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Achieving Competitive Sustainable Advantages (CSAs) by Applying a Heuristic-Collaborative Risk Model

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Abstract: Increasing disruption and turmoil continuously challenges organizations regarding the achievement of short- and long-term objectives. Such a hostile environment results from both the natural evolution of the business landscape complexity and the emergence of unpredictable disruptive evets such as the COVID-19 pandemic. More than ever, organizations should continuously develop business strategies that help them to become more agile, adaptative, sustainable, and effectively respond to the countless business risks (threats and opportunities). Innovation, such as the development and implementation of new technology, new ways of thinking and executing work, are just some of the major factors that can help organizations to increase their likelihood of success. In this work, is proposed the incorporation of a heuristic risk model into a typical organizational business intelligence architecture, to identify collaborative critical success factors across the different phases of a project life cycle which can be used to guide, monitor, and increase the success outcome likelihood of ongoing and upcoming projects. Some benefits of the incorporation include: a higher speed regarding the collection and treatment process of project collaborative data, the output of more accurate results with residual bias associated, a timely and efficient 360° view regarding the identification of project collaborative risks, and the impact (positive or/and negative) of these on a project's outputs and outcomes. Finally, the model capabilities of performing descriptive, predictive, and prescriptive analysis, enables the generation of unique and actionable project's lessons learned which can be used to make more data-informed decisions, and thus enhances the achievement of sustainable competitive advantages. The development and implementation of the proposed incorporation is illustrated with a with a real case study.

Keywords: organizational risk management; organizational network analysis; critical success factors; business intelligence architecture; sustainability; organizational digital transformation; industry 4.0

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1. Introduction

The incredible pace of change caused by nature and human behavioral phenomena, pressures organizations to be more flexible and agile [1,2]. In the actual business landscape, essentially characterized by a gig economy model, organizations must craft and execute strategies the most efficient and effective way possible, otherwise they risk disappearing.

A way that is simultaneously intriguing, fruitful, and dangerous, is to act on an organization's intra- and inter-collaborative dimension to help organizations efficiently develop and implement their strategies. It is intriguing, because it is by nature a complex, hard to understand, and still a very underresearched subject. It is fruitful, because if approached correctly, it provides unique and competitive advantages. Finally, it is dangerous, because if not performed correctly, organizations risk failure on a large scale. In other words, acting on an organization's intra- and inter-collaborative dimension, implies to understanding the extent to which the myriad of organizational collaborative behaviors impact outputs and outcomes.

In short, we can identify three different, but interrelated collaborative dimensions in organizations. They are: (1) people, (2) environment, and (3) tools.

In the people dimension organizations should seek the implementation of effective ways of working that simultaneously increase productivity and efficiency while reducing costs, by addressing internal behavioral change and effective leadership. Effective leadership, also known as a "no one-size fits all approach," aims essentially to develop and implement a customer centric approach and enable a better customer experience (eliminate customer friction), incorporated in an organization's mission, vision, values, brand promise, and service credo [1,2]. Leadership is still about vision, buying in, empowerment, adoption of an ambidextrous leadership style, and most of all, it is about producing useful change [1,2].

In the tools dimension, organizations can use or/and develop techniques, processes, frameworks, and procedures in order to increase efficiency, productivity, quality, safety, and overall satisfaction (employees, customers, and suppliers) through a sustainable way of thinking and executing work. Since the development of the management principles by Henri Fayol in the 1920s, or the standardization of work developed by Henry Ford in the 1930s, business, management and leadership tools, such Agile methodologies, Six Sigma, Lean Management, Design thinking, Brainstorming, World Class Manufacturing (WCM), Total Quality Management, Balanced Score Card, Flow Tree Diagrams, Cost Benefit Analysis, just to name a few, have been helping organizations in the most diverse areas such as finance, economy, engineering, medicine and so on, to become more efficient and sustainable [3–5].

In today's business landscape, essentially characterized by microchips, transistors, telecommunications, and the internet of things, the fourth industrial revolution is heading at full speed towards organizations [3–5]. Computers are redefining human experience at a rapid pace, providing new solutions, greater possibilities, and unlocking secrets of the universe. From driving cars to diagnosing disease, from sorting photographs to flying planes, from optimizing crop yields to predicting climate patterns, today's computing platforms are advancing the human experience in positive and unpredictable ways [3–5]. Namely the advances in the data science field have been continuously providing organizations an efficient competitive advantage to run their business more efficiently [3–7]. Such advances enable the creation of more and diverse data (usually called Big Data) in an astonishing speed stored in digital platforms, which is becoming more and more central in the development of organizational strategies. Such Big Data can be analyzed by the application of artificial intelligence tools, such as machine learning, or data mining techniques (CRISP-DM or SEMMA frameworks for example) to perform descriptive, predictive, and prescriptive business analysis [3–7]. However, if such data are not properly managed, it may bring organizations many challenges and issues that are difficult to solve [3–5].

In recent years, enabled by the advance of the internet of things (the ability of being connected), organizations have been developing digital structures that collect and analyze data to create knowledge for sustainable business [1,3–5]. A very popular structure known as Business intelligence (BI) architecture analyzes large sets of internal, and external organizational data in order to find hidden unique insights (behavioral patterns and trends) to produce actionable business insights to help organizations in the decision-making process [3,4]. A BI architecture is a networked digital structure that is analysis structured, and unstructured data allocated in systems such as supervisory control and data acquisition (SCADA), that arrives from many different business sources, such as finance, human resources, engineering, sales, marketing, just to name a few [3–5]. According to research, organizational BI structures are responsible for predicting over 70% accuracy in online marketing campaigns [6]. BI structures can help organizations to manage internal and external Big Data to create unique insights, such as predicting customer and brand lifetime value, predicting customer churn, predicting customer segmentation, predicting disease spread, performing predictive maintenance, performing risk modelling, performing fraud detection, performing sentiment analysis, and performing predictive up and cross sell, just to name a very few [4–6].

In the environment dimension which regards not only to the environment as the nature of mother earth but also where organizations exist and operate, aspects, such as how organizations position themselves in the market, analyze and understand the different business needs, develop strategic business plans, integrate different working cultures, predict how disruptive changes may affect well-established business models, their internal organizational structure, circular economy, and the three principal pillars of sustainability, just to name a few, are of critical importance to organizations [7–9].

The three mentioned dimensions aim to ground stability and dynamism, built upon a network of teams within a people-centered culture that operates in rapid learning and fast decision cycles which are enabled by technology and guided by a powerful common purpose to co-create value for all stakeholders [8]. Continuously improving the three mentioned dimensions will contribute to transforming organizations into agile organisms enabling them the ability to quickly and efficiently reconfigure strategies, structures, processes, people, and technologies in order to keep delivering value and minimize the loss of opportunities in today's volatile, uncertain, complex, and ambiguous (VUCA) business landscape [7,8].

However, despite all the advances in the three dimensions described above, there are still many challenges that organizations must overcome in a daily basis. For example, effective decision-making is almost fully dependent upon high quality and on timely information; thus, only when having reliable systems that in a timely manner outputs meaningful information, can decision-making become more efficient and effective [7–9]. Another example of a challenge is that digitalization process has not been always successful. This essentially occurs because organizations are quickly realizing that they lack proper foundational digital platforms and systems on which to build other applications in a scalable, competitive way [7].

In this study is proposed the incorporation of a heuristic project risk model used to identify project critical success factors (the POL model [9]) developed based on three key pillars (1) project management, (2) risk management, and (3) social network analyses) into a typical organizational BI architecture. In Figure 1 is illustrated the overall incorporation process. The heuristic project risk model analysis all the different phases of a project lifecycle in search for unique repeatable behavioral patterns that are associated to successful, and unsuccessful delivered projects.

The incorporation of the heuristic risk model into a BI architecture contributes to the development of several interrelated organizational and social dimensions, such as innovation, working culture, sustainability, competitive advantages, and digitalization just to name a few. Concretely, the proposed incorporation aims to make organizational processes and procedures more effective and efficient as these are critical aspects of success in organizations as suggested by several research [1,3,5,6,8–12]. The overall process of the incorporation is illustrated in a case study where all the steps are detailed. The importance of illustrating the overall process through the illustration of a case study relies in the complexity associated with the overall incorporation process due to the fact that it comprises the connection of several different organizational areas.

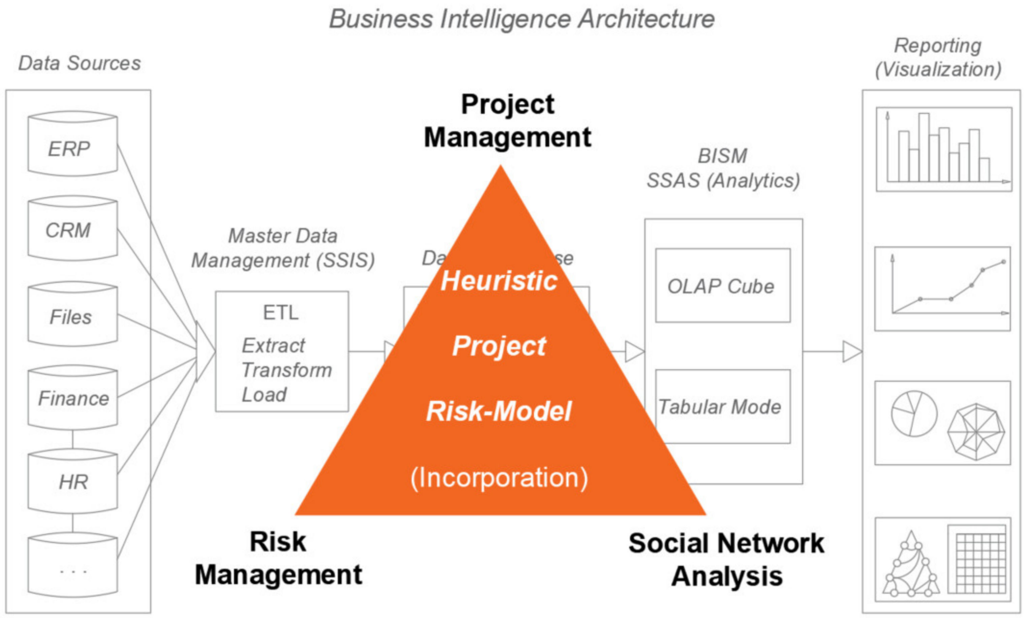

Figure 1. Incorporation of a heuristic project risk model into a BI architecture. Adapted from [10].

The main aim of the incorporation is to illustrate how organizations can explore potential hidden opportunities to drive sustainable business and achieve competitive advantages, using the capabilities offered by the tools and techniques comprised in the actual data science package (intelligent networks, data mining, algorithms, metrics, machine learning and so on), to understand in a measurable way how the different working cultures that exist within and between organizations impact their outcomes and outputs.

As a result of the proposed incorporation, organizations obtain higher speed regarding the collection and treatment process of project collaborative data, more accurate results with residual bias associated, and a timely and efficient 360° view regarding the identification of project collaborative risks and the impact (positive or/and negative) of these on project's outputs and outcomes. Still the capabilities of the model to be incorporated in performing descriptive, predictive, and prescriptive analysis, enables the generation of unique and actionable project lessons learned which can be used to make more data-informed decisions, and thus enhance the achievement of sustainable competitive advantages.

The proposed incorporation is aligned with the latest research concerning the importance of data in an organizational and social dimension, highlighted in the well-known terms of industry 4.0 and the organizational digital transformation process [3,12]. In this regard, it provides organizations a more valuable and data-driven approach regarding the management of organizational collaborative initiatives which is possible because the proposed incorporation automates the processes of collection, processing, and analysis of behavioral data associated with successful and unsuccessful project outcomes, enabling a continuously refining process regarding the identification of project critical successful factors through a continuous improvement cycle which is characterized as a supervised machine learning model. The proposed incorporation will also enable to better understand the relationship between dynamic interactions and innovation by analyzing in a more data-informed approach the implications that key innovation factors proposed by several researchers, such as diversity and inclusion [13,14], the adoption of an ambidextrous leadership style [2], or still the adoption of a more hands-on approach regarding the management innovative collaborative networks [15] have in innovation outcomes. This is particularly important in organizational and research dimensions because it is aligned with several research that argue that innovation is a primary source of competitive advantages and success [16,17]; however, very little is known about the real factors (individual and collective) that drive innovation [18].

Still, the proposed incorporation enables to measure the importance of the mix of formal and informal organizational networks more accurately in an organizational context, which will help to support or contradict either research that argues the importance of informal organizational networks in improving performance and innovation [19–22], or research that argues that other factors have higher importance in improving performance and innovation [23]. In this area, the proposed incorporation will be crucial to shed light in which behaviors lead to the two collaborative extremes ((1) collaborative overload or (2) lack of collaboration), that ultimately may lead to the emergence of event risks, variability risks, ambiguity risks, emergent risks, and collaborative risks as proposed by several research [24–26].

Finally, the efficient application of the proposed incorporation contributes to the to the three fundamental pillars of sustainability ((1) economic, (2) social, and (3) environmental [27–29]), which according to research can be a fruitful source of benefits which includes an increase in revenue (organizations that engage in sustainable initiatives experience at about 20% of increase revenue, 16% of cost reduction, and 30% increased brand value [28]), and a change in consumer behaviors (more than 50% of consumers are willing to pay 5% more for products delivered and produced in a sustainable way, and 76% would wait one extra day for a delivery [27]).

2. Literature Review

2.1. Risk Management in Organizations

According to the Project Management Institute (PMI) a project can be defined as a temporary endeavor with a well-defined start and finish, that aims for the creation of a unique value, product, or service [30]. It is through the efficient accomplishment of projects that organizations deliver value and execute their strategies [30,31]. Such tools and techniques usually comprise a set of best practices based on lessons learned, which have been collected across many years of experience and are supported essentially by math and statistics. Project management can be defined as the application of knowledge, skills, tools, and techniques to project activities, to meet project requirements, across all the different project phases of a project lifecycle [30].

However, regardless of how an organization is equipped with the best tools and techniques and best practices, implementing a project is always associated with risks (threats or/and opportunities). Risk can be defined as an uncertain event or a set of circumstances that, should they occur, will have an effect (positive or negative) on the achievement of one or more objectives [30]. In project management, risks are usually associated with how they impact project scope, quality, schedule, costs, and resources, the so-called project triple constraints [30]. Some types of risks include [25,26] event risks (risks related to something that has not yet happened, but if it does happen, it will impact on one or more project objectives), variability risks (characterized by a number of possible known outcomes but one does not exactly know which one will really occur), ambiguity risks (uncertainties that emerge from lack of knowledge or understanding, also called of know-how and know-what risks which may include the application of new technology, market conditions, competitor capability or intentions, and so on), emergent risks (known as “Black Swans”, such risks cannot be seen because they are outside a person’s experience or mindset that usually they arise from game-changers and paradigm shifters, such as the release of disruptive inventions or products), and collaborative risks (risks that arise from the different behavioral patterns of project entities such as individual stakeholders, groups, departments, organizations, across a project lifecycle).

Project risks can be seen as project critical success factors as proposed by project management authors and researchers [31–33]. Project critical factors may include experience of project teams, project manager’s ability to solve problems [31], poor management during the strategy formulation stage [33], project mission not properly defined, lack of top management support, undetailed project schedule, poor client consultation (voice of customer), lack of necessary and proper technology, and expertise, ambiguity client acceptance, lack of proper monitoring and feedback of project activities, poor communication, and non-readiness to handle crises and deviations from plans or contingency plans, just to name a few. Project risk management, which combines the project management and the risk management scientific fields, can be defined as the whole process (that includes principles, frameworks, procedures, standards, and application of best practices) that comprises a set of well-defined and structured steps, supported by mathematical approaches such as statistics and probability, to effectively and efficiently manage a variety of risks in projects (as the above mentioned) that may emerge across the different phases of a project lifecycle.

A very popular standard that helps organizations to manage risk is provided by the International Organization for Standardization (ISO) 31000:2018 [34].

This standard contains a set of well-defined principles that aim the creation of value in organizations by effectively identifying and managing risks guided by eight sequential and circular well-structured steps as illustrated in Figure 2b. These include: (1) establishing scope, context and criteria (defining risk management scope activities, which includes internal and external context where organizations seeks to define and achieve its objectives, and risk criteria which specifies the amount of risk that an organization is willing to take); (2) risk identification (finding, recognizing and describing risks that might help or prevent an organization achieving its objectives); (3) risk analysis (understand the nature of risk, uncertainties, risk sources, consequences, likelihood, events, scenarios, controls, and their effectiveness); (4) risk evaluation (comparing risk analysis results with established risk criteria to determine where additional action is required); (5) risk treatment (specify risk treatment and monitoring plans); (6) record and reporting (continuously monitoring and reviewing the evolution of identified risks and the efficacy of applied controlled measures); (7) communication and consultation (the diffusion of risk related information across organizational structure); and finally (8) monitoring and review (includes the monitoring of implemented measures, and the emergence of new risks).

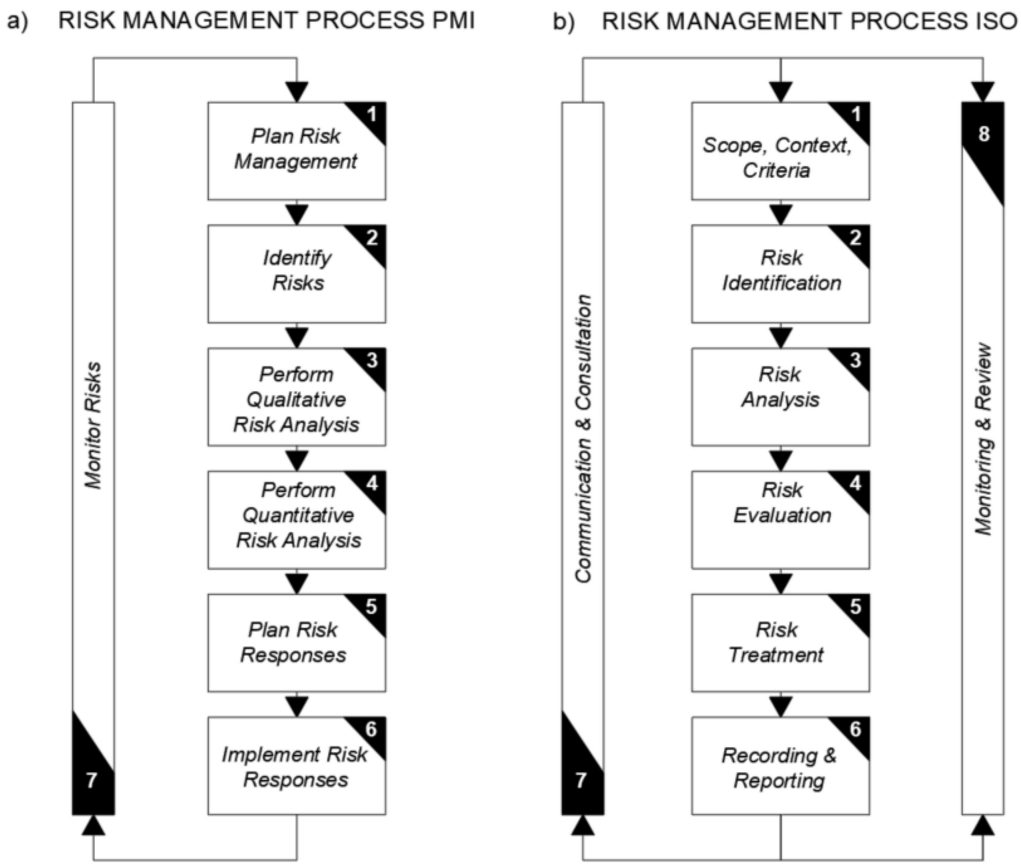

Figure 2. Risk management process according to the PMI [30] (**a**), and the ISO [34] (**b**).

The ISO 31000:2018 standard is a high-level perspective approach that can be incorporated and adapted into each organizational risk management structure. To a certain extent and with the respective adaptations, such as what the PMI performed, as it defined their project risk management standard approach as illustrated in Figure 2a [30]. The PMI's approach includes seven circular well-structured steps, which mirror the risk management standard proposed by the ISO 31000:2018 illustrated in Figure 2b. These include: (1) plan risk management (the process of defining how to conduct risk management activities for a project); (2) identify risks (the process of identifying individual project risks as well as sources of overall project risk, and documenting their characteristics); (3) perform qualitative risk analysis (the process of prioritizing individual project risks for further analysis or action by assessing their probability of occurrence and impact as well as other characteristics); (4) perform qualitative risk analysis (the process of numerically analyzing the combined effect of identified individual project risks and other sources of uncertainty on overall project objectives); (5) plan risk responses (the process of developing options, selecting strategies, and agreeing on actions to address overall project risk exposure, as well as to treat individual project risks); (6) implement risk responses (the process of implementing agreed-upon risk response plans); and finally (7) monitor risks (the process of monitoring the implementation of agreed-upon risk response plans, tracking identified risks, identifying and analyzing new risks, and evaluating risk process effectiveness throughout the project). The heuristic risk model to be incorporated into a BI architecture, was developed as a functioning philosophy of approaches to risk management defined in both the ISO and the PMI risk management standards as illustrated above.

2.2. Social Network Analysis in Organizations

The application of graph theory to analyze social behavior has exponentially increased over the years [35–37]. Such application, known today as a social network analysis (SNA), can be defined as the application of graph theory to study the dynamic interaction of entities within a network [36,37]. The SNA focuses on relationships between entities rather than entity's individual attributes [36,37]. It assumes that social actors such as individuals, groups, or organizations, are embedded within a network of interdependent relationships with other social actors, where the intersection of such relationships defines an individual's role, its position in the social organizational structure, or even an organization's position in the market [36–39]. A typical social network can be defined as a set of entities (E1, . . . , E*n*) also called of nodes or actors, which can be characterized by some of their attributes, such as their age, sex, beliefs, educations, social status, and are usually connected by directed or reciprocal links that represent preferences [36]. Such entities may represent individuals, groups, or organizations, whereas the connections represent a given relationships between those entities such as like, dislike, advice, friendship, trust, support, interest, and dependency just to name a few [36]. In Figure 3 are illustrated the typical SNA steps (Figure 3a) and a typical social network representation (Figure 3b).

The typical steps to run an SNA include (Figure 3a) [19]: (1) identify a strategically important group (target an important group within an organization, defining the boundaries which may include the function, department, key people, a particular community or even a country and the type (degree detail) of information to be collected, that must be analyzed internally and cross functional); (2) access meaningful and actionable relationships (define how to obtain valuable and insightful information without too much disturbance by strategically develop observations, surveys, or consulting logs or email communication); (3) map relationships (following the process of mapping it as illustrated in Figure 3b); (4) visual analyses results (when a social network is not too dense to be analyzed with a naked eye as in Figure 3b, it is possible to immediately draw conclusions); (5) quantitative analyses results (consists in the application of SNA metrics to quantitatively measure mapped interactions); (6) create meaningful feedback sessions or follow-up (organize and execute follow-up interviews); (7) implement supportive or corrective measures in order to aim to a desired status, (8) assess progress and effectiveness (continuously monitoring of effectiveness of implemented measures); and finally (9) re-assess (perform another SNA assessment usually after a period of 9 up to 12 months to asses effectiveness of implemented measures).

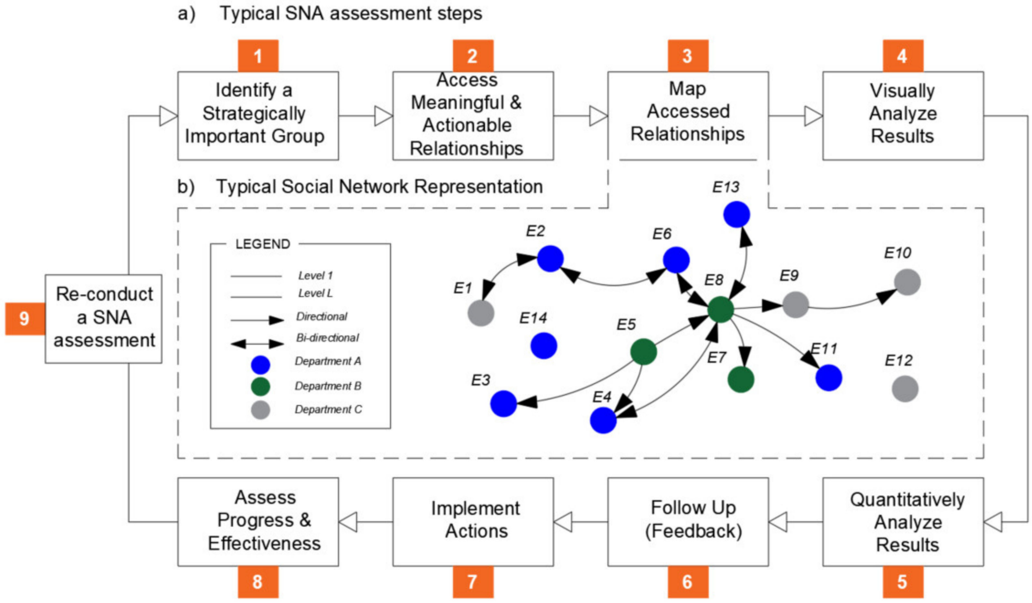

Figure 3. Typical nine SNA assessment steps (**a**), and the typical representation of a social network (**b**).

The SNA process can be categorized into five different dimensions. They are [38,39]: (1) structure (mapping of relationship patterns among the different entities and can be measured at individual and collective level with the application of SNA centrality metrics such as in/out/total degree, closeness, betweenness, prestige (for individual), and connectivity, centralization, density, transitivity (for collective); (2) relationships (characterization of time dependent, intimacy dependent, emotional intensity and reciprocity dependent links (ties) between actors within a network such as strong and weak ties, negative or positive ties, directed or indirect ties, weighted or non-weighted ties, frequency, tie's stability over time, tie's multiplexity and so on); (3) resources (analysis of the relationship between tie quantity and strength and actor's resources); (4) attributes (analysis of the relationships between actors personality and position within the network's structure); and (5) cognition (focuses on individuals' cognitive interpretations of the network, how an actor is perceived in the network related to power, prestige, influence and so on).

Because it is very difficult to find anything that is not one way or the other connected, SNA can be applied in a wide range of different areas such as agriculture [40], organizational science industry, management, and leadership [41], and political science [42], just to name a few. Because dynamic relationships are complex by nature, they cannot be explained by traditional social theory and data analysis methods, rather by methods that are based on sociology which take into consideration the individual's social context in the process of making choices [9]. SNA is the most accurate and appropriated approach to study and analyze such dynamic relationships by applying a variety of centrality metrics developed based on graph theory [9,36], a mathematical structure that is used to model pairwise relationships between entities such as persons, organizations, departments and so on [9,36], that contributes to explain the way social structures evolve across time, and how they impact the environment where they exist [43].

In an organizational context, the application of SNA can be translated as the challenge of correlating the countless actor's dynamic interaction behavioral patterns, with organizational outcomes (for example a project's outcome, successful or unsuccessful) [9].

Assessing and understanding how the mix of formal and informal organizational networks impact organizational outputs and outcomes, can be leveraged to improve decision making. Regarding organizational performance measurement, it is highly appropriate that the study of organizational behavior, as one of the most critical aspects in organizational performance, focuses on the attributes of individuals [38,39]. However, exclusive focus on the individual in isolation to search characteristics that defines a successful employee, does not see the entire picture.

Though individual skills and expertise are important and to a certain extent decisive, the way people jointly work, and the function of both the attributes of the people and their environments, are even more decisive when it comes to performance and innovation [9,22,39]. The application of SNA in organizations has been gaining high popularity across the recent years essentially because it enables to map networks of informal collaboration (usually a mix between formal and informal networks of collaboration) such as communication (who and with which frequency communicates with who regarding personal and professional subjects), information-flow (how information flows within and across functional departments), problem solving or advice (who goes to whom for advice or expertise know-how on work or personal related matters), know-how (who knows what and how), access (who has access to whom), and trust (who trusts whom), just to name a few [9,44].

In a social network, centrality refers to the structural location of an entity, rather than the entity's own inherent attributes such as age, tender, or gender just to name a few [35,36]. Research suggests that centrality is a measure of importance, influence, prestige, control, and prominence and it can be quantitatively measured by the application of graph theory centrality metrics [45,46]. In a project management environment, network centrality is associated with informal power in collaborative social networks [9] that will influence coordination and decision making in project management and ultimately influence project outcome, such as success or failure [47–49]. The heuristic risk model to be incorporated into a BI architecture, was developed as an analytical tool for application of the SNA tools and techniques in the quantitative identification of the different behavioral patterns across the different phases of a project lifecycle.

2.3. Business Intelligence Architecture in Organizations

Business intelligence (BI) can be simply defined as a set of strategies and technologies used by an organization for the data analysis of business information [50]. BI comprises a set of tools, methodologies, systematic processes, technologies, frameworks, and architectures that acquire or collect, transform (usually organizational business data) from both internal and external raw data into insightful, valuable, actionable and meaningful information that organizations can use to understand past, actual, and future business trends such as consumer behavioral patterns, supporting them in a more efficient and effective way in the organizational strategical decision-making process [51].

The term business intelligence is credit to Howard Dresner, who described BI as being a set of concepts and methods to improve business decision-making processes by using fact-based computerized support systems [52]. A BI architecture describes the standards and policies for organizing data through the help of computer-based tools, techniques and technologies that originate business intelligence systems used for data collection, analysis, and reporting [10–12,52]. Although several literatures show the countless benefits of a BI architecture, research argues that such benefits are not always clear, essentially due to the application of non-efficient metrics [52,53].

BI comprises many interrelated dynamic areas or components such as data science, data mining, machine learning, Big Data, data analytics, business analysis, systems engineers, risk management, programming, just to name a few [11]. Usually, a typical organizational BI has an architecture as it is illustrated in Figure 4 [10].

In Figure 4 is illustrated the typical architecture (the flow diagram throughout the information is acquired, treated, and disseminated) and main components (comprised by data sources, data management systems known as extract, transform and load, data warehouses, business analytics, and reporting) of a business intelligence system.

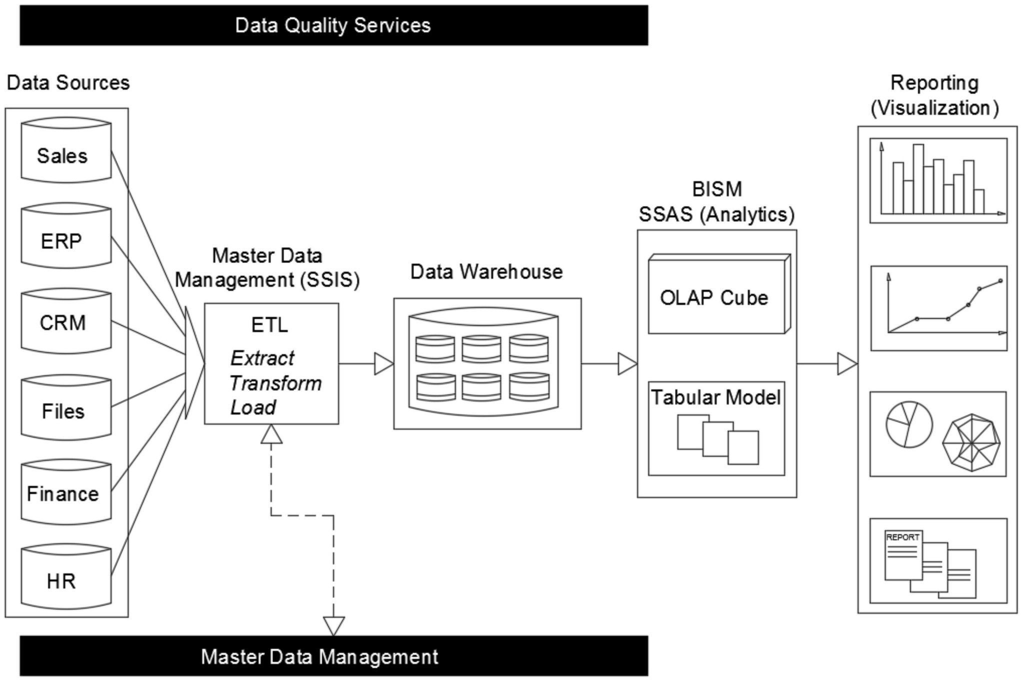

Figure 4. Typical BI architecture. Adapted from [10].

First a typical BI architecture implies to have an organizational dynamic interconnected network of communication where information that is produced, internally and/or externally acquired (data source) from diverse organizational areas such as sales, finance, human resources engineering, marketing, or directly from diverse organizational data systems such as customer relationship management (CRM) or enterprise resource planning (ERP) or simply just single office or other files formats, can be easily accessed and are fully readable [10].

Second, the accessible and readable information available in such databases, undergoes an extraction process that consists of cleaning, consolidating, and transforming, so that such information contained in diverse data sources, can fit into the data warehouse "architecture". After that, the treated information is loaded into the data warehouse. This is the process of extracting (pull data from external sources), transforming (transform pulled data into demanded standards) and loading (data converted into a data warehouse) BI information (ETL), also called the data incorporation process. For example, this process essentially extracts data from a sales database and transforms it (combines, matches and so on), to fit in the model of the data warehouse tables. For example, a tool to execute such process can be the SQL Server Incorporation Service (SSIS), which essentially connects to multiple data sources such as Oracle, DB2, Text Files, XML, Web services, SQL Server, and so on.

Third, the BI data warehouse store data that arise from the ETL data entry point [10]. Data warehouses are built on normalization standards, which are efficient for transactional systems, for example, to reduce redundancy and increase performance of queries for reports and analytics. BI systems and tools make use of data warehouses as a source of information to generate reposts and analyses.

Fourth, although data warehouses that are designed to be the source of analysis and reports work much faster than operational systems for producing reports, they are still not fast enough to cover all requirements (queries). This happens because a data warehouse it is still a relational database, and databases have several constraints that reduce the response time of a given query. The requirement for faster processing and a lower response time on one hand, and aggregated information on another hand, originates another layer in BI systems. This layer, called the data model (BI Semantic Model (BISM)), contains a file-based or memory-based model of the data for producing very quick responses to reports and visualizations [10]. One of the most well-known solutions for a data model, is provided by Microsoft and is split into two technologies: the OLA cube technology (also called multidimensional), which is a file-based data storage that loads data from a data warehouse into a cube model, which contains descriptive information as dimensions (for example, customer and product) and cells (for example, facts and measures, such as sales and discount), and the in-memory tabular model, which is faster in terms of response time than the OLA cube model. The in-memory tabular model loads all data rows from tables into the memory and responds to queries directly from memory. Both, tabular and multidimensional solutions, are provided by Microsoft is a combination of SQL server analysis services (SSAS), and the BI semantic model (BISM).

Fifth, the reporting and visualization BI system, is the part that the final user can see. Final information can be visualized through several different methods such as strategic and tactical dashboards, scorecards, critical success factors (CSFs), key performance indicators (KPIs) and detailed or consolidated reports [10]. There are countless applications to visualize results and create reports such as the Microsoft Power BI (from Microsoft) or Tableau (from Salesforce) or even simply Microsoft Excel (from Microsoft) just to name a few.

Finally, every organization that has a BI architecture has a master data management (MDM) system process and data quality services (DQSs). An MDM is the process of maintaining the single version of truth for master data entities across multiple systems [10].

Alongside the data warehouse, one of the most important components from a BI system is the business analytics (BAs), or simply the analytics. BAs can be simply defined as a continuous and iterative exploration of past business performance [11]. BA is the component of BI that analyzes collected, transformed, and treated raw data collected through several different data sources, searching for patterns in such data, enabling organizations to predict trends. It enables organizations to learn from the past and make better and more data-driven decisions for the future and make better business adjustments to ongoing business activities to improve business outcomes. BAs can be divided in six different stages, ((1) descriptive, (2) exploratory, (3) explanatory, (4) predictive, (5) perspective and (6) experimental) and function on two timelines (the past and the future). In Table 1, are illustrated the different BA stages function of the two timelines and a brief description on each one of them [11].

Table 1. Business analytics stages.

Point in Time	Analytics Stage	Stage Question	Brief Description
Analysis about the past	Descriptive	What happened?	Resume facts about the performance of a business for example. Consulting business records, logs, outputs, and outcomes.
	Exploratory	What is going on?	Dive deep into the data to understand patterns and confirm hypothesis either using ad hoc software or simply follow leads.
	Explanatory	Why did it happen?	Identify root causes for outputs and outcomes by following methodical processes such as storytelling, structured interviews, social network analysis, and so on.
Analysis about the future	Predictive	What will happen?	Identify the likelihood of future outcomes based on historical data. Correlations between past events (situations) and past outcomes.
	Prescriptive	How do we take advantage?	Identify ways and means to take advantage of the findings and predictions. This can be performed through simulations.
	Experimental	How well will it work?	Test hypothesis or alternatives to understand actual performance on the field. This can be performed on the filed in a real case.

As it is illustrated in Table 1, there are six different stages in business analytics, where three of them are related with the analysis of the past, and three are related with the analysis of the future. Being able to efficiently analyze interpreter data is a critical success factor to accurately predict future trends, outputs, and outcomes such as a project outcome (success or failure). The heuristic risk model is to be incorporated into the above-described typical BI architecture.

3. Materials and Methods

In this section is illustrated the incorporation process of the heuristic project risk model (the heuristic risk model (project outcome likelihood model) [9]) to identify project critical success factors into an organizational business intelligence architecture. First it is introduced the project risk model to be incorporation into a BI architecture, and then the incorporation the project risk model into a typical BI architecture.

3.1. Introduction to the Heuristic Project Risk Model

In Figure 5 is illustrated the project risk model to be integrated into a BI architecture. The heuristic project-risk model [9] illustrated in Figure 5, has as major function the identification of project critical success factors across the different phases of a project lifecycle.

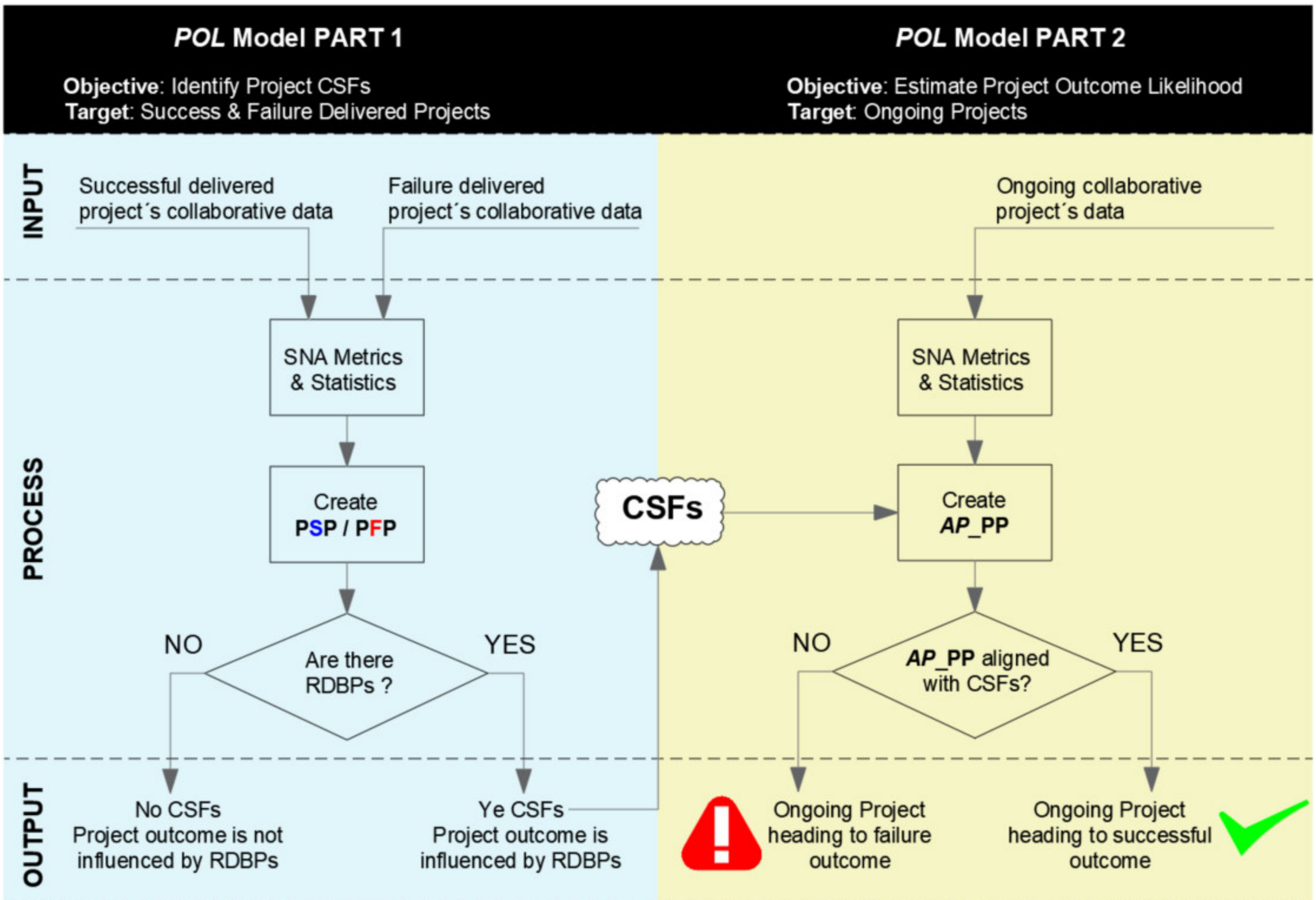

Figure 5. The heuristic risk model functioning principle, adapted from [9].

The model illustrated in Figure 5 was developed based on three principles: (1) project management (contributes to the terminology used in project management, and the structure of a project lifecycle), (2) social network analysis (contributes to the tools and techniques to uncover and measure the dynamic interactions of project people throughout a project lifecycle), and (3) risk management (contributes to the risk identification and treatment process and framework). The model was divided in two parts.

In part 1 the model identifies and quantitatively measures critical success factors from past delivered projects regarding how to project people's dynamic interaction across a project lifecycle. First, specific data collected in project meetings, mails, and surveys, form successful and unsuccessful delivered projects are collected according to outcome type (successful or unsuccessful delivered) analyzed through the application of SNA centrality metrics and statistics. Then, for each set of analyzed successful and unsuccessful delivered projects, two project's profiles are be created. One profile characterizes all successfully delivered projects (PSP), and the other profile characterizes all unsuccessful delivered projects (PFP). The characterization is quantitatively performed by the application of the same SNA centrality metrics in both successful and unsuccessful delivered projects. After that, the model compares each metric of successful against unsuccessful delivered projects searching for unique repeatable behavioral patterns (RDBPs) for success and unsuccessful delivered projects. Finally, if the value of a given metric has a different value for the successful delivered project from the unsuccessful delivered project (if RDBP are found), a project critical success factor is identified (CSFs). The contrary is also true.

In part 2 the heuristic risk model uses the identified critical success factors in part 1 to provide guidance to upcoming projects, in order to enhance the chances of project success outcome. First, for an ongoing project the same approach from part 1 is undertaken to create the actual point project profile (AP_PP), and then the values are compared with the values that are the critical success factors (identified in part 1), and the function of the output; the model indicates if the project is heading to a successful outcome (if the *AP_PP* values are aligned with the CSFs), or if not (if the values of the *AP*_PP are not aligned with the CSFs). In order to identify critical success factors, the project risk model analyzes five global collaboration types. They are: (1) communication and insight, (2) internal and cross boundaries-collaboration, (3) know-how sharing and power, (4) clustering (variability effect, PSNVar), and (5) teamwork efficiency. They are illustrated in Table 2.

Table 2. The five global collaboration types of the heuristic risk model [9].

1.	Communication and insight	Analyzes how important project stakeholders are conducting the project communication, and the impact in project outcome. Analyzes the feedback level between the different project teams, the impact of the presence of important stakeholders in project outcomes, how the internal and external mail communication is made, and so on.
2.	Internal and cross boundaries-collaboration	Analyzes to which extent is one team more dependent on the other, regarding project related information across the different phases of a project lifecycle, and the volume of E-mail sent to seek and provide project-related information, and the impact in project outcome.
3.	Know-how sharing and power	Analyzes the extent to which project-related information provided by one team to other team or teams is recognized as important and decisive, and the impact for a certain project outcome.
4.	Clustering (variability effect, PSNVar)	Analyzes the extent to which the variability (changing the project team set) of the project social network across all phases of a project lifecycle, influences project outcome.
5.	Teamwork efficiency	Analyzes the extent to which a project outcome is associated to the feedback speed of project information-related between different project teams across all phases of a project lifecycle.

Each of the five global collaboration types are analyzed by the application of developed metrics based on SNA centrality metrics, such as Role attendee Degree, Mail cohesion Degree, Feedback Degree, Information Seeking/Providing Degree, Action Key Players, Meetings Cohesion Degree, and Transferring speed [9]. The application and incorporation of the heuristic risk model into a typical BI architecture comprises two essential analyses:

(1) analysis about the past (the descriptive, exploratory, and explanatory analysis), and the (2) analysis about the future (the predictive, prescriptive, and experimental analysis). These two essential analyses are illustrated in Table 3. In Table 3 are illustrated the relationships between the project risk model [9], the ISO risk management process [34], and a typical BI architecture [10,11].

Table 3. Relationships between the heuristic risk model, ISO Risk management process and a BI architecture.

SNA Assessment Approach (Heuristic Risk Model)	ISO Risk Management Process	BI Architecture Components (BA)
Identify a strategically important group. Objective: Successful and unsuccessful delivered projects. Project dynamic collaboration data from the different phases of a project lifecycle.	Scope, context and criteria	Analysis about the past. It comprises the following three analytics components: 1. Descriptive, 2. Exploratory, 3. Explanatory
Assess meaningful and actionable relationships. Objective: collect, and prepare collaborative data (mails, meetings, and surveys) from successful, and unsuccessful delivered projects from the different phases of a project lifecycle.	Risk identification	
Visualize the results. Objective: prepare and draw social network relationships maps function of collected information	Risk analysis	
Quantitatively analyze the results. Objective: Prepare and calculate network's relationships centrality metrics function of collected information. Identify project critical success factors.	Risk evaluation	
Create meaningful feedback sessions. Objective: discuss and implement corrective measure function of identified project critical success factors.	Risk treatment	Analysis about the future. It comprises the following three analytics components: 4. Predictive, 5. Prescriptive, 6. Experimental
	Recording and reporting	
	Communication and consultation	
Assessing progress and effectiveness. Objective: prepare social networks relationships maps.	Monitoring, and reviewing	

As it can be seen in Table 3, two major blocks can be defined. The first block regards the analysis about the past (essentially descriptive analysis), and the second block regards the analysis of the future (essentially predictive analysis).

The first block concerns three analytic types (descriptive, exploratory, and explanatory). These correspond to part 1 of the heuristic risk model where project critical success factors are identified. This includes identifying strategically important groups, assessing meaningful and actionable relationships, visualizing the results, and quantitatively analyzing the results. In terms of the risk management approach, the first block comprises the activities of scope, context and criteria, risk identification, risk analysis, and risk evaluation.

The second block concerns the analysis about the future comprising three analytics (predictive, prescriptive, and experimental) which correspond to the part of the heuristic risk model where identified project critical success factors are used to support or guide upcoming projects. In terms of a typical SNA assessment, it comprises the activities of creating meaningful feedback sessions and define and implement corrective or supportive measures and assess progress and effectiveness of implemented measures. In terms of risk management approach, the second block comprises the activities of risk treatment, recording and reporting, communication, and consultation, and monitoring and reviewing.

3.2. Incorporation Process of the Heuristic Risk Model into a Typical Business Intelligence Architecture

In this section the incorporation of the project risk model into a typical organizational BI architecture is illustrated. In Figure 6 is illustrated a typical organizational BI architecture [10] (grey), and the incorporation of the project risk model structure (orange) into the BI structure.

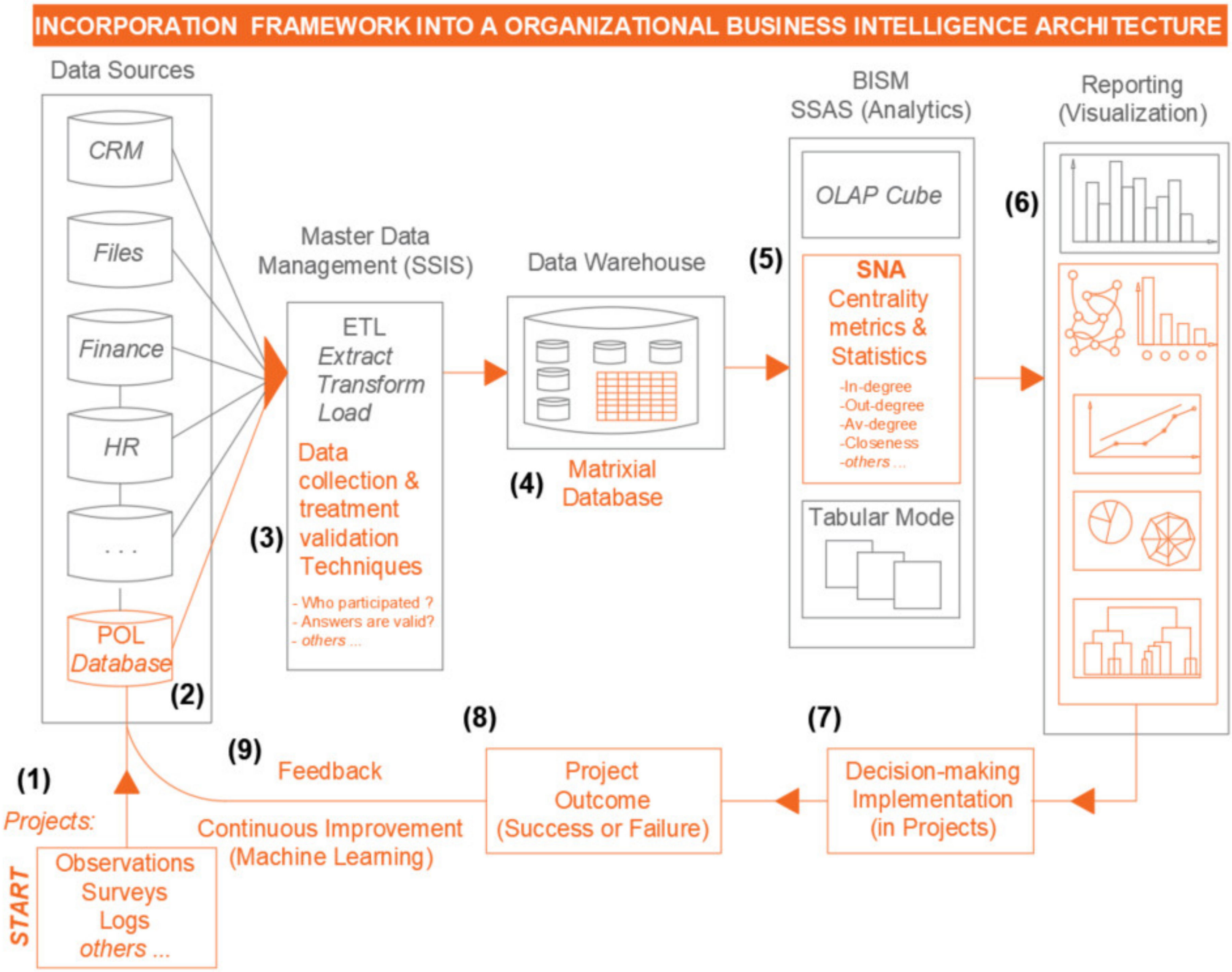

Figure 6. Incorporation of the heuristic project risk model into a typical BI architecture.

Before initiating the steps illustrated in Figure 6, a "logical place" (also known as the IT infrastructure) within an organization must be created. This step includes all the tasks and activities related with IT in order to create the necessary networks of communication which supports the collecting, storing, analyzing, and reporting systems. In Table 4 is illustrated the respective steps illustrated in Figure 6.

Table 4. Incorporation process steps of the heuristic risk model into a BI architecture.

Step	Description
1	Relational data from collaborative successful and unsuccessful delivered projects must be collected using methods, such as surveys, observations, and logs. Collected data should mirror the five global collaboration. types (5-GCT) of the project risk model. Because the heuristic approach does not guarantee optimal or perfect results, the more projects that are analyzed, the more reliable is the identification of project critical success factors.
2	Collected data are stored initially in a dedicated database. This database can be developed in any type of the most recommended available software if it remains reliable across time. This database is the one which contains the information related to projects that were successful and unsuccessful (temporarily).
3	Temporarily stored data undergo a process of cleaning, treatment, and validation of collected data ETL process (extract, transform and load (ETL) process) which essentially consists in efficiently extracting necessary and sufficient information for the next steps.
4	Treated data are first stored in a database called a data warehouse. The data stored in the data warehouse are data that are already in the respective database format (usually in matrixial form) and ready to be analyzed.
5	Stored data in the data warehouse go through an analytic process. In this step, a set of SNA centrality metrics such as degree, in-degree, out-degree, betweenness, closeness, among others, are applied to the collected data in order to quantitatively measure the dynamic interactions of project people across the different phases of a project lifecycle captured in project meetings, mails, and surveys. The analysis process aims for the identification of project critical success factors across the different phases of a project lifecycle of delivered projects. It is in this step, the project risk model concludes if there are or not critical success factors, and functions of the analyzed data.
6	Once the calculations are executed, the results may be displayed in charts (bar, circular, spider, and so on) and in network diagrams (graphs). Usually, results illustrated in charts regard the factors that are identified as critical for project success as well as the associated numerical value for each factor function of a given SNA centrality metric. The results illustrated in a network form (graphs) show the mapping of organizational relationships that are the mirror of the mix of formal and informal dynamic relationships between project stakeholders across the different phases of a project lifecycle. Both, charts, and networked results, are vital to the next step where decisions are to be taken.
7	The decision-making process takes place. Here, due to the function of the results obtained, decisions are taken in order to align the identified dynamic behavioral collaboration patterns with the organizational goals and objectives. Once the decision-making process is over, and the managers know what actions they need to take in order to guide the project people to the successful dynamic behaviors, it is time to implement them in an ongoing or upcoming project.
8	Once decisions are agreed upon, it is vital to implement them in the most efficient way possible. In this step which direction a project (ongoing project) is heading is measured and monitored (success or failure). This analysis is formed through the comparison between implemented measures of a function of the information of the critical success factors, and the ongoing status of a project.
9	At the end of a given project, all the produced relational data aree collected and associated to the respective project outcome. These data then go to the heuristic risk model database (2) as new input data for the identification of project critical success factors. This initiates the automatic continuously improvement cycle of refining project critical success factors. In this step, the data collected from a finished project (either successful or unsuccessful) are analyzed through the same circuit from steps 1 to 9.

4. Application Case and Results

4.1. Introduction to the Case Study

A small organization in northern Europe in the life sciences area decided to incorporate the heuristic project risk model into their BI architecture. The incorporation took place in 2019. The organization (named as organization A in this work due to legal and protection reasons) develops equipment and techniques that are utilized in the health area, namely in the development of equipment for detection of internal human organ malfunctions. The organization has 3 different locations and 42 employees in total. Because the organization has a BI architecture where the different laboratories are connected to exchange project information in a timely, secure, and efficient way, the incorporation of the heuristic project risk model was seen as an advantage to enhance the capabilities of the organization regarding the collaborative dimension between some of their laboratories. Another reason for the incorporation of the heuristic risk model is the past problems that the organization experienced in the collaborative dimension. Therefore, organization A decided to implement a collaborative working approach that aims for the continuous monitoring of collaborative initiatives between different R&D departments. Organization A is not part of the team that developed the heuristic risk model, nor part of the team that developed the incorporation of the heuristic risk model into a BI architecture. The main objective of organization A with the incorporation of the heuristic project risk model into the BI architecture is to enhance the capabilities of the heuristic project risk model in the identification of project critical successful factors, so that these can be replicated in future collaborative projects, and thus increase their success outcome likelihood.

Before starting the incorporation of the heuristic project risk model into organization A's BI architecture, a few steps must be taken to access the feasibility of the implementation in two different but related dimensions: (1) human, and (2) financial.

The steps to access the feasibility of the incorporation may strongly vary from organization to organization (function of the industry type, confidentiality level, trust level, size, and so on) and therefore no standard approach is suggested. Nevertheless, the conduction of a typical SNA to identify the readiness and acceptance degree of an organization is recommendable. Regarding the human dimension, it evaluates the degree of acceptance of a given organization social network on the incorporation of the heuristic risk model into a BI architecture. In this dimension, subjects such as legal, ethical, and personal concerns must be properly addressed, where General Data Protection Regulations (GDPRs) [54] represent the fundamental pillars that an organization must comply with. Regarding the financial dimension, a general cost-benefit analysis must be conducted in order to validate the ROI associated with the incorporation process. Here, strategic tools and techniques such as a SWOT analysis are critical to identify the advantages and disadvantages of both, the incorporation and application of the heuristic risk model. In Table 5 are illustrated some of the major points that organization A addressed to access the feasibility of the implementation of the heuristic project risk model regarding the two mentioned dimensions into organization A's BI architecture.

Table 5. Assessing the feasibility of the incorporation of the heuristic project risk model into organization A's BI.

Human Dimension	Financial Dimension
Are employees willing to participate without a respective counterpart or compensation?	Is there a financial cost-benefit analysis that clearly addresses the return of investment (ROI) in all dimensions that comprise the incorporation process?
Are the data collection methods aligned with GDPR regulations?	Is there an existing BI architecture able to incorporate the heuristic project risk model?
Are the impacts (positive and negative) of conducting an assessment clearly understood by the organization and each one of the participants?	Is there a need to create first a BI architecture to incorporate the heuristic project risk model? Is there a respective cost-benefit analysis?
Are data collection methods (questions addressed to the employees) too invasive?	Do the overall benefits outnumber costs?
Are data collection methods extracting meaningful and actionable insights?	Are benefits being calculated in a short-, middle- or long-time term approach?
Are results of the assessment being used for constructive critical approach meetings?	Does the organization have/need to create a back-up/exiting plan in case of withdraw?
Is there a need to have a specialized network analysist to conduct the whole assessment?	Which will be the platform supplier of the whole incorporation?
Is there the risk of the emergence bias in the assessment process? Is there a strategy to efficiently deal with them?	Which will be the softwares used? Source-free? Cloud services for matrices database-systems? Software as a service (SaaS), platform as a service (PaaS), or infrastructure as a service (IaaS)? Other?

After having conducted the feasibility study regarding the incorporation process of the heuristic project risk model into organization A's BI architecture, organization A concluded that the advantages potentially clearly outnumber the disadvantages and decided to step forward.

4.2. Incorporating the Heuristic Risk Model into a BI Architecture

The incorporation process of the heuristic project risk model into organization A's BI architecture follows all the steps described in chapter 3, Figure 6. In Figure 7 are illustrated the different locations of organization A and the incorporation process of the heuristic project risk model into organization A's BI architecture.

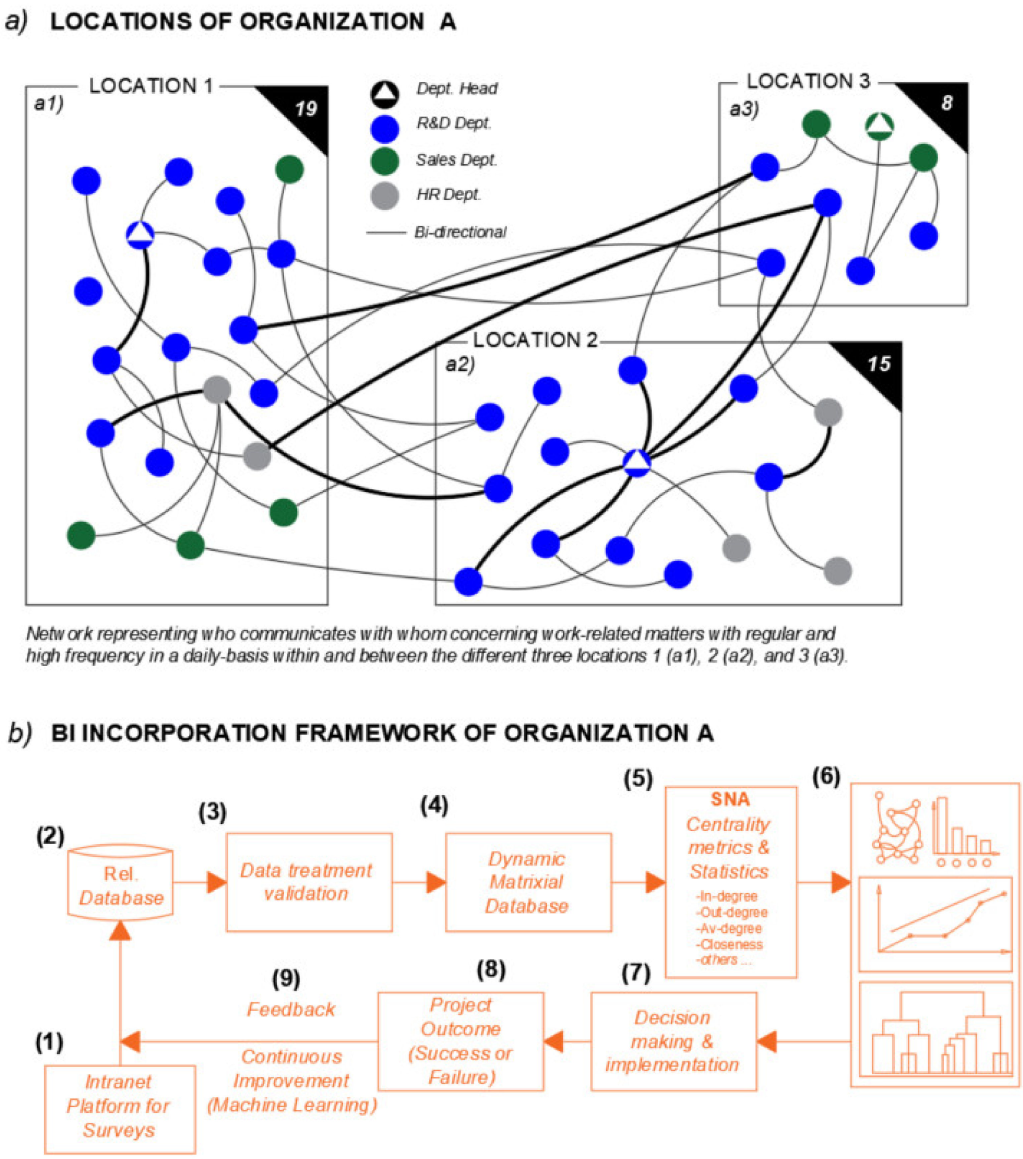

Figure 7. Case Study, organization A's locations (**a**), and respective incorporation process diagram (**b**).

As can be seen in Figure 7a, organization A has three different locations (location 1, 2, and 3) with a different number of employees at each location (19, 15, and 8 respectively). The circles and respective colors represent one employee and the department where it belongs. The results illustrated in Figure 7 illustrate the tone of the four phases organization A used to manage their R&D projects; the development phase, also known as the second phase (phase II) of an R&D project lifecycle. The project had a duration of about one year and a budget of about EUR 0.5 million. This phase was chosen because it is a critical phase in an R&D project once it determines the allocation of the individual energies and efforts of the different R&D department's elements. The links between the different elements of organization A represent the mix of formal and informal relationships that arise from the results obtained from the application of the heuristic risk model. The network illustrated in Figure 7a represents the 'who communicates with whom' network regarding work-rated matters with regular and high frequency in a daily-basis within and between the different geographical three locations of organization A (a1, a2, and a3). For example, in Figure 7a it can be seen that the department's head of location 2 has the highest number of nominations (7 links), where 5 out of 7 are of high frequency (bidirectional high frequency) on a daily basis. In Figure 7b is illustrated the incorporation process of the heuristic project risk model into organization A's BI architecture. To efficiently conduct the incorporation process organization A followed all the steps illustrated in Figure 6. These steps are briefly described in Table 6, where they are adjusted to the organization A's needs and profile:

Table 6. Incorporation process steps of the heuristic risk model into organization A's BI architecture.

Step	Description
1	Organization A defined an intranet platform for the assessment (data introduction point) where the responses to the questions in the surveys addressed to the 42 employees of organization A are saved. Organization A decided only to collect data through the application of project surveys, and therefore used their intranet site where the employees can access to participate in the assessment. At the time of the assessment, each one of the 42 elements received an email in their inboxes with a link that directions them to this intranet site where they then can see the questions and provide the respective answers.
2	Organization A created a dedicated database for the reception of all data that is captured in the surveys (answers to the questions addressed to the 42 elements). The dedicated database also has a dedicated server with redundancy replication to a second server (backup) in the case of any malfunction event. The database was named as relational database, which represents the first deposit where relational data are stored.
3	Collected data are checked for validity by applying a routine that identifies unanswered questions and invalid question's answers. This process takes place as the respondents take the survey in the intranet site of organization A. In other words, the survey cannot be finished (submitted) if the respondent does not comply with all the pre-defined survey rules.
4	A routine places the data collected in the surveys into 2×2 adjacent matrices. For each answered question comprised in the survey, an adjacent 2×2 matrix is generated. An adjacency matrix is defined as a square matrix that is used to represent a finite graph (also known as an organizational social network), where elements (responses of the respondents) of the matrix indicate whether pairs of vertices (people) are adjacent or not in the graph [36]. The responses of the respondents can vary from 0 to 1. For example, a zero (0) value between any two vertices (elements of organization A) represents the inexistence of a connection (preference or nomination). On the other side a $\neq 0$ value between any two vertices represents the existence of a preference or nomination. The preferences or nominations can vary in their intensity and are represented by quantitatively numerical values that are $\neq 0$. There is also the possibility to generate an incidence matrix. An incidence matrix is a logical matrix that shows the relationship between two classes of objects, such as for example people and a given event [36]. These matrices are very important because when data from potential respondents are not available to generate an incidence matrix, an incidence matrix can be deduced.
5	A routine picks the data in the matrixial form and plot the respective networks, where the employees are represented by dots as illustrated in Figure 7a, and the preferences or nominations are represented by quantitatively links representing different intensities. Simultaneously, graph algorithms (SNA centrality metrics, such as in, out, and total-degree, average degree, density, closeness, betweenness and so on) perform a quantitative analysis to the matrices located in the dynamic matrixial database. This results in two different but related analyses: (1) visual, and (2) quantitative. The visual analysis illustrates what is called as a real time picture or sometimes an X-ray view, into the organizational social network. When networks are not too dense (when they do not have too many links and/or entities) such as in the case of the network in Figure 7a, is it possible to outdraw between 85 and 100% of results. In other words, this means that with a visual analysis it is possible to perform a complete analysis of a network without applying quantitative metrics.The quantitative analysis can be seen as a quantitative support of what is observed in the visual analysis (when a visual analysis is possible to obtain a complete understanding of what is going on in the social network) or can be seen as the only possible way to perform a complete analysis of social network when a it is impossible to draw results from a visual analysis (when for example in a social network too many links and/or entities exist).
6	The results are displayed using dashboarding tools. These tools, such as Power BI from Microsoft, ORA CASOS from Carnegie Mellon University in Pennsylvania USA [55], and UCINET from a group of researchers in the SNA field (Lin Freeman, Martin Everett, and Steve Borgatti) [56], just to name a few, illustrate in both a visual and quantitative way the results of the assessment. These traditionally include bar, circular and trend line charts, dendrograms, and graph-networks.

Table 6. *Cont.*

Step	Description
7	The decision-making process takes place with qualitative and quantitative data support output by the previous step. In this step results from the assessment can be included as feed (input data) for the strategical decision-making process tools or techniques such as a SWOT analysis, VRIO analysis, PESTLE analysis, Porter's Five forces, or Cost-benefit analysis, just to name a few.
8	In an ongoing project, results of the assessment regarding the ongoing project are compared with previously identified project critical success factors and analyzed in which direction is the ongoing project heading to (success or failure).
9	The overall process is automatically continuously monitored, providing input to the begining (start) of the analysis circuit, acting as supervised machine learning process. For example, it may include the reformulation of questions to be addressed to employees to extract more efficiently insight regarding a particular subject that was highlighted as critical importance in previous assessments. Steps 7, 8, and 9 are entirely customizable to the function of the objectives and goals of a given organization.

5. Discussion

In the previous section all the steps of the incorporation of the heuristic risk model into an organization A's BI architecture are detailed and described. In this section, we discuss the incorporation process (benefits and limitations) as well as the benefits obtained.

The major objective of the presentation of this case study is to illustrate the required best practices, benefits, and difficulties, regarding the incorporation of the heuristic project risk model into an organizational BI architecture. Though the organization is relatively small, the process of incorporation of the heuristic risk model into a BI architecture was successfully concluded, and fully translated all the average difficulties and benefits that an organization should encounter across the whole incorporation process.

Regarding the benefits and difficulties of the incorporation of the heuristic project risk model into organization's BI architecture, these can be divided in two dimensions: (1) for the employee (employee feedback), and (2) for the whole organization (managers/results feedback).

Regarding (1) employee feedback, the great majority accepted the whole process of the incorporation. The great majority reported advantages in the whole process of automatizing the assessment of the heuristic project risk model, because it enabled them to answer the survey questions in a more comfortable environment than the traditional assessment performed in a room providing answers on a sheet paper, or directly proving answers to their superiors. This enabled them to fell less pressured, which in turn may contribute to bias reduction while providing answers to the surveys. Some employee said still that the incorporation brought another level of collaboration, boosting accountability and empowerment within the organization A's social network.

Regarding the (2) results feedback for the whole organization, the overall efficiency of organization A increased by 12% compared with the previous traditional assessment. However, on the downside, some employees felt that they were being over-monitored by the whole incorporation. Some employees reported that the trust level would never be the same as before because people would be always playing look-a-like, because they knew that they were being constantly monitored and where afraid that the incorporation process results would impact their compensations and career progression.

A major benefit of the incorporation proposed in this work is that it enhances the capabilities of the process of the identification of project critical success factors across the different phases of a given project lifecycle. This means that the process will become faster and more accurate (contrary to a full analytical approach). A faster process means that the speed of the processes of data collection, data cleaning, data transformation, calculations, and results displaying will greatly increase. A more accurate process means that the descriptive, predictive, and prescriptive analytic processes contained in the heuristic project risk model to be incorporated into a business intelligence architecture, is performed with more exactness.

These two factors combined (faster, and more accurate) efficiently enable the generation of more, and more diverse project-related knowledge in a more quantitative data-supported way, enabling thus a more efficient 360° view approach regarding the impact (positive or/and negative) of potential collaborative risks in project outcomes.

The incorporation proposed in this work, if performed in an efficient way, enables the generation of unique and actionable project lessons learned, that due to their ability of being fully quantitatively measured can easily be reproduced, applied, and monitored in upcoming projects, contributing thus to the achievement of sustainable competitive advantages in project's environments.

In today's business landscape, information is one of the most important resources an organization has right after an organization's most valuable assets, their people [57]. This means that when an organization can make decisions based on timely and accurate information, the organization can improve its overall performance. In this line of thought, the incorporation presented in this work enables organizations to make better informed and more data-driven business decisions, which can be the source of competitive advantages. This is true if organizations can extrapolate information from indicators in the external and internal environments and make accurate forecasts regarding future trends or economic conditions.

6. Conclusions

In this work the incorporation of a heuristic project risk model into a typical organizational business intelligence architecture is proposed and described. The proposed incorporation aims for the timely and efficient identification of project collaborative risks and was developed by combining two critical project areas (1) project risk management, and (2) social network analysis. The objective of the incorporation presented in this work is essentially to enhance the potential of the process of identification of project critical success factors, which is enabled by the application of the heuristic project risk model in projects environments.

In academical terms, the proposed incorporation in this work addresses some important fields of research, such as innovation, sustainability, project risk management, and social network analysis. Regarding the innovation perspective, the proposed incorporation in this work can be seen as an innovation model to be explored by organizations as they engage in collaborative initiatives. This fact is aligned with the latest research that argues that a more hands-on approach (more control from managers over their team's activities and interactions) in collaborative initiatives drives better results than a more hands-off approach management style [15]. The proposed incorporation in this work contributes to the identification in a quantitatively way of how much diversity and inclusion really counts for successful organizational outcomes as it is proposed by some authors [13,14,54], and how best it should be managed.

In a project risk management perspective, the proposed incorporation in this work contributes with a unique insight into the dynamic relationships between project people across the different phases of a project lifecycle, regarding some of the actual identified most common risks that may occur as projects are being undertaken, as proposed by [25,26].

Through the application of a social network analysis and centrality metrics in an automated perspective (product of the incorporation of the heuristic project risk model in the BI architecture) based on graph theory, the proposed incorporation in this work contributes to the development of existing and new social networks analysis centrality metrics as a critical tool in the identification of project critical success factors regarding the dynamic interaction of project people across the different phases of a project lifecycle as proposed by [9,35–37,57].

In a managerial perspective the proposed incorporation in this work aims to improve organizational processes and procedures by unlocking the power of the identification of project critical success factors, making organizations leaner and more agile, contributing to the achievement of sustainable competitive advantages. As direct consequence of the application of the heuristic project risk model in a project management environment, the proposed incorporation enables organizations to identify and refine in an automated way project critical success factor across the different phases of a project lifecycle. Identifying project critical success factors is considered the heart of the engine (incorporation of the heuristic project risk model into a BI architecture) that aims to help organizations achieve sustainable competitive advantages [1,9].

Finally, the proposed incorporation in this work provides organizations a set of competitive advantages that are essential, translated by the optimal management of organizational resources, thus becoming more resource-management sustainable promoting alignment with the 17 UN Global Goals [29] and the three major components of sustainability, people, planet, and profit. This fact provides organization employees and their customers a higher sense of awareness regarding a sustainability mind-set, which is translated into more profit for organizations. In fact, research shows that more than 50% of consumers are willing to pay 5% more for products delivered sustainably, and 76% would wait one extra day for delivery [27]. Furthermore, according to research organizations that engage in sustainable initiatives experience at about 20% of increase revenue, 16% cost reduction, and 30% increased brand value [28].

As for future research, and because the information survey-based collecting process is strongly conditioned by the good will of the participants (which contains a certain amount of bias), it is suggested that further research should be undertaken in order to develop new ways of collecting project information related data, that can minimize or eliminate bias. This aspect is particularly important because according to the latest research, the unique and powerful insight that social network research provides to the study of social structures and the respective scientific knowledge generated, is to a certain extent challenged or even threatened by suspicious ethics committees [57]. This happens, because such committees consider that the three main principles of biomedical research are not fully met when an automated SNA assessment is undertaken in an organization, (1) consent, (2) the possibility to opt out, and (3) anonymity [58,59]. Furthermore, the data collection process is still aggravated by the recent growing on personal data protection, including for example the appointment of new supervision agents, such as Data Protection Officers (DPOs) in organizations that restrict access to critical relational data to the effective application of SNA in organizations [58–60]. Still, due to the fear of the increasing cyberattacks, participants become, to a certain extent, reluctant to provide personal information, due the apparent fragility that digital platforms are seen to have, regarding protection against those cyberattacks. Such challenges have direct implications on the data colleting process when applying the heuristic risk model, which are amongst the major barriers to efficient functioning of the incorporation proposed in this work. Here, further investigation should be carried out in order to minimize potential damages in case of breaches and leaks originated by cyberattacks, and law infractions in data collection methods.

Because the application described in this work addresses a relatively small organization, it is also suggested to implement the incorporation in more (larger and small) organizations in order to address the model behaviors regarding the identification of project critical success factors. By doing so, it is possible to improve the applicability and feasibility of the model and the overall incorporation in different environments/scenarios.

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