders, Indústria 4.0, fornecedora multinacional automotiva.

ABSTRACT

Due to technological advances in digitization and connected manufacturing processes, multinational companies have faced challenges imposed by Industry 4.0 in order to improve their productivity. The present work aims to approach a case study involving internal stakeholders analysis for an Industry 4.0 working network of a multinational automotive supplier. From data collection and surveys, it is intended to develop stakeholders' power and influence qualitative analysis, which are based on their main interests in the projects managed by the concerned department. In order to bring a better understanding of the identified stakeholders in regards to the development of the strategic projects, they are initially divided in two categories related to the organizational and project levels. Besides, based on the obtained internal stakeholders classification, it is proposed a communication concept in order to fulfill stakeholders expectations, once these represent, according to their level of power and influence, fundamental factors in a project development.

Key-Words: Stakeholders, Industry 4.0, multinational automotive supplier.

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SUMMARY

1 INTRODUCTION

Technological advances in regards to digitization and connected manufacturing have driven great improvements in industrial productivity since the emergence of the Fourth Industrial Revolution, also known as Industry 4.0.

In order to transform and increase production, foster industrial and economic growth, multinational companies have faced challenges to adjust and adopt new technologies required by Industry 4.0. Consequently, encouraged by this manufacturing revolution, big companies have undertaken the challenge by creating solutions for a global scale where managing stakeholders closely can change the course of a project.

Today almost every project takes place in a context where stakeholders play a major role in the accomplishment of the tasks. Often the project is sensitive to actions and decisions taken by the stakeholders (KARLSEN, 2002). On this basis, the stakeholders interests and expectations are key elements when studying stakeholders influence over a project or a department.

Through a stakeholder analysis it is possible to obtain fundamental information regarding their level of interest and influence and this way, develop strategic actions to fulfill their requirements.

Therefore, this case report covers an analysis of stakeholders influence on Industry 4.0 projects and their management performed by a multinational automotive supplier department responsible for innovations in manufacturing. Besides, it is aimed to present an internal stakeholders identification and an analysis based on the principles of Stakeholders Theory, Salience Model and Power-Interest matrix. Through the conducted analysis, a proposal of a communication concept is suggested in order to reinforce the importance of the internal stakeholders engagement in the development of manufacturing projects for Industry 4.0.

1.1. OBJECTIVES

1.1.1 General Objectives

Through this present thesis it is aimed to comprehend the influence of internal stakeholders on the development of innovation projects and solutions deployment in a multinational automotive supplier. For this purpose, stakeholder analysis have been performed in order to classify the stakeholders and achieve their expectations, enabling this way the establishment of an international working network to deploy solutions for Industry 4.0.

1.1.2 Specific Objectives

- Identifying which are the internal stakeholders and their expectations towards the concerned department.
- Evaluating the influence of internal stakeholders on the development of innovation projects and standard solutions for Industry 4.0 through a predominantly qualitative approach.
- Elaborating a proposal of communication plan with the internal stakeholders in order to align worldwide activities.
- Explaining the importance of the achieved results in regards to internal stakeholders management.

1.2 ARGUMENTS OF THE CASE STUDY

The knowledge and management of stakeholders are essential factors in project steering, once they may influence and act upon solution development. In the present context, motivated by the technological challenges imposed by Industry 4.0, the projects conducted by the concerned department imply the participation of an international working network which engages in solution deployment in a global scale. Therefore, it becomes necessary to know and manage all individuals who can affect or be affected during the solution development and implementation processes, once the commitment and responsibility related to social and economic factors within the organization are considered.

Once the strategic projects managed by the concerned deparment aim to increase efficiency in production processes within I4.0 requirements and consequently, saving financial resources, it becomes fundamental to fulfill the main stakeholders expectations, according to their level of power and influence over the

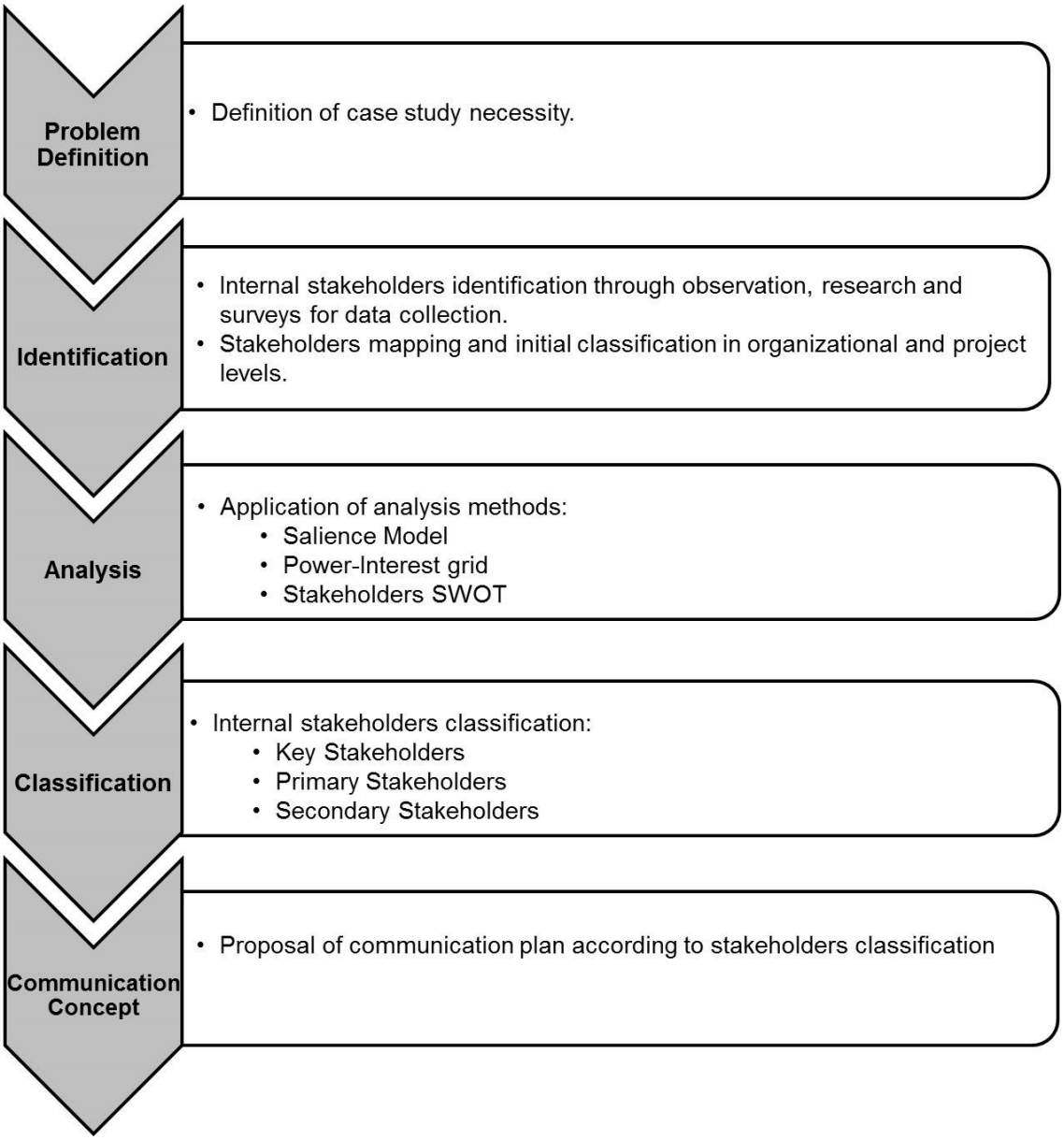
projects. This way, the present study approaches an internal stakeholder analysis with the focus to classify them in categories in which they can be accordingly managed.

1.3 METHODOLOGY OF WORK

In this chapter it is covered the methodology which the present case study is carried out. As stated by Silva and Menezes (2005), within a qualitative research, the environment is a direct source of data collection and researcher is the key tool. Additionally, it is a descriptive research. In this context, a predominantly qualitative approach was adopted using different data collection sources, in order to gather appropriate data for analysis, including interviews and questionnaires with the company's target group. Besides, a statistic quantitative approach was also conducted as a complementary method through statistical techniques in order to validate conclusions.

The fluxogram in Figure 1 represents the methodology described during the conducted case study.

Figure 1- Fluxogram of the case study methodology



Source: The author (2019).

2 THEORETICAL FOUNDATION

The following theorical foundation focus in four fundamental fields: The Stakeholders Theory, Models of Governance, Project Stakeholders Management and Industry 4.0. This way, the correlation between internal stakeholders, the development of technological innovation projects for Industry 4.0 and the importance of their management is highlighted, aiming to foster this case study propositions.

2.1 THE STAKEHOLDERS THEORY

The term stakeholder is used as a general term to describe individuals, groups, or organizations that have an interest in the project and can mobilize resources to affect its outcome in some way. A formal definition of a stakeholder is: “individuals and organizations who are actively involved in the project, or whose interests may be positively or negatively affected as a result of project execution or successful project completion” (Project Management Institute (PMI®), 1996 apud Smith, 2000).

From a stakeholder perspective, business can be understood as a set of relationships among groups that have a stake in the activities that make up the business (FREEMAN, 1984; JONES, 1995; WALSH, 2005 apud PARMAR et al., 2010). In addition, as stated by Freeman (1984) apud Parmar et al. (2010), it is executive’s job to manage and shape these relationships to create as much value as possible for stakeholders and to manage the distribution of that value.

In 1984, R. Edward Freeman originally detailed the Stakeholder Theory of organizational management and business ethics that addresses morals and values in managing an organization. Stakeholder Theory is a view of capitalism that stresses the interconnected relationships between a business and its customers, suppliers, employees, investors, communities and others who have a stake in the organization. The theory argues that a firm should create value for all stakeholders, not just shareholders (STAKEHOLDER THEORY, 2018). From shareholding perspective, according to Bezerra (2014), the company was considered an economic entity and its success was based only on its profitability.

Stakeholder Theory draws on four of the social sciences: sociology, economics, politics and ethics, especially the literature on corporate planning,

systems theory, corporate social responsibility and organizational studies (MAINARDES, ALVES and RAPOSO, 2012). The authors also pointed Freeman (1984) as the theory founding theorical landmark, who defines how stakeholders with similar interests and rights form a group.

Freeman is considered to be the founder of a concept that acknowledges the existence of stakeholders in relation to business practice. These have been, and continue to be further elaborated and developed by many authors. In principle, stakeholder access to companies (and organizations in general) has been developed into a Strategic, Prescriptive or Descriptive Approach (DOHNALOVÁ and ZIMOLA, 2013).

According to Dohnalová and Zimola (2013), the strategic approach enhances that the company's stakeholders are strong entities of strategic importance with the ability to influence the organization's existence. This way, as stated by the authors, it focuses on the analysis of the relationship between stakeholders and management and the economic results of the company and also refer to Freeman (1984) and his concept of stakeholders management as a representative of this approach.

The Normative Dimension defines stakeholders by using social norms. It is rather, more focused on the ideals of Social Responsibility and Social Organizations. In a narrower sense, groups that have legitimate claims against the organization and an important responsibility are considered as stakeholders. In a broader sense, all existing entities around the company are considered as stakeholders. Preston and Donaldson (1995) are prominent representatives of the Normative Approach, where the significance of managers and their roles in the company builds on moral and philosophical principles (DOHNALOVÁ and ZIMOLA, 2013). Differently, the authors define the descriptive approach as more focused on the description of individual stakeholder's cooperative and competitive interests.

According to Parmar et al. (2010), throughout the 1980's and 1990's, Freeman and other scholars shaped the vocabulary "stakeholder" to address to these three interconnected problems relating to business: (1) The problem of value creation and trade; (2) The problem of ethics of capitalism; (3) The problem of managerial mindset. Based on that, as stated by the authors, stakeholders theory suggest that if the relatioships between a business and the group of individuals who can affect or be affected by it is taken into analysis, then there is a great chance to deal effectively with the three mentioned problems.

Donaldson and Preston (1995) apud Parmar et al. (2010) explicitly acknowledge and systematically discuss the notion that stakeholder theory has four distinct parts: descriptive (e.g., research that makes factual claims about what managers and companies actually do), instrumental (e.g., research that looks at the outcomes of specific managerial behavior), normative (e.g., research that asks what what managers or corporations should do), managerial (e.g., the research that speaks to the needs of practitioners).

According to Mitchell, Agle and Wood (1997), stakeholders theory attempts to identify the fundamental question in a systematic way: which groups are stakeholders deserving or requiring management attention and which are not.

Early stakeholders theorists such as Dill (1975) and Freeman and Reed (1983) apud Parmar et al. (2010), examined the ability of stakeholders to influence the firm in terms of the nature of their stakes and the source of their power. Later, Mitchell, Agle and Wood (1997) identified urgency, power and legitimacy as factors that determine how much attention management will give to various stakeholders (PARMAR et al., 2010).

As stated by Mainardes, Alves and Raposo (2012), taking into consideration the model proposed by Freeman (1984) includes a broader spectrum of stakeholders and not only the traditional (clients, shareholders, members of staff, suppliers and competitors), one issue that has concerned field research from the outset is how to deal with all stakeholders simultaneously. According to Fassin (2008) apud Mainardes, Alves and Raposo (2010), this is simply not possible and the utilization of criteria prioritizing stakeholders has always been a theorical requirement.

Classifying stakeholders according to their level of power and importance has been proposed by many authors and from different perspectives. Among the mentioned theorists, the most popular and well-known approach was proposed by Mitchell et al. (1997) and entitled stakeholder salience and as pointed out by Mainardes, Alves & Raposo (2012), this has been the most commonly discussed and deployed model in the literature.

Stakeholders dynamics is implicitly incorporated in the work of Mitchell et al. (1997) who used three attributes in measuring the importance of a stakeholder: Legitimacy – the moral or legal claim a stakeholder has to influence a particular project; Power – their capacity to influence the outcome of a given project; and

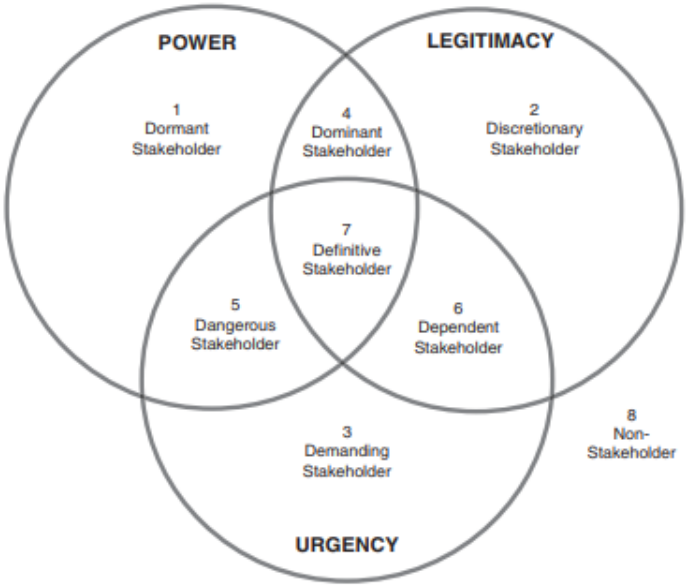
Urgency – the degree to which their claims are urgent or compelling (NAHYAN et al., 2014).

As stated by Suchman (1995) apud Mitchell, Angle and Wood (1997) , legitimacy is “ a generalized perception or assumption that the actions of an entitity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs and definitions”. Besides, Mitchell, Angle and Wood (1997) also complement that legitimacy is a desirable social good, that it is larger and more shared than a mere self-perception, and that it may be defined and negotiated differently at various levels of social organization.

By adding urgency as one of the stakeholders attributes, Mitchell, Angle and Wood (1997) consider changing the model from static to dynamic. This way, the authors believe that urgency, with synonyms including “compelling”, “driving” and “imperative”, exists only when two conditions are met: (1) when a relationship or claim is of a time-sensitive nature and (2) when that relationship or claim is important or critical to the stakeholder.

According to Nahyan et al. (2014), a stakeholder possessing all three attributes is categorized as highly important (definitive stakeholder), two factors as medium (dominant, dangerous or dependent stakeholder), and one factor as low (dormant, discretionary or demanding). Any individual possessing none of the above factors in a project is regarded as a non-stakeholder. The Figure 2 below illustrates the mentioned attributes in a stakeholder topology.

Figure 2 – Stakeholder's topology.



Source: Mitchel et al (1997).

According to Mitchel, Angle and Wood (1997), latent stakeholders are those possessing only one of the three attributes, and include dormant, discretionary and demanding stakeholders. Expectant stakeholders are those possessing two attributes, and include dominant, dependent, and dangerous stakeholders. Definitive stakeholders are those possessing all three attributes. Finally, individuals or entities possessing none of the attributes are nonstakeholders.

Based on the diagram of Figure 2, Alves, Gomes & Corsino (2014) explain that stakeholders which possess only one attribute – power; legitimacy; or urgency – are classified respectively as "dormant" (1); "discreet" (2); and "demanding" (3). These stakeholders may also be called "latent." Meanwhile, stakeholders which combine two attributes – power and legitimacy; power and urgency; urgency and legitimacy – would correspond respectively to the "dominant" (4); "dangerous" (5); and "dependent" (6) types. They are recognized as "moderate" stakeholders or even "spectator" stakeholders because they are always expecting something. Finally, the interested parties which exert power, legitimacy and urgency in a articulate manner, classified as "definitive" (7) stakeholders, are the most important groups, because they use the three attributes combined to influence the company in their favor. The

non-stakeholders or potential stakeholders (8) lie outside of the complex and are considered individuals or entities which do not possess any influence attribute.

Figure 3 – Stakeholder Type Classification Options.

Stakeholder Type Classification options	
Latent stakeholders (in possession of only one attribute, probably receiving little company attention)	*Dormant stakeholder*. Groups and individuals with the power to impose their wills on the organization but lack either legitimacy or urgency. Hence, their power falls into disuse with little or no ongoing interaction with the company. Nevertheless, company management needs to be aware and to monitor this stakeholder and evaluate its potential to take on a second factor *Discretionary stakeholder*. Groups and individuals with legitimacy but that lack both the power to influence the company and any urgency. In these cases, attention should be paid to this stakeholder under the framework of corporate social responsibility as they tend to be more receptive *Demanding stakeholder*. When the most important attribute is urgency. Without power and legitimacy, they do not demand greatly of the company but they require monitoring as regards their potential to gain a second attribute
Expectant stakeholders (in possession of two attributes resulting in a more active posture both from the stakeholder and from the company)	*Dominant stakeholder*. Groups and individuals that hold influence over the company guaranteed by power and legitimacy. Correspondingly, they expect and receive a lot of attention from the company *Dangerous stakeholder*. When there is power and urgency but stripped of any legitimacy. The coercive stakeholder (and possibly violent) may represent a threat to the organization *Dependent stakeholder*. Groups and individuals that hold attributes of urgency and legitimacy but which however depend on another stakeholder for their claims to be taken into consideration
Definitive stakeholder (whenever the stakeholder holds power, legitimacy and urgency with managers therefore paying immediate attention and prioritising this stakeholder)	
Non-stakeholder (when groups and individuals neither hold any influence nor are influenced by organization operations).	

Source: Mainardes, Alves and Raposo (2012).

2.2 MODELS OF GOVERNANCE

According to Williamson (1979), as mentioned by Derakhshan, Turner and Mancini (2018), in one of the earliest definitions, governance was described as the engagement of two actors in an economic transaction that requires them to monitor and control the transaction, protect the interests of each party, and reach the most efficient share of values.

Similarly, Müller et al., (2016) apud Derakhshan, Turner and Mancini (2018) define that project governance describes the interactions between project participants and the mechanisms adopted can heavily influence the engagement of the stakeholders and their trust in the project. As mentioned by the authors, these definitions shed light on the strong link that exists between governance and stakeholders.

Besides, Müller (2009) apud Derakhshan, Turner and Mancini (2018) suggests that the functions of the governance mechanisms are: directing and controlling the organization, balancing goals (economic, social, environmental, individual) and defining rights and responsibilities of stakeholders.

2.3 STAKEHOLDERS MANAGEMENT

As stated by Parmar et al. (2010), management includes behavioral areas such as organizational behavior, organizational theory and human resource management as well as management science, manufacturing and operations. From this perspective, in his studies, Sturdivant (1979) apud Parmar et al. (2010), proceeded the concept that managers should aim for cooperation with the entire system of stakeholders.

All existing methodologies of project management are built under the determined network diagram models which are focused on the operational level, i.e. the lowest level of execution the project management activities. In fact, the methodologies known today in the world as well as the standards - PMBOK, PRINCE2, IPMA ICB, P2M, and certification systems, have been developed on this basic principle – models are intended to be used by the project manager and project management team (VOROPAEV and KLIMENKO, 2015). Although, as stated by the authors, there are many other interested parties (stakeholders) taking active part in project management activities, once they make decisions at tactical and strategical levels of management. Hence, it is also necessary to take into account their interests and consider the key stakeholders as subjects of management.

A project stakeholder can be defined in many different ways. The PM standards in project management define stakeholders as: ”Persons and organizations such as customers, sponsors, the performing organization, and the public that are actively involved in the project, or whose interests may be positively or

negatively affected by the execution or completion of the project" (PMBOK, 2008 apud JOHANSEN, EIK-ANDRESSEN E EKAMBARAM, 2014).

In addition, as defined by PRINCE2 (2012), any individual, group or organization that can affect, be affected by, or perceives itself to be affected by an initiative (program, project, activity, risk).

According to Hilson and Simon (2012) apud Johansen, Eik-andressen e Ekambaram (2014) stakeholders are any person or party with an interest in the outcome of the project and/or an ability to exert influence. Therefore, as defined by Freeman (1984), any group or individual who can affect or is affected by the achievement of the organization's objectives. Similarly, Artto et al. (2011) apud Johansen, Eik-andressen e Ekambaram (2014) defines stakeholders as individuals, groups or organizations that the project may affect or that can affect the project. Besides, the author also complements that stakeholders can have a direct or indirect connection to a project, or to the resulting product. Therefore, according to him, this connection can be based upon a possibility to affect the result of the project directly or indirectly.

2.4 INDUSTRY 4.0 – THE FOURTH INDUSTRIAL REVOLUTION

In today's competitive business environment, companies are facing challenges in dealing with big data issues of rapid decision-making for improved productivity. Many manufacturing systems are not ready to manage big data due to the lack of smart analytic tools. Germany is leading a transformation towards 4th Generation Industrial Revolution (Industry 4.0) based on Cyber-Physical System-enabled manufacturing and service innovation (LEE, BAGHERI and KAO, 2014).

Advances in computation and communication are taking shape in the form of Internet of Things, Machine-to-Machine technology, Industry 4.0, and Cyber Physical Systems (CPS). The impact of engineering such systems is a new technical systems paradigm, multiple needs can be identified along three axes: (i) online configuring an esemble of systems, (ii) achieving a concerted function of collaborating systems, and (iii) providing the enabling infrastructure (MOSTERMAN and ZANDER, 2015).

According to Bahrin (2016) there are four stages in the ongoing process called the Industrial Revolution. The first revolution occurred towards the end of the 18th century which was mechanical production on the basis of water and steam. The

second Industrial Revolution at the beginning of the 20th century happens during the introduction of conveyor belts and mass production, to which names of icons such as Henry Ford and Frederick Taylor are linked. The third revolution takes places in the digital automation of production by means of electronics and information technology (IT) system. Today, the industrial landscape is again being transformed to the fourth stage with the rise of autonomous robots, contemporary automation, cyber-physical systems, the internet of things, the internet of services and so on.

In 2011, the German government have brought into the world a new heading called *Industrie 4.0* (I4.0) assumed as the fourth industrial revolution. I4.0 aim is to work with a higher level of automatization achieving a higher level of operational productivity and efficiency, connecting the physical to the virtual world (ALCÁCER and CRUZ-MACHADO, 2019). Yet, according to Alcácer and Cruz-Machado (2019), I4.0 can be assumed as Cyber-Physical Systems (CPS) production, based on heterogeneous data and knowledge integration and it can be summed up as an interoperable manufacturing process, integrated, adapted, optimized, service-oriented which is correlated with algorithms, Big Data (BD) and high technologies such as the Internet of Things (IoT) and Services (IoS), Industrial Automation, Cybersecurity (CS), Cloud Computing (CC) or Intelligent Robotics.

This revolution is characterized by its reliance on the use of CPS capable of communication with one another and of making autonomous, de-centralised decisions, with the aim of increasing industrial efficiency, productivity, safety and transparency (BOYES et al., 2018).

Industry 4.0 or fourth Industrial Revolution also refers to the next phase in a digitization of the manufacturing sector where the Internet of Things (IoT) looks to play a huge role that have the potential to feed information into it and add value to manufacturing industry to realize a low-volume, high-mix production in a cost-efficient way (WILLIAM, 2014 apud BAHRIN et al. (2016).

It can be concluded that the term Industry 4.0 describes different—primarily Information Technology(IT) driven—changes in manufacturing systems. These developments not only have technological but also versatile organizational implications (LASI et al., 2014 apud NAGY et al., 2018).

2.5 TECHNOLOGICAL REQUIREMENTS OF INDUSTRY 4.0

Aiming to tranform production, advanced digital technology used in manufacturing has represented the combination of the technological trends of Industry 4.0. According to Gerbert et al. (2015), nine technology trends are the building blocks of Industry 4.0: Autonomous robots, Simulation, Horizontal and Vertical System Integration, Industrial Internet of Things (IIoT), Cybersecurity, The Cloud, Additive Manufacturing, Augmented Reality, Big Data Analytics.

Many of the nine advances in technology that form the foundation for Industry 4.0 area already used in manufacturing, but with Industry 4.0, they will transform production: isolated, optimized cells will come together as a fully integrated, automated, and optimized production flow, leading to greater effficiences and changing traditional production relationships among suppliers, producers and customers - as well as between human and machine (GERBERT et al., 2015).

2.5.1 Internet of Things (IoT)

The concept of the Internet of Things (IoT) was introduced in 1999, after the explosion of the wireless devices market, and the introduction of Radio Frequency Identification (RFID) and the Wireless Sensor Networks (WSN) technologies (SFAR et al., 2017).

According to Dorsemaine et al. (2015), the IoT is defined as a group of infrastructures, interconnecting connected objects and allowing their management, data mining and the access to data they generate. Also, Satyavolu, et al. (2017) apud Boyes et al. (2018) states that IoT represents a scenario in which every object or “thing” is embedded with a sensor and is capable of automatically communicating its state with other objects and automated systems within the environment.

Boyes et al. (2018) defines it as a system comprising networked smart objects, cyber-physical assets, associated generic information technologies and optional cloud or edge computing platforms, which enable real-time, intelligent, and autonomous access, collection, analysis, communications, and exchange of process, products and/or service information, within the industrial environment, so as to optimize overall production value. This value may include: improving product or

service delivery, boosting productivity, reducing labour costs, reducing energy consumption, and reducing the build-to-order cycle.

Therefore, according to Sfar et al. (2017), IoT applications increase manufacturing productivity by providing a comprehensive view of the production chain and making instant adjustments.

2.5.2 Big Data Analytics

With recent developments that have resulted in higher availability and affordability of sensors, data acquisition systems and computer networks, the competitive nature of today's industry forces more factories to move toward implementing high-tech methodologies. Consequently the ever growing use of sensors and networked machines has resulted in the continuous generation of high volume of data which is known as Big Data (LEE, BAGHERI and KAO, 2015).

Still in regards to industrial Big Data environment, according to Lee and Kao (2014), with more advanced analytics, the advent of cloud computing and a Cyber-Physical Systems (CPS) framework, future industry will be able to achieve a fleet wide information system that helps machines to be self-aware and actively prevent potential performance issues. Lee and Kao (2014) apud Vaidya, Ambad and Bhosle (2018) states it is a need of Industry 4.0 to convert the regular machines to self-aware and self-learning machines to improve their overall performance and maintenance management with the surrounding interaction.

Big Data makes it possible to analyze the data at a more advanced level than traditional tools allowed. With this technology, even data which has been collected in various mutually incompatible systems, databases and websites is processed and combined to give a clear picture of the situation in which there is a specific company or person (WITKOWSKI, 2017). Therefore, according to the author, Big Data Analytics enable industries to quickly and efficiently manage and use the constantly growing database due to its feature of collecting information from different sources.

2.5.3 Augmented Reality

Due to the Industry 4.0 initiative, Augmented Reality (AR) has started to be considered one of the most interesting technologies companies should invest in, especially to improve their maintenance services (MASONI et al., 2017).

The principle of Augmented Reality, is the combination of two scenarios: digitally processed reality with digitally added artificial objects (HOŘEJŠÍ, 2015 apud ALCÁCER and CRUZ-MACHADO, 2019). According to Rentzos (2013) apud Alcácer and Cruz-Machado (2019) the usage of Augmented reality on manufacturing processes regarding simulation, assistance and guidance has been proven to be an efficient technology. He also emphasizes that using AR can help on closing gaps, e.g., between product development and manufacturing operation, due to the ability to reproduce and reuse digital information and knowledge at the same time that supports assembly operations.

In addition, Syberfeldt (2016) states with augmented reality, artificial information about the environment and its objects can be overlaid on the real world in order to enhance the operator's perception of reality.

2.5.4 Autonomous Robots

As stated by Pedersen (2016) apud Alcácer and Cruz-Machado (2019), nowadays, to reach the flexibility demanded level, robots are essential on production systems. Additionally, Salkin (2018) apud Alcácer and Cruz-Machado (2019) highlights that abilities on computing, communication, control, autonomy, and sociality are achieved terms when combining microprocessors and Artificial Inteligence (AI) with products, services and machines to make the become smarter. Processes such as produt development, manufacturing and assembling phases, are processes that adaptive robots are very useful on manufacturing systems.

An essential face of Industry 4.0 is autonomous production methods powered by robots that can complete tasks intelligently, with the focus on safety, flexibility, versatility, and collaborative. Without the need to isolate its working area, its integration into human workspaces becomes more economical and productive, and opens up many possible applications in industries (BAHRIN et al., 2016).

2.5.5 Simulation

In the past few decades, computer simulation has become an indispensable tool for understanding the dynamics of business systems (RODIČ, 2017). Based on that, the author states that the Industry 4.0 paradigm requires modelling of manufacturing and other systems via the virtual factory concept and the use of advanced artificial intelligence (cognitive) for process control, which includes autonomous adjustments to the operation systems (self-organization). The new simulation modelling paradigm is best surmised by the concept of “Digital Twin”.

The concept of Digital Twin extends the use of simulation modelling to all phases of product life cycle, where the products are first developed and tested in full detail in a virtual environment, and the subsequent phases use the information generated and gathered by the previous product life cycle phases. Combining the real life data with the simulation models from design enables accurate productivity and maintenance predictions based on the realistic data (RODIČ, 2017).

According to Mourtzis, Doukas and Bernidaki (2014), simulation comprises an indispensable set of technological tools and methods for the successful implementation of digital manufacturing, since it allows for the experimentation and validation of product, process and system design and configuration.

2.5.6 Horizontal and Vertical System Integration

The paradigm of Industry 4.0 is essentially outlined by three dimensions: (1) horizontal integration across the entire value creation network, (2) end-to-end engineering across the entire product life cycle, as well as (3) vertical integration and networked manufacturing systems (Platfform Industrie 4.0 (2015); Acatech (2015); VDI/VDE-GMA (2015) apud STOCK and SELIGER, 2016)

2.5.7 Cybersecurity

With the increased connectivity and use of standard communications protocols that come with Industry 4.0, the need to protect critical industrial systems and manufacturing lines from cybersecurity threats increases dramatically. As a result, secure, reliable communications as well as sophisticated identity and access management of machines and users are essential (GERBERT et al., 2015).

Kannus and Ilvonen (2018) apud Alcácer and Cruz-Machado (2019) defined Cybersecurity as a new term on a high level of information security, and through the word “cyber” it spreads to apply also on industrial environments and IoT.

Also according to Alcácer and Cruz-Machado (2019) , IoT has to be built based on safety communications on each point of the manufacturing process and safety interoperability has to be assured between facilities as basic elements of the supply chain value. This way, Piedrahita (2018) apud Alcácer and Cruz-Machado (2019) states that Cybersecurity technology relies on protection, detection and response to attacks.

2.5.8 The Cloud

With Industry 4.0, according to Gerbert et al. (2015), organizations need increased data sharing across the sites and companies boundaries. Besides, with the improvement of cloud technologies performance, it will be possible to achieve reaction times of just several miliseconds. As a result, machine data and functionality will increasingly be deployed to the cloud, enabling more data-driven services for production systems (GERBERT et al., 2015)

Moreover, the connection of different devices to a same cloud to share information (i.e. connectivity) can be extended also to a set of machineries that belonged to a same plant or facility, in order to have a “digital production” (MARILUNGO, 2017).

2.5.9 Additive Manufacturing (AM)

Additive Manufacturing (AM) enables the fabrication of components in a process, where slices of a virtural model are created and produced in a layer-upon-layer additive building process (KIANIAN, 2016). As stated by the author, AM thus differes radically from traditional manufacturing which is either substractive, where material is removed from a block of material, or formative, in which material is formed by a mold.

Among the benefits offered by this manufacturing technology, according to Agenda (2014), AM production capabilities have the potential to reduce the environmental impact of manufacturing, por exemple, by production of lighter, more

complex and integrated parts, which require less raw material usage in their fabrication. Consequently, accurately pointed by Agenda (2014), less raw material usage uses less of earth's scarce resources, which is a key sustainable challenge relating to economic growth.

According to Dilberoglu (2017), the physical part of the smart factories is limited by the capability of the existing manufacturing systems. This makes AM as one of the vital components of industry 4.0. Due to the necessity for mass customization in industry 4.0, non-traditional manufacturing methods are needed to be developed. Thus, AM may become a key technology for fabricating customized products due to its ability to create sophisticated objects with advanced attributes (new materials and shapes).

2.6 CHAPTER CONSIDERATIONS

A movement that started off as Germany's brainchild has become an imperative undertaking for companies and countries to bolster their manufacturing prowess. Public and private sector bodies are starting to dedicate more time and resources towards the research and prototyping of innovation-driven manufacturing (ROLAND BERGER GMBH, 2016).

Therefore, driven by the technological demands imposed by Industry 4.0, many companies and multinationals have dedicated investments in the areas of research, development and implementation of solutions in order to adapt their plants on a global level, so they can work in a standardized way. Consequently, the management of its internal and external stakeholders is an important factor, as they affect or are affected by decisions, projects and solution deployment.

3 DEVELOPMENT

This chapter addresses the conducted approaches of stakeholders' analysis according to the identification and classification processes, with which it is aimed to obtain relevant information regarding their levels of power and influence over projects related to I4.0 production.

3.1 DEPARTMENT UNDER STUDY

This case report is carried out within a department of a multinational automotive supplier, which stands for innovation projects in manufacturing. The department focuses on embracing the raise of benchmark performance in manufacturing by using the latest technologies for Industry 4.0.

Aiming to improve efficiency and quality, and in addition, allow global solution rollouts, it is intended to establish Industry 4.0 infrastructure standards, including the establishment of standardized machine connectivity, which represents one of the primary technological principles of Industry 4.0.

In order to ensure global operation and create an international expert I4.0 network, the deployment of solutions is definitely related to the management of stakeholders' expectations, once global operation and support must be ensured all over the organization.

With the purpose to fulfill the technological fields required by Industry 4.0 and create viable solutions, an international working mode is set up and organized in working teams, which are composed by specialists from different plants and locations, who work on specific topics according to business needs and Industry 4.0 demands. This way, solutions can be evaluated, defined and aligned with partners and providers, ensuring global range operation and fostering the engagement of stakeholders, which is fundamentally important once the solutions developed by each working team are interconnected and should be applied in a global scale.

As a major step into the following stakeholders' analysis and subsequently its classification, the identification phase is presented on the next page.

3.2 INTERNAL STAKEHOLDERS IDENTIFICATION

The strategic activities planned to be conducted by the I4.0 working network defined previously can only be successful once there is a stakeholders management process considered. As stated by Bourne (2005), a stakeholder is someone affected by a project and having a moral (and perhaps a non-negotiable) right to influence its outcome. This way, it becomes fundamentally important to manage the involved stakeholders carefully.

According to PMBOK (4th edition, 2008), identifying stakeholders is the process of identifying all people and organizations impacted by the project, and documenting relevant information regarding their interests, involvement, and impact on the project success.

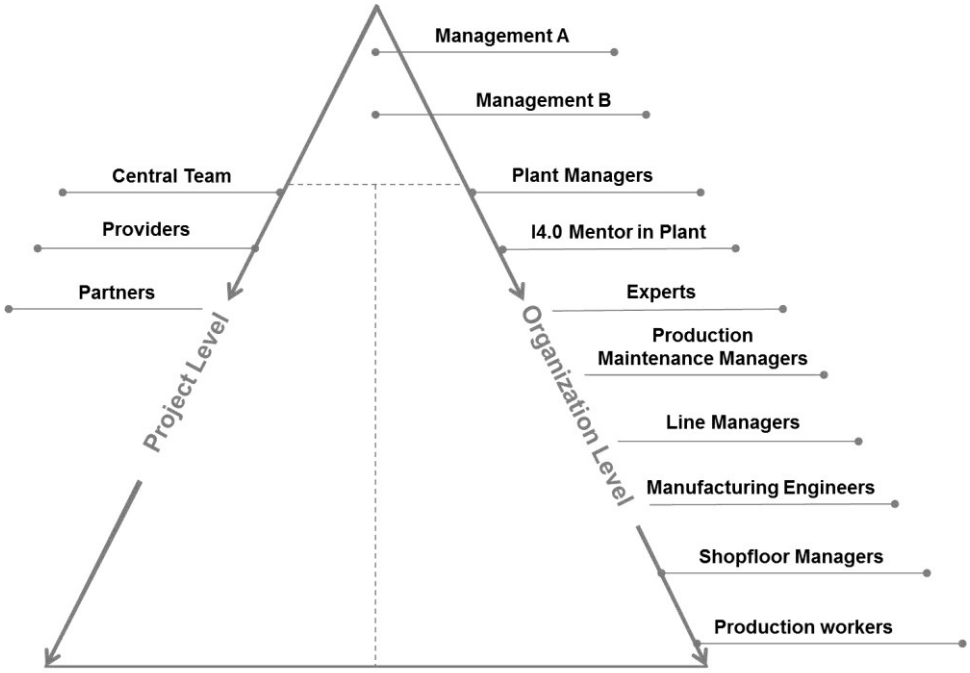
The present study focuses on the internal stakeholders influence on the projects developed by the concerned department. Therefore, as stated by Heerkens (2002), one thing that makes internal stakeholders particularly important is that the perceived success of your project is often judged by the perceived satisfaction of internal stakeholders.

In order to initiate an analysis targeted to the internal stakeholders, an identification process was firstly conducted through studies and surveys with the department. The survey conception as part of the identification approach was carried out with the purpose to list all internal stakeholders who could affect positively or negatively the projects and subsequently, who has the power to influence and make them succeed or fail.

A preliminary list of general stakeholders was drawn up alongside the central department and as part of the exploratory research, the identification survey was developed based on questionnaires. The stated survey is not presented here due to secrecy reasons.

The identification analysis is demonstrated in the Figure 4. The following diagram illustrates the stakeholders in two separated categories: Organizational and Project levels.

Figure 4– Stakeholders Identification



Source: the author (2019).

Assuming the strategic projects metioned here as the main point of identifying the internal stakeholders, the pyramid in Figure 4 demonstrates the stakeholders divided in two separated levels, acccording to their roles in regards to these projects and the company in general.

Therefore, in the Organization level, the stakeholders are listed in accordance with their position and hierarchical level within the company. In contrast, the other side illustrates the Project level, where the stakeholders of the concerned department may change according to each specific project, since each one involves different experts, partners and providers.

3.2.1 Internal Stakeholders Interests

Since the definition of stakeholder stands for individuals who have some interest or level of influence that can impact the project results, it is fundamental to know their expectations and interests towards the concerned department. Therefore, through surveys conducted within the company, data was collected and listed as shown in Table 1.

Table 1 – Stakeholders' Interests

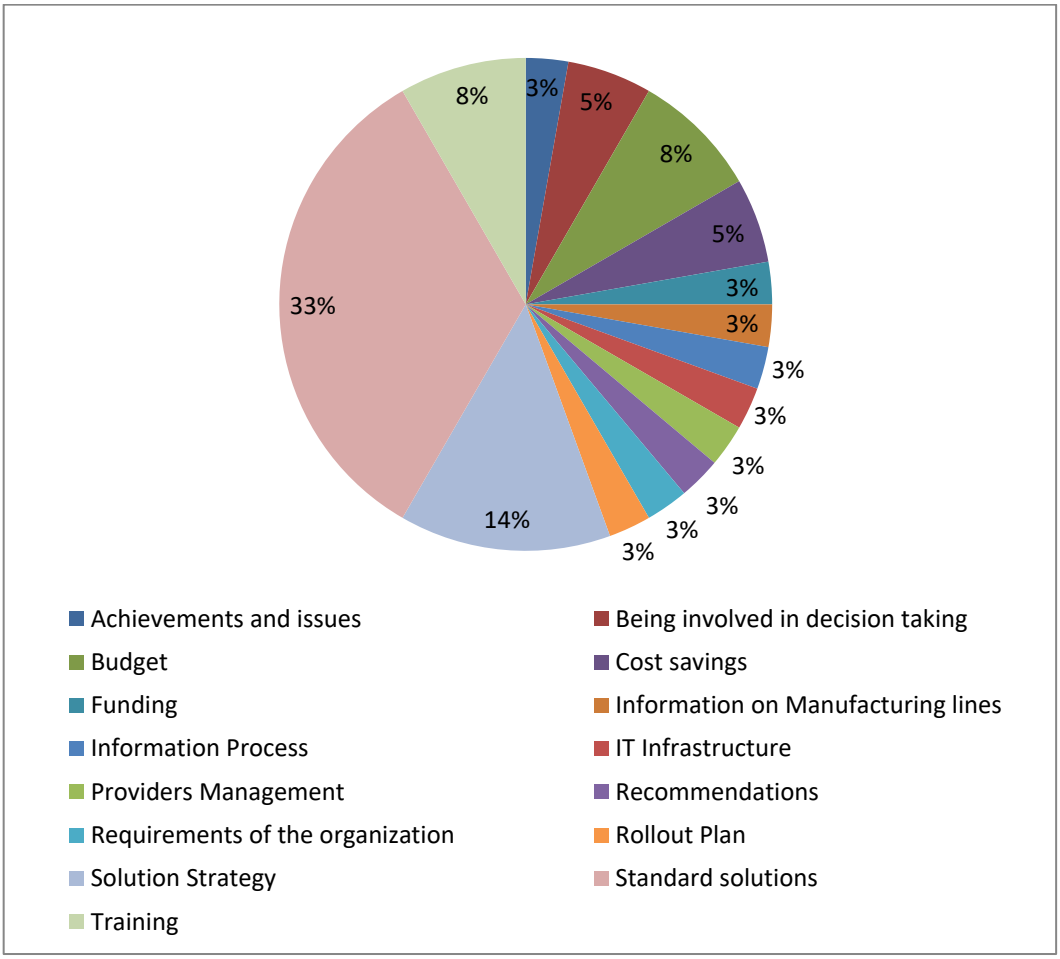
Stakeholder	Interests in Regards the Concerned Departmet
Management A	Cost savings Standard solutions Strategy IT infrastructure, information processes
Management B	Budget and cost savings Solution strategy Achievements and issues
Plant Manager	Being involved in decision taking Requirements of the organization Standard solutions to support their tasks
Production Maintenance Managers	Standard solutions Funding and providers management
I4.0 Mentor in Plant	Standard solutions Strategy Rollout Plan Recommendations
Central Team	Standard solutions Strategy Budget allocation
Experts (Solution, Process, Technology, Data)	Being involved in decision taking Requirements of the organization Standard solutions to support their tasks
Providers	Requirements of strategic projects Standard solutions
Line Manager	Standard solutions for operational support Training Information on manufacturing lines, KPIs and analytics
Manufacturing Engineers	Standards solutions for operational support Training
Shopfloor Manager	Standards solutions for operational support Training
Production Workers	Standard solutions
Partners	Strategy Standard solutions

Source: The author (2019).

Once the stakeholders interests are known, it is substantial to understand the urgency and importance each concern holds. For this reason, as a complementary analysis, a quantitative approach was conducted and through statistical technique, information related to the frequency of stakeholders interests was obtained, thereby providing the level of importance of each interest in the department under study.

The Figure 5 illustrates the chart obtained from the statistical approach, which was carried out based on the answers obtained from the questionnaires and contemplates, as a statistical sample, a significant number of representants of the central team. Therefore, it embraces the frequency of each stakeholder interests which were previously identified.

Figure 5 – Internal Stakeholders Interests.



Source: The author (2019).

As the chart in Figure 5 illustrates, there is a major interest concentrated in standard solutions, solution strategy, budget, training, cost savings, being involved in decision taking and requirements of the organization, categorized as the main significant topics. This is due to the fact that the projects conducted by the department team aim the development and deployment of standard solutions in the manufacturing, attending to the I4.0 requirements and seeking for cost savings. Consequently, most of the internal stakeholders either in the organization or project level benefit from such solutions and are affected by them, which legitimizes their concerns.

3.3 STAKEHOLDERS ANALYSIS AND CLASSIFICATION

Stakeholder analysis is often considered the first step in strategic planning activities on an organizational level (SMITH, 2000). It embraces techniques to identify and comprehend stakeholders' needs and expectations and this way, enables a better understanding of attributes, power, influence and involvement within a project.

As one of the first actions for project strategic planning in an organizational level, the following stakeholder analysis takes into consideration the needs and expectations of all involved parties within the mentioned I4.0 working network and this way, allows their classification according to the following models and their further analysis.

3.3.1 Salience Model

The stakeholder analysis aims to classify the stakeholders in order to provide information for an effective management regarding which stakeholders are prominent and should be managed closely. This way, it is fundamental to understand their power, interests, influence and impact over a project or company.

Both common used tools such as the Power-Interest and Influence-Impact grids focus on two parameters. However, in the salience model there are three paramenters taken into consideration: power, legitimacy and urgency. In this method, as stated by Mitchell, Angle and Wood (1997), seven types are examined – three possessing only one attribute, three possessing two attributes, and one possessing

all three attributes. The authors also defend that according to this model, the entities with no power, legitimacy, or urgency in relation to the firm are not stakeholders.

Through the parameters used in the salience method, the stakeholders are divided in three group categories. As defined by Mitchell, Angle and Wood (1997), the low salience classes (areas 1, 2 and 3), termed “latent” stakeholders, are identified by their possession or attributed possession of only one of the attributes. According to the authors, this class of stakeholders can be described as follows:

1. **Dormant:** these stakeholders possess power to impose their will, although they might not have any interaction with the firm. However, because of their potential to acquire a second attribute, management should remain cognizant of such stakeholders, for the dynamic nature of the stakeholder-manager relationship suggests that dormant stakeholders will become more salient to managers if they acquire either urgency or legitimacy (MITCHELL, ANGLE and WOOD, 1997).
2. **Discretionary:** this group hold the attribute of legitimacy although they do not have the power to influence on urgent claims. The authors also reinforce that due to the absent power and urgent claims, it is not absolutely necessary to engage a relationship with these stakeholders, although managers can choose to do so.
3. **Demanding:** stakeholders classified as demanding hold the only attribute of urgency, but due to the lack of power and legitimacy, their urgent claims do not represent a significant salient cause.

Regarding stakeholders who present two out of three of the stakeholders attributes defined by this method, there is a new qualitatively zone of salience, denominated as moderate. Compared to the latent category, this one demands a higher level of engagement with the stakeholders, classifying them as expectant. Within the moderate-salience there will be three classes:

4. **Dominant:** According to Mitchell, Angle and Wood (1997) in deference to their legitimate claims, these stakeholers also have the ability to act on these claims. This way, Mitchell, Angle and Wood (1997) reinforce that in the situation where stakeholders are both powerful and legitimate, their influence

in the firm is assured, since by possessing power and legitimacy, they form the “dominant coalition” in the enterprise.

5. **Dangerous:** once a stakeholder holds urgency and power but lack legitimacy, it is believed that this one will be coercise and thus represents danger to a project of organization.
6. **Dependent:** this group embrace the stakeholders who lack power but possess urgent legitimate claims because they depend on other stakeholders within the company for power to comply with their will or claim.

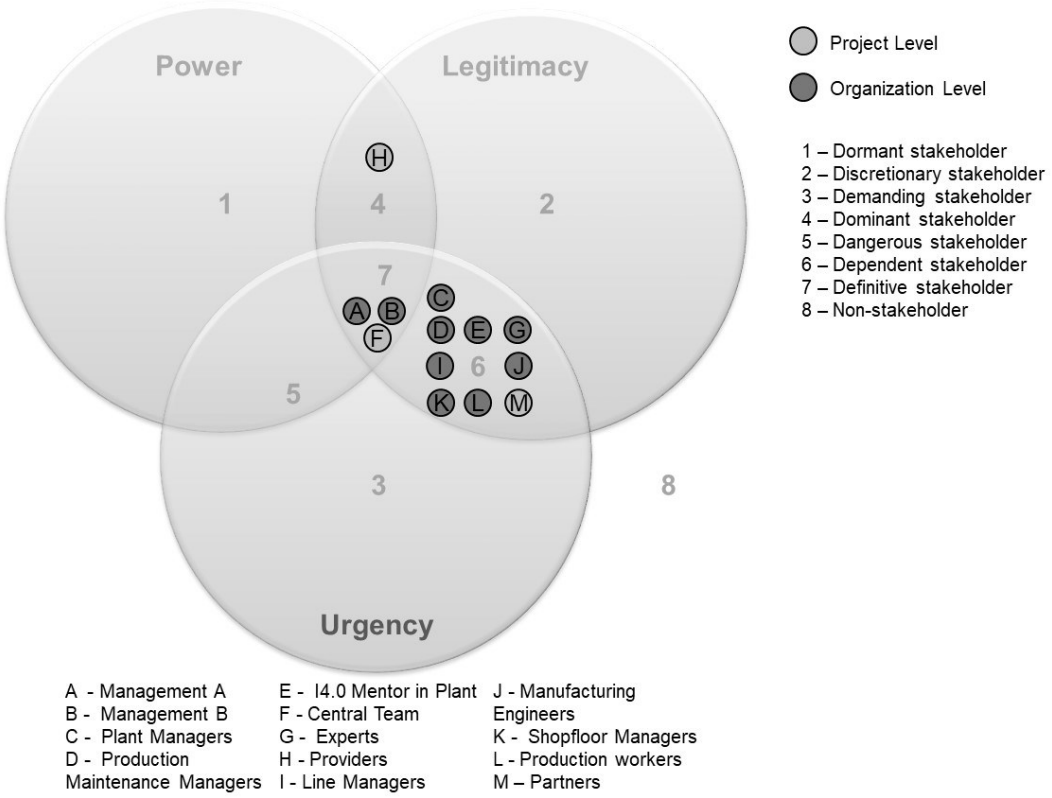
As established previously, a salience of a particular stakeholder will be high once this one holds the three defined attributes of stakeholders, being this way categorized as definitive.

7. **Definitive:** stakeholders who possess the three attributes such as power, legitimacy and urgency in their claims. Their expectations should be prioritized and there must be immediate actions to attend their claim.

In contrast, individuals who do not possess any other attributes are not considered stakeholders by the salience model and would be represented as Nonstakeholder (8).

Based on these criteria, and the previous stakeholders expectations listed on Table 1, the following analysis of salience shown in Figure 6 was carried out.

Figure 6 – Salience Model Applied to the Identified Stakeholers



Source: The author (2019).

From the classication of stakeholders according to the salience model, illustrated in the Figure 6, it is noticed most of stakeholders are concentrated within the dependent category, once they possess legitimacy and urgency as attributes. Therefore, these are the expectant stakeholders and their level of salience is moderate. The urgency in their claim, in this case, is mostly related to their high interest in standard solutions, although their level of power over the course of projects and decisions is low.

However, the analysis also exposes one stakeholder, the providers, as dominant, once it has power and legitimacy as its attributes and thus, represents a moderate level of salience as well.

Representing a high level of salience, the definitive group embraces three stakeholders, which are: the Management A, Management B and the Central Team. This is due to their power to change or even stop the projects, their legitimacy and

their high urgency in ther claim, manly related to standard solutions, strategy and cost savings.

3.3.2 Power-Interest Matrix

Stakeholders analysis is a crucial step once it provides information for their further classification and communication requirements. Hence, the first analysis was conducted applying a classification tool which considers two primary variables. Accoding to Roseke (2019), these two variables are:

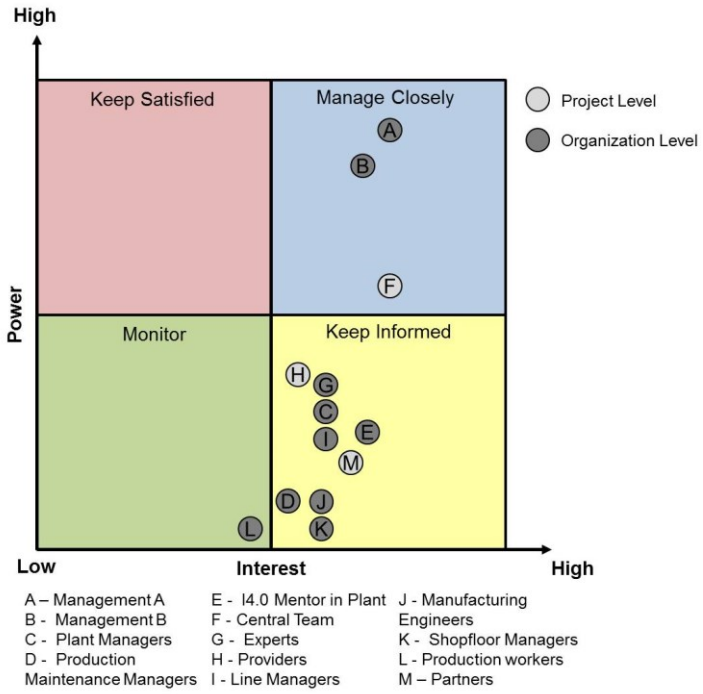
- Power: the ability of a stakeholder to change or stop the project.
- Interest: amount of involvement the stakeholder has in the project. It is the size of the overlap between the stakeholder's and the project's needs.

Once the power and expectations (and therefore their likely interest) has been established we can use a power interest matrix to assist the analysis (HARRIS, BOTTEN and McCOLL, 2008). Mendelow (1991) apud Harris, Botten and McColl, (2008) has proposed such a matrix. It contains the stakeholders' power level on the y-axis and their interest level on the x-axis.

In order to classify the stakeholders in accordance to their levels of interest, the statistic methodology presented previously in Figure 5 was additionally taken as a basis to the power-interest analysis. Once the prevalent interests remain on standard solutions, solution strategy, budget and planning, these were considered the most relevant interests. Thus, in addition to their amount of involvement, the stakeholders who hold concerns in these topics were classified as the most interested ones in regars to the department and its strategic projects.

Therefore, the Figure 7 illustrates a model of a Power-Interest grid, built in accordance with the information on stakeholders interests and expectations, as suggested by the mentioned model.

Figure 7 – Stakeholders Power-Interest Grid.



Source: The author (2019).

From the matrix shown in Figure 7, it is possible to comprehend the levels o of power and interest each of the previously mapped stakeholders have on the concerned department and consequently, the ability to affect the course of the strategic projects as well as their level of interest in the solutions deployed. The following evaluation will be also helpful to establish a future communication plan. Additionally, the matrix in Figure 7 presents classification categories, divided in the four quadrants, according to:

- **Keep Satisfied:** this quadrant should contain the stakeholders who hold low interest in the projects but hold a high power to change their course. This way their expectations and concerns must be considered. The previous qualitative and quantitative analysis does not consider any stakeholder in this quandrant.
- **Manage Closely:** this category contemplates the considered “key players” of the projects, this way their expectations should be managed carefully. According to Baker (2012), this suggests that interactive and push would be two of the major communications methods used with this group.

- **Monitor:** the stakeholders under this category have both low power and interest in the projects and this way can be occasionally contacted.
- **Keep Informed:** these stakeholders have a high level of interest and even though their power is relatively low, they should be informed.

Based on the classification method presented, the stakeholders indicated as Management A and Management B are classified as **“actively engaged”** due to their high level of power and hierarchical authority to change the course of the projects or even stop it, once their interests are focused on cost savings and budget. Their level of interest is also highly estimated since their expectations mainly rely on the achievements and issues related to standards development and solution strategy, considered in the statiscal analysis as the main interests. This way, they were placed in the matrix as **“manage closely”** group.

According to their expectations, the Central Team (F) is stated with a high interest level, since they are composed by working teams and members of the concerned department and are actively involved in the development and deployment of the strategic solution projects. This way, their capacity to influence and affect the course of the projects should be carefully taken into account, representing their high level of power and categorizing them in the “**manage closely**” group as well.

The “**keep informed**” group hold the most of the stakeholders considered in the previous identification. This group present a high level of interest however a low level of power over the projects and decision taking. The plant managers (C), for instance, are primarily interest in standard solutions to support on their tasks, this way their level of interest is also considered high, in accordance to the quantitative approach in Figure 5. Although their power over the development of such projects is relatively low, once they do not participate in the development of strategic projects. Thefore, they should be informed about the phases of the projects but not consulted.

Similarly classified as “**keep informed**”, with a low power over the projects but a high interest in the solution deployment, the production maintenance managers (D) hold ther expectations on standards establishment, funding and providers management. All these factors should be taken into consideration once these stakeholders can be directly affected by the course and results of the conducted projects.

As well as plant managers, the I4.0 Mentor in plant have expectations in regards to standard solutions. However, they are also interested in strategy, rollout plan and recommentations, which represent a higher level of interest, even though their power over the projects is fairly low, classifying them in the "**keep informed**" category.

Despite their lower level of power over projects decisions, if compared to the Central Team, the experts hold high interest in the solution development though the strategic projects, once they expect to receive support on their tasks and be actively involved in decision taking and thus, they are classified as "**keep informed**".

Indicated by a relevant level of power and interest, providers are interested in the course of project development since they are involved in technology and support provision. This way, they also hold a relevant level of power once their engagement to the concerned projects can directly affect their results.

Line managers (I), in turn, have a low power since they are not engaged in the development of the strategic activities. Nevertheless, their level of interest can be significantly high once their expectations are mainly related to standards solutions for operational support, training and information on manufacturing lines. Likewise, the manufacturing engineers hold a low power in regards to the activities but are also interested in similar topics.

Furthermore, the shopfloor managers are classified as "keep informed" as they hold interest in standard solutions for their operational work, representing a high level of interest in the outcome of the strategic projects, while their ability to change it or affect it is reasonably low, once they also do not directly participate in solution development.

As part of the "monitor" stakeholders group, the shopfloor workers are classified due to their low level of interest and power, although they can be occasionally contacted since the solutions and results of some projects can affect their work.

On the basis of the outcome obtained with the Salience Model and Power-Interest matrix, there is a noticeable distinction among the stakeholders. Besides, an inconsistency emerged from both analysis in regards to two stakeholders in particular: providers and production workers. This discrepancy is mainly relevant when the stakeholders are divided according to their level of power. This occurs because by the Salience Model the stakeholders are classified in three major groups,

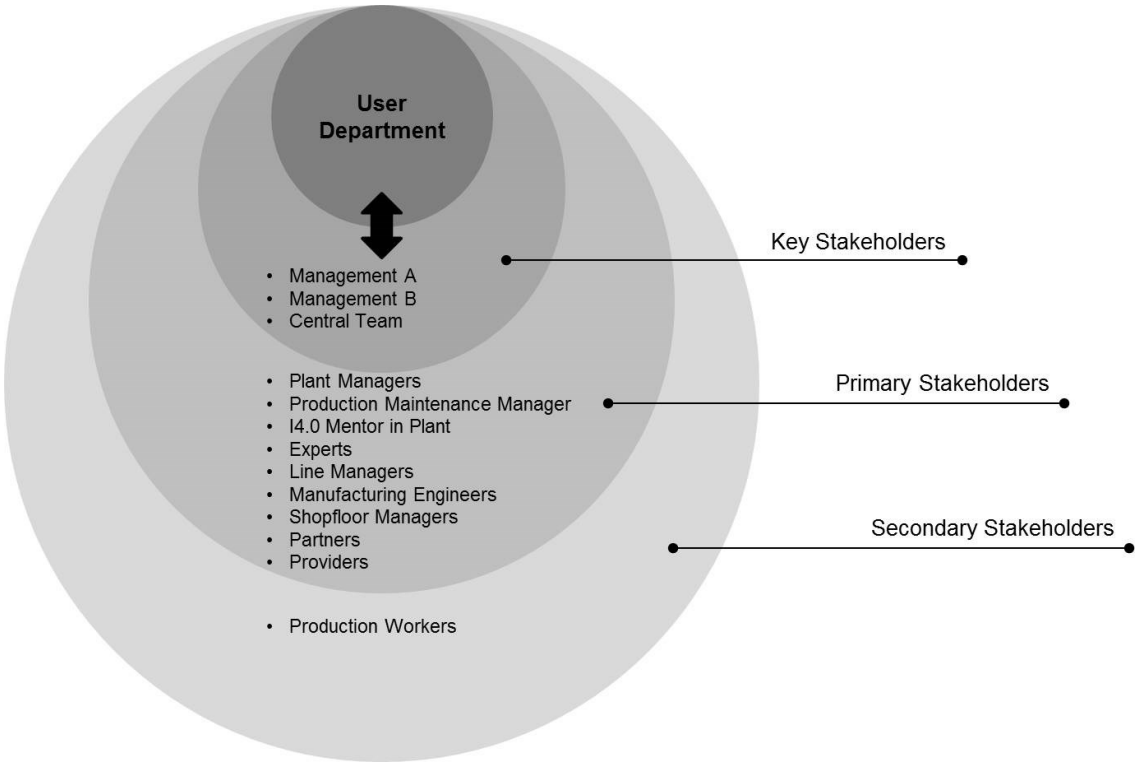
contemplating the interaction among power, legitimacy and urgency. Although, through this classification tool, it is not possible to identify the level of power and intensity of each classification aspect.

Through the first applied method, providers hold power and legitimacy, although they do not have urgency for projects' results. On the other hand, the Power-Interest matrix presents them as significantly powerful.

The production workers, in turn, hold power and legitimacy but through the Salience model, the level of each of these aspects is not revelead, leading to categorize them as primary stakeholders. However, their level of power is demonstrated in the Power-Interest Matrix, which brings together a qualitative and quantitative analysis. Since the Power-Interest matrix provides a deeper understanding of the stakeholders' power over the strategic projects, and in this case the level of power is comparatively low, production workers were assigned as secondary stakeholders.

In contrast, the Power-Interest matrix demonstrates the level of power along the y-axis and the level of interest along x-axis, as a qualitative tool which allows the distinction among the stakeholders through a comparative way of these two main aspects. Therefore, the results indicated in the Power-Interest matrix were used as a fundament for the stakeholders divison in clusters, as shown in Figure 8.

Figure 8 – Stakeholders Clusters.



Source: The author (2019).

3.3.3 Stakeholders SWOT

SWOT analysis is an attempt to reveal the strengths and the weaknesses of an organization, to analyze opportunities for improvement, and to see possible external obstacles that need anticipations (THAMRIN and PAMUNGKAS, 2017).

Since this tool has been widely used in strategic planning within organizations, it was also applied to this stekaholders study as a complementary method to demonstrate which are the strengths, weaknesses, threats, opportunities related to the classified stakeholder groups and their level of influence.

In this context, the stakeholders strengths represent which aspects they could help or exercise any kind of influence on the department and its strategic projects. The weaknesses are represented by their constraints and how they could affect the projects. In addition, the opportunities denote the positive expertise, experience, connection or even influence this group of stakeholders can have over the projects. Conversely, the threats mean the dangers this group can bring to the department as well as the risks they can put at the projects' results.

According to Namugenyi et al. (2019), in SWOT analysis, the company's strengths and weaknesses are internal elements while opportunities and threats are viewed as environmental factors. In the present study, the internal elements are considered those that are influential in project level and the external ones, in the organizational level.

Therefore, strengths represent internal capabilities and factors related to the concerned department and can contribute to its strategic projects success. Weaknesses, in contrast, represent negative factors or restraints that might hinder or impede the progress of the projects. Opportunities are seen as positive aspects which could affect the projects but can have connections outside the concerned department. In turn, threats are considered the negative elements external to the department under study.

For this purpose, a SWOT standard template was adapted with an additional column containing the level of power that each stakeholders group possess towards the department and consequently, over the strategic projects. Besides, the stakeholders were listed according to their cluster division, as shown in Table 2.

Table 2 – Stakeholders SWOT Analysis with Power Category.

Stakeholder Group	Strenghts	Weaknessess	Opportunities	Threats	Power
Key stakeholders					
Management A	Budget management Interest for savings and standard solutions	Not actively involved in strategic activities development	Experience from other projects	Power to block budget	High
Management B					
Central Team	Actively involved in strategic activities development Strong interest in standar solutions	Not involved in budget allocation	Experience from other projects	Power to change the course of a project through management decisions	High
Primary Stakeholders					
Subgroup 1	Common interest in standard solutions, solution strategy, requirements of the organization.	Not actively involved in strategic activities development	Directly affected by standard solution implementation.	Should be aware and willing to apply standard solutions.	Low
Subgroup 2	Common interest in standard solutions and trainings	Not actively involved in strategic activities development	Actively affected by standard solution implementation and involved in executing solutions tasks on shofloor level.	Lack of sufficient knowledge on standard solutions. Require specific trainings.	Low
Secondary Stakeholders	Standard solutions	Not actively involved in strategic activities development and implementation	Actively affected by standard solution implementation and involved in executing solutions tasks on shopfloor level.	Lack of sufficient knowledge on standard solutions. Require specific trainings.	Low

Source: The author (2019).

Through SWOT analysis, it can be seen the key stakeholders present a high level of power and influence over the strategic projects, although within this group there are distinguished strengths, weaknesses, opportunities and threats once it embraces management level representatives and central team.

The primary stakeholders, in turn, were divided in two subgroups. Although they hold the same level of power, there are different aspects to be considered in regards to the SWOT analysis, once they also belong to different hierarchical levels within the organization and this way, according to the information on Table 2, should be dealt differently in the strategic management.

The last cluster considered in this SWOT analysis contemplates the secondary stakeholders, which as a result of the Power-Interest matrix, embraces the production workers. These stakeholders hold low power over the strategic projects, however they are greatly influenced by the standard solutions implementation by performing tasks on shopfloor level.

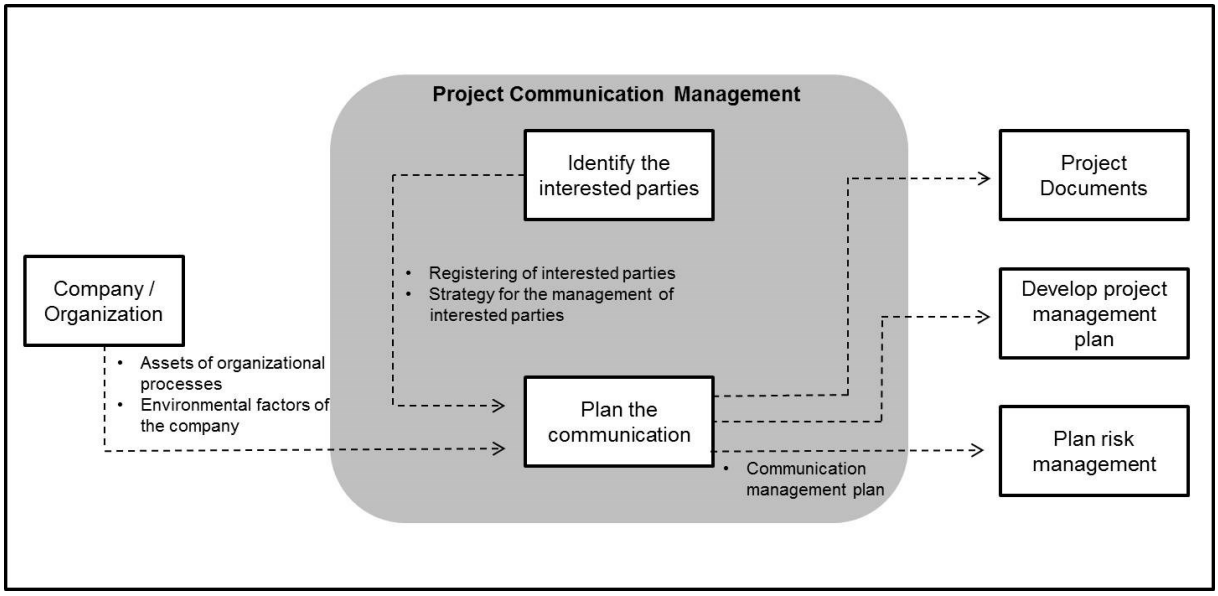
3.4 PROPOSAL FOR COMMUNICATION CONCEPT

In accordance with the PMBOK (2008), planning communication is the process of determining the need of information of the interested parties in the project and defining a communication approach. This way, the identification of the parties interests and the definition of appropriate ways to establish communication with them are important variables for a successful relationship with stakeholders.

Besides the identification of the stakeholders, the communication plan embrace their level of participation and interests in the concerned projects, as well as organizational process assets such as historical information of communication activities from other projects and environmental factors of the company, once the communication strategy should fit the project scenery.

Therefore, planning communication, according to PMBOK (2008) can be divided in three groups of actions: inputs, tools and techniques and outputs. Based on that, the diagram in Figure 9 illustrates the communication planning process.

Figure 9 – Data flow chart of the communication planning process.



Source: Adadpted from PMBOK (2008).

The communication planning process, as illustrated in Figure 9, contemplates inputs that embrace the registering of the interested parties and strategy for their management, which in the present study belong together to the identification process and classification of the stakeholders. The environmental factors of the company and assets of organizational processes are related to internal aspects of the organization and due to secrecy matters they will not be detailed in this case study.

As part of the tools and techniques engaged in the communication planning process, a fundamental part is related to the requirements of the communication from the interested parties. Therefore, examining these requirements and the available methods of communication is a fundamental part of the process.

As a desirable output, the communication management plan is part of the project management plan and in the present study represents a proposal for the concerned department by integrating the communication of its strategic projects.

3.4.1 Identification of Interested Parties

The PMBOK (2008) defines as fundamental for the project success identifying the interested parties since the beginning and analyzing their levels of interest, expectations, importance and influence. On that basis, the identification

procedure was performed in order to list the main stakeholders of the concerned department for a subsequent analysis and classification.

Primarily, an internal survey was conducted with the department team where the 5W1H methodology was applied, as shown in the Table 3. From the initial question based on who the stakeholders are, the following ones were introduced with the purpose to register information regarding the main communication requirements.

Due to grounds of secrecy, the mentioned official survey is not attached to this present study. Nevertheless, the results obtained from the identification phase of this survey were a fundamental basis for the stakeholders listing, according to what was demonstrated in the topic 3.3.

Table 3 – Initial Identification Survey through 5W1H Methodology.

Who
Who are the main internal stakeholders?
What
- What do the stakeholder want to know from the department? - What information should be exchanged?
Why
Why should communication be established?
When
When should communication take place? (frequency)
Where
Where should communication take place?
How
How should the communication happen?

Source: The author (2019).

After registering the interested parties, as demonstrated in topic 3.2 and recognizing the internal stakeholders, it was also useful to obtain further information on each revealed stakeholder, such as their position within the company and

specially their role in the mentioned strategic projects and this way, how they can influence the standard solutions development.

Besides, for planning strategic management, it is essential to evaluate the stakeholders requirements and expectations in order to improve their positive influence and increase their support, mitigating their potential negative impact. With this purpose, the stakeholders classification was conducted through different tools, as shown in topic 3.3, which provided proper information for constructing a communication plan with stakeholders.

3.4.2. Managing Communication Requirements

As defined by the PMBOK (2008), the methods for transferring information between the interested parties in the project can vary significantly and some factors may affect the project such as: urgency of the information need, technology availability, project team experience with the communication systems, project duration and project environment. Besides, for an effective communication plan, it is vital to consider the stakeholders expectations and the available communication methods according to the importance and urgency of the subject to be communicated.

Therefore, the established communication might be through an interactive method, which occurs between two or more parties in a multidirectional information exchange and include in most part, face-to-face meetings, calls and video-calls. Differently, the active communication is considered a push method once it is addressed to specific individuals who require information. This communication type does not initially verify the comprehension of the information sent and it might happen through e-mails, reports, announcements or press releases.

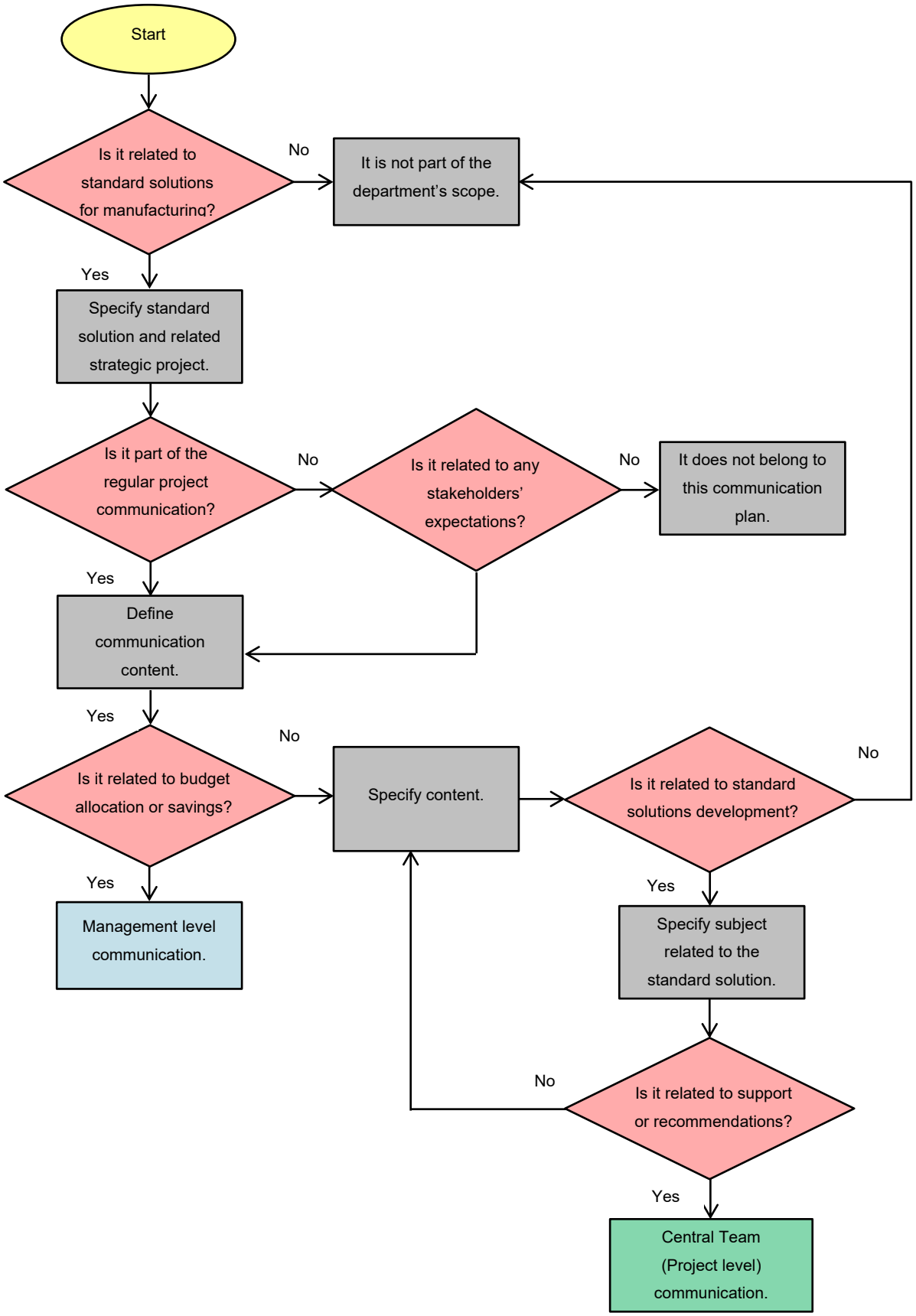
Another method of communication is passive (pull), which in big companies is frequently used for reporting an extensive amount of information or adreesed to a big target audience and it requires the receivers to access the content informed. This might include intranet, e-learning and repositories.

In order to achieve stakeholders requirements and expectations, the communication management plan should primarily embrace the information to be shared including its format and content, communication frequency, participants, methods and technology, responsibles and documents to be presented. In addition, it

might also include the usage of websites, company's communication platforms and project management softwares if used as project tool.

The fluxogram illustrated in Figure 10 denotes the communication path based on stakeholders expectations divided in communication levels, according to their main interests in the concerned department. This way, it represents a basis for communication planning.

Figure 10 – Communication path based on stakeholders expectations.



Source: The author (2019).

3.4.3. Communication Concept

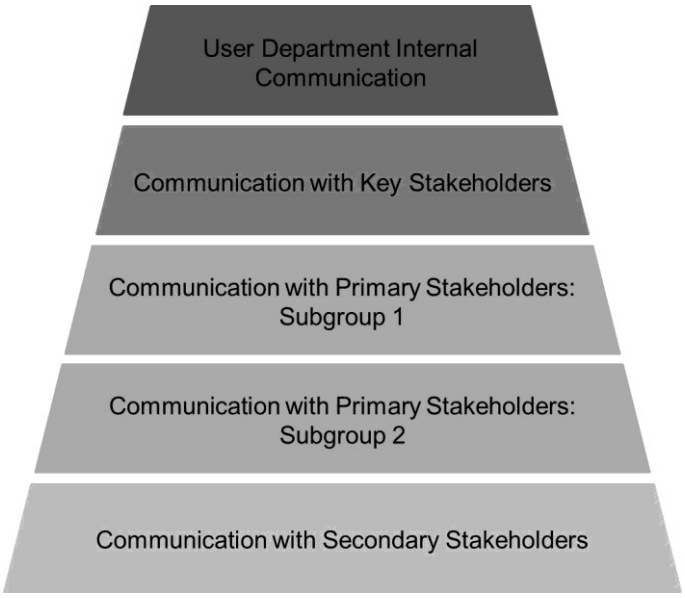
According to the communication requirements on subject and urgency alongside stakeholders' expectations which were previously recognized, it is possible to plan communication as a product of the previous analyses with the goal of establishing information exchange between the concerned department and the interested parties in its strategic projects.

The Figure 11 illustrates a pyramidal layout for the communication between the user department and its stakeholders. The first level contemplates the internal communication of the concerned department, followed by the communication with its key stakeholders, which will present different approaches and targets, once they represent distinct hierarchical levels within the organization and distinguished participation in the stratetic projects.

The third and fourth levels represent the communication with primary stakeholders. Since this group was divided in two separate subgroups due to their interests and levels of power over the projects, there will be differences across the communication plan.

The bottom level covers the secondary stakeholders and since this group do not directly exchange information with the user department, the present study proposes this group should be communicated through other stakeholders in a top-down communication process according to project needs and requirements.

Figure 11 – Communication Pyramid.



Source: The author (2019).

In order to present the main aspects of a communication plan with the groups of stakeholders illustrated in Figure 11, the Table 4 contemplates the proposal related to the key stakeholders. Notably, in relation to the central team communication, it is considered appropriate to part it in two separate categories, once in one level, communication should include all working team mentors for specific topics involving general decisions and clarifications related to the projects. In addition, the central team should also establish internal communication among each working team mentors and experts. Therefore, in the presented proposal, the central team internal communication will embrace the participation of the related working team mentor and experts more often, once it aims to discuss detailed topics of project development.

Table 4 – Proposal of Communication plan with Key Stakeholders.

Stakeholder	Goal	Communication type	Frequency	Participants
Management A	• Cost savings • Strategy • Standard solutions	Face-to-face	Quarterly	• Manager level A • Manager level B • Department manager
Management B	• Budget • Cost savings • Achievements and issues of the strategic projects	Face-to-face	Monthly	• Manager level B • Department team
Central Team (All working teams)	• Standard solutions development • Progress of stregic projects • Budget allocation	Face-to-face	Quarterly	• Department team • Working team mentors
Central Team (Internal)	• Development of strategic solution • Progress and issues of projects	Face-to-face	Weekly	• Working team mentor • Working team experts

Source: The author (2019).

Among the primary stakeholders, it is also considered applicable to separate the communication plan due to their different interests on the concerned department. The subgroup 1 includes the plant managers, I4.0 mentors in plant, experts in plant, partners and providers. The subgroup 2, according to their shared interests and level of power, includes the production maintenance managers, line managers, manufacturing engineers and shopfloor managers.

Therefore, the proposal for the communication plan with the primary stakeholders is demonstrated in Table 5. As indicated in the mentioned proposal, the

communication with the subgroup 1 of the primary stakeholders will follow distinct targets and involve different participants. This is due to the difference in interests among the primary stakeholders in relation to the organizational and project levels.

In the organizational level, the primary stakeholders with a relevant level of power are mainly interested in strategy, standard solutions and requirements from company's division. Therefore, the communication with this group should proceed according to a top-down information and recommendation approach.

However the subgroup 1 of primary stakeholders additionally hold interests in project level. This is notably the case of providers, once it is fundamental to establish communication with this group according to each specific standard solution. Nevertheless, on this level, the communication between the project mentor and the related provider should embrace the exchanging of target concerns.

Table 5 – Proposal of Communication plan with Primary Stakeholders.

Stakeholder	**Goal**	**Communication type**	**Frequency**	**Participants**
Subgroup 1 (Organization level)	• Standard solutions • Solution strategy • Requirements	Group calls	monthly	• Department team • Plant managers • I4.0 mentors in plant • Experts in plant
Subgroup 1 (Project level)	• Specific standard solution • Trainings	Group calls	monthly	• Central team mentor • Provider representant

Source: The author (2019).

4 FINAL CONSIDERATIONS

Through the case study reported in this present work and the conducted methods of identification of internal stakeholders and their interests in regards to the strategic projects managed by the concerned department, it has become possible to evaluate their expectations by applying the Salience Method and the Power-Interest grid.

The application of the Salience Method resulted in the classification of the internal stakeholders in three different categories. However, this tool does not allow the visualization of their level of power and influence over the projects, revealing a paucity of information of this method. Through the Power-Interest matrix this need was supplied and additional information regarding the internal stakeholders' power and interest was obtained.

Therefore, it is reasonable to conclude that the application of both methods of analysis are complementary in order to reveal fundamental information for the understanding of internal stakeholders. Besides, the results obtained from both analyses were considered for the construction of a stakeholders SWOT.

In the SWOT analysis, the stakeholders strengths, weaknesses, opportunities and thereats were evaluated in accordance with the classification clusters obtained from the results of the Power-Interest grid. Besides, the level of the stakeholders’ power was also takein into consideration.

From SWOT assessment, a new group division among the internal stakeholders was required once influential elements in project and organizational levels were also considered. Consequently, fundamental factors were obtained demonstrating the distinct strengths, weaknesses, opportunities and thereats among the listed stakeholders and possible obstacles for the mentioned department and its projects.

As a product of the stakeholders analyses conducted during this study, a proposal of a communication plan was developed in order to fulfill the expectations of the stakeholders. Once the communication, in related case, requires the exchange of information according to the stakeholders’ needs and interests, it was fundamental to separate the communication proposal in order to embrace the key and primary stakeholders engaging.

The development of this case study has mainly allowed the profound understanding of the internal stakeholders' interaction and influence on solution projects related to I4.0 at global scale. Therefore, it has become evident the importance of stakeholders management in regards to their expectations and interests, considering their level of power and influence.

Fundamental information on stakeholders classification and mainly their level of power and interest were applied to applied to a communication concept which was elaborated in order to fulfill internal stakeholders’ expectations and provide their engagement to the managed projects.

4.1 SUGGESTIONS FOR FORTHCOMING STUDIES

Due to the limited time of study, the internal stakeholders were identified according to the observation period and therefore, as a result of each project phase managed by the mentioned department, new influential individuals can arise and must be also considered. Additionally, it is suggested:

- Conduct stakeholders mapping during each new phase of the strategic projects;
- Perform the maintenance of the communication plan proposed according to the practical requirements;
- For a complete stakeholders identification and analysis, it is useful to also consider the external individuals, since these are the stakeholders of the organization in general.

REFERENCES

AGENDA, U. **A swedish agenda for research and innovation within additive manufacturing and 3d printing:** coming together to lead the way, 2014. Available in: https://scholar.google.com/scholar?q=Ume%C3%A5%20Agenda,%20A%20Swedish%20Agenda%20For%20Research%20and%20Innovation%20Within%20Additive%20Manufacturing%20And%203D%20Printing:%20Coming%20Together%20to%20Lead%20The%20Way,http:www.er.umu.sedigitalAssets153153181_vinnova_swedishagenda_additivemanufacturing3dprinting_2014.pdf,%202014. Acessed on: 1 abr. 2019

ALCÁCER, V.; CRUZ-MACHADO, V. Scanning the Industry 4.0: a literature review on technologies for manufacturing systems. **Engineering Science and Technology, an International Journal**, v. 22, is. 3, p. 899-919, jun. 2019.

HARRIS, D. R.; BOTTEN, N.; MCCOLL, J. **Marketing for Stakeholders.** Italy: Elsevier Ltda, 2008.

ALVES, E. R.; GOMES, E. R.; CONRSINI, L. F. The Characteristics of Power, Legitimacy and Urgency of Stakeholders and the Actions of Corporate Social Responsibility of Companies. **Asian Journal Of Business And Management Sciences.** Rio de Janeiro, p. 34-43. jan. 2014.

BAHRIN, M. A. K. et al. Industry 4.0: A Review on Industrial Automation and Robotic. **Jurnal Teknologi.** Malaysia, p. 137-143. 23 mar. 2016.

BAKER, E. Planning effective stakeholder management strategies to do the same thing. **Pmi® Global Congress 2012.** Vancouver, p. 1-12. 2012.

BEZERRA, F. **Stakeholders:** Do Significado à classificação. 2014. Available in: https://www.portal-administracao.com/2014/07/stakeholders-significado-classificacao.html. Acessed on: 10 nov. 2019.

BOURNE, L.; WALKER, D. H. T.. Visualising and Mapping Stakeholder Influence. **Management Decision.** Austrália, p. 649-660. jun. 2005.

BOYES, H. et al. The industrial internet of things (IIoT): An analysis framework. **Computers In Industry.** p. 1-12. jun 2018.

DERAKHSHAN, R.; TURNER, R.; MANCINI, M. Project governance and stakeholders:: a literature review. **International Journal Of Project Management.**, p. 98-116. 21 nov. 2018.

DILBEROGLU, U. M. et al. The Role of Additive Manufacturing in the Era of Industry 4.0. **Procedia Manafufacturing.**, p. 545-554. 2017.

DOHNALOVÁ, Z.; ZIMOLA, B. Corporate stakeholder management. **Procedia - Social And Behavior Sciences.** Zlin, p. 879-886. 2013.

DORSEMAINE, B. et al. Internet of Things: a definition & taxonomy. **9th International Conference On Next Generation Mobile Applications, Services And Technologies.** Paris, p. 72-76. 2015.

GERBERT, P. et al. **Industry 4.0:** The Future of Productivity and Growth in Manufacturing Industries. 2015. Available in: https://www.bcg.com/pt-br/publications/2015/engineered_products_project_business_industry_4_future_productivity_growth_manufacturing_industries.aspx#. Acessed on: 01 feb. 2019.

HARRIS, D.; BOTTEN, N.; MCCOLL, J. **Marketing for Stakeholders.** Italy: Elsevier Ltda, 2008.

HEERKENS, G. R.. **Project Management.** United States of America: Mcgraw-hill, 2002. Available in: http://group27.narod.ru/ucheba/files/McGraw_Hill-Project_Management.pdf. Acessed on: aug. 2019.

JOHANSEN, A.; EIK-ANDRESSEN, Petter; EKAMBARAM, Anandasivakumar. Stakeholder Benefit Assessment: Project Success through Management of Stakeholders. **Procedia: Social and Behavior Sciences.** p. 581-590. 19 mar. 2014.

KARLSEN, J. T. Project Stakeholder Management. **Engineering Management Journal.** p. 19-24. dec. 2002.

KIANIAN, B. et al. The Adoption of Additive Manufacturing Technology in Sweden. **Procedia Cirp.** p. 7-12. 2016.

LEE, J.; BAGHERI, B.; KAO, H.. A Cyber-Physical Systems architecture for Industry4.0-based manufacturing systems. **Manufacturing Letters.** Cincinnati, p. 18-23. 2015.

LEE, J.; BAGHERI, B ; KAO, H. Recent Advances and Trends of Cyber-Physical Systems and Big Data Analytics in Industrial Informatics. **Int. Conference On Industrial Informatics (indin).** Porto Alegre. jul. 2014.

LEE, J.; KAO, H.. Service innovation and smart analytics for Industry 4.0 and big data environment. **Procedia Cirp.** Cincinnati. dec. 2014.

MAINARDES, E. W.; ALVES, H.; RAPOSO, M. A model for stakeholder classification and stakeholder relationships. **Management Decision.** Portugal, p. 1861-1879. 2012.

MARILUNGO, E. et al. From PSS to CPS Design: A Real Industrial Use Case Toward Industry 4.0. **Procedia Cirp.** p. 357-362. 2017.

MASONI, R. et al. Supporting remote maintenance in industry 4.0 through augmented reality. **Procedia Manafufacturing.** Italy, p. 1296-1302. 2017.

MITCHELL, R. K.; ANGLE, B. A.; WOOD, D. J. Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of Who and What Really Counts. **Academy Of Management Review.** p. 853-886. 1997.

MOURTZIS, D.; DOUKAS, M.; BERNIDAKI, D.. Simulation in Manufacturing: Review and Challenges. **Procedia Cirp.** p. 213-229. 2014.

MOSTERMAN, P.; ZANDER, J. Industry 4.0 as a Cyber-Physical System study. **Software And Systems Modeling.** aug. 2015.

NAHYAN, M. T. Al et al. Project Management, Infrastructure Development and Stakeholder Engagement: A Case Study from the UAE. **Procedia Technology.** Australia, p. 988-991. 2014.

NAMUGENYI, C.; NIMMAGADDA, S. L.; REINERS, T. Design of a SWOT Analysis Model and its Evaluation in Diverse Digital Business Ecosystem Contexts. **Procedia Computer Science.** p. 1145-1154. 2019.

NAGY, J. et al. The Role and Impact of Industry 4.0 and the Internetof Things on the Business Strategy of the ValueChain: The Case of Hungary. **Sustainability.** p. 3-25. sep. 2018

PARMAR, B. L. et al. Stakeholder Theory: The State of the Art. **The Academy Of Management Annals.** p. 403-445. 2010. Available in: https://edisciplinas.usp.br/pluginfile.php/4436004/mod_folder/content/0/Parmar%2C%20Freeman%2C%20Harrison%2C%20Wicks%2C%20Purnell%20_%20De%20Colle%2010%20Stakeholder%20theory%20The%20state%20of%20the%20art%20AMA.pdf?forcedownload=1. Acessed on: 19 may 2019.

PRINCE2. **Glossary of Terms in English.** 2012. Available in: https://www.axelos.com/corporate/media/files/glossaries/prince2-2009-glossary-of-terms_gb-v1-1.pdf. Acessed on: 12 nov. 2019.

PROJECT MANAGEMENT INSTITUTE. **A Guide to the Project Management Body of Knowledge:** PMBOK Guide. 4. ed. Project Management Institute, 2008.

RODIČ, B. Industry 4.0 and the New Simulation Modelling Paradigm. **Organizacija.** Slovenia, p. 193-207. 28 aug. 2017.

ROLAND BERGER GMBH. **Skill Development for Industry 4.0:** BRICS Skill Development Working Group. 2016. Available in: http://www.globalskillsummit.com/Whitepaper-Summary.pdf. Acessed on: 03 nov. 2019.

ROSEKE, Bernie. **How to Perform a Stakeholder Analysis.** 2019. Available in: https://www.projectengineer.net/how-to-perform-a-stakeholder-analysis/. Acessed on: 01 sep. 2019.

SFAR, A. R. et al. A Roadmap for Security Challengesin Internet of Things. **Digital Communications And Networks.** Algiers. apr. 2017.

SILVA, E. L.; MENEZES, E. M. **Metodologia da Pesquisa e Elaboração de Dissertação.** 4. ed. Florianópolis: Universidade Federal de Santa Catarina, 2005. 139 p.

SMITH, Larry W.. Stakeholder analysis: a pivotal practice of successful projects. **Paper Presented At Project Management Institute Annual Seminars & Symposium.** Houston. 2000.

SYBERFELDT, Anna et al. Support Systems on the Industrial Shop-floors of the Future: Operators' Perspective on Augmented Reality. **Procedia Cirp.** Sweden. may 2016.

STAKEHOLDER THEORY. **About the Stakeholder Theory.** 2018. Available in: http://stakeholdertheory.org/about/. Acessed on: 10 nov. 2019.

STOCK, T.; SELIGER, G.. Opportunities of Sustainable Manufacturing in Industry 4.0. **Procedia Cirp.** Germany, p. 536-541. 2016.

THAMRIN, H.; PAMUNGKAS, E. W. A Rule Based SWOT Analysis Application: A Case Study for Indonesian Higher Education Institution. **Procedia Computer Science.** Bali, p. 144-150. oct. 2017.

VAIDYA, S.; AMBAD, P.; BHOSLE, S. Industry 4.0: A Glimpse. **Procedia Manafufacturing.** Aurangabad, p. 233-238. 2018.

VOROPAEV, V.; GELRUD, Ya.; KLIMENKO, O.. Who Manages What?: Project Management for Different Stakeholders. **Procedia - Social And Behavior Sciences.** p. 478-485. 14 jul. 2015.

WITKOWSKI, K. Internet of Things, Big Data, Industry 4.0: Innovative Solutions in Logistics and Supply Chains Management. **Procedia Engineering.** Zielona Gora, p. 763-769. 2017.