sustainability

Article

Knowledge as an Organizational Asset for Managing Complex Projects: The Case of Naval Platforms

Alberto Cerezo-Narváez [1,*], Andrés Pastor-Fernández [1], Manuel Otero-Mateo [1], Pablo Ballesteros-Pérez [1] and Francisco Rodríguez-Pecci [2]

[1] School of Engineering, University of Cadiz, 11519 Puerto Real, Spain; andres.pastor@uca.es (A.P.-F.); manuel.otero@uca.es (M.O.-M.); pablo.ballesteros@uca.es (P.B.-P.)
[2] Navantia SME, 11100 San Fernando, Spain; frodriguezp@navantia.es
* Correspondence: alberto.cerezo@uca.es; Tel.: +34-956-483-211

Abstract: Knowledge management (KM) involves learning from past experiences to avoid or correct scope misalignments, quality deviations, safety problems, time delays and/or cost overruns. KM is frequently materialized as a risk management (RM) plan. An RM plan allows for anticipating, avoiding, mitigating, or reducing potential problems impacting project performance. However, despite their high complementarity, KM and RM are not the same, nor share the same purpose. In the advent of the fourth industrial revolution, managing complex projects involves many KM-related challenges, such as differential competitiveness enhancement and value chain streamlining. Naval platforms are complex projects that require the integration of multiple sources of knowledge and information. They also need to keep on integrating latest digital technology innovations in their production processes. In this context, streamlining the requirements management may become a differential asset for project stakeholders of naval platforms. Namely, enhancing requirements management can make the customers' needs easier to meet, shorten the projects duration, reduce costs, optimize resources, and allow for higher flexibility. However, requirements management has KM as pre-requisite and RM as consequence. Unfortunately, potential synergies between KM and RM have remained largely unexplored in the project management literature, and so has requirements management as a potential bridge between both concepts. In this paper, a holistic model for shipbuilding organizations linking KM and RM is proposed. The model draws from existing KM and RM models while considering organizational factors, technological platforms, and competitiveness factors. A case study of a naval platform showing the model's applicability is provided. It is shown how the model can allow shipbuilding companies to sustain a competitive advantage by facilitating more robust decision making in dynamic project environments. Furthermore, the model also facilitates the identification of the companies' core competences to reach and keep a strong position in current global markets.

Keywords: knowledge management; risk management; intangible asset; competitive advantage; complex projects; project management; configuration management

Citation: Cerezo-Narváez, A.; Pastor-Fernández, A.; Otero-Mateo, M.; Ballesteros-Pérez, P.; Rodríguez-Pecci, F. Knowledge as an Organizational Asset for Managing Complex Projects: The Case of Naval Platforms. *Sustainability* **2021**, *13*, 885. https://doi.org/10.3390/su13020885

Received: 27 October 2020
Accepted: 14 January 2021
Published: 17 January 2021

1. Introduction

Public and private organizations operate in a dynamic environment where risks are varied regarding both their nature and impact [1]. Hence, project failure rates can be reduced when risks are mitigated or properly managed [2]. However, most research on risk management (RM) has focused on addressing threats rather than taking advantage of potential opportunities. Similarly, organizations tend to associate risks with financial aspects, mostly in terms of cost and investment decision making. As a result, non-economic risk factors are frequently neglected, especially in complex projects [3].

Complex projects refer to those projects that involve significant ambiguity and/or uncertainty [4]. Risks are uncertain events or conditions that may have a positive or negative effect on project objectives [5,6]. Hence, risks arise mostly due to the presence of uncertainty and are more likely in complex projects. Paradoxically though, this uncertainty can stem both from the lack or excess of information [7]. While traditionally the lack of information had been the default scenario, businesses nowadays have access to an increasing amount of information (both external and internal to the company). In addition, as project complexity increases, there is a pressing need to put every piece of actionable information to use. This is the only way of making optimal decisions and constitutes the very goal of knowledge management (KM) [8].

KM is then a critical aspect of both organizational and projects success [9,10]. Knowledge is indeed an essential asset for organizations that operate in uncertain environments [11]. In the specific case of project-based organizations, knowledge mostly depends on data retrieval and information interpretation. However, the organization's culture, as well as the ethical values and experience of decision makers, also affects how information is processed [12]. Analogously, knowledge transfer forms the basis of preliminary estimates when undertaking projects. However, they will also become the baseline for subsequent estimates against which future activities and processes will be compared [13].

For these reasons, KM and RM are not isolated compartments. On the contrary, a significant overlap exists between KM and RM in organizations, especially when managing complex projects [14]. However, taking advantage of the shared aims of KM and RM does not happen naturally. It takes some organizational alignment and actions that will be described in this paper.

Hence, this research proposes a holistic KM model for managing complex projects that can be applied in dynamic environments that also require RM. The model is summarized in Figure 1 and draws from several KM- and RM-based models in project management (PM). A case study in the shipbuilding sector will also be introduced to show the model applicability. It is anticipated that the model will be applicable to organizations aiming to integrate KM and RM in complex PM settings when trying to implement sustainable business practices.

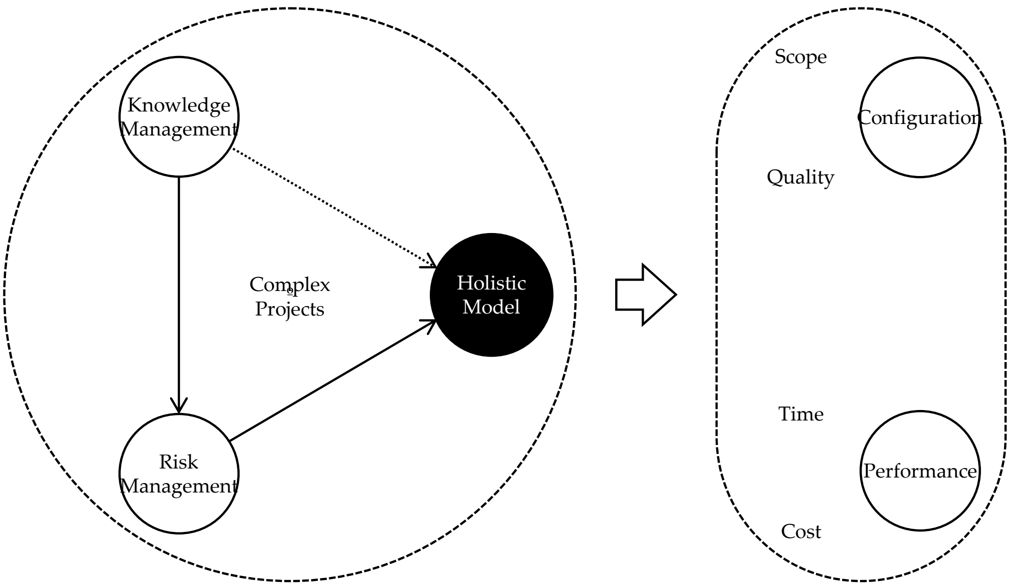

Figure 1. Model dimensions and performance variables.

The rest of the paper is structured as follows. Section 2 presents the research problem and outlines the research gap. Section 3 presents a literature review of KM models. This section also investigates the context in which organizations undertake complex projects and how they must integrate KM, RM and PM. Section 4 presents the research methodology. Section 5 describes the organizational structure of the shipbuilding company implementing the proposed model. Section 6 presents the model elements and implementation results. Finally, Section 7 summarizes the major conclusions, limitations, and research continuations.

2. Research Problem

Knowledge has become a production factor itself, equivalent to land in the pre-industrial agrarian period, or to capital in the 19th and 20th century industrial economies [15]. Organizations, despite still being commonly divided into functional departments, have moved from hierarchical (vertical) structures to a set of horizontal (coordinated) sections that feed each other with information and apply specialized knowledge. This organic structure allows them to adapt to the rapid changes society demands while developing sustainable practices [16]. Information is considered a key element for decision making, as it allows reducing or minimizing the uncertainty inherent to any project environment [17].

KM exploits and develops the knowledge assets that organizations possess so that they can accomplish their goals [18]. However, sometimes it is difficult to anticipate the occurrence of some high-impact risks [19]. This kind of uncertainty usually occurs when there is a lack of information regarding the possible outcomes of an action [20,21]. That is, there is uncertainty regarding what can happen, with which probability and/or with which impact [22]. In these cases, knowledge can be a differential factor for taking the right course of action (or the wrong one).

Managing complex projects is of great interest for organizations who want to align their strategy and competitive advantage to survive in a changing environment. Some researchers quote that "complex projects are dynamic systems that run on the edge of chaos" [23]. For this reason, RM greatly conditions the project outcomes [24]. With adequate knowledge, risks can be identified, evaluated, and controlled. Therefore, KM also becomes a crucial tool for organizations to allow them to anticipate potentially adverse situations [25].

Indeed, organizations operate in a "network" of risks. These risks are highly varied from human errors to natural disasters, and from unstable environments to financial crises [26,27]. All these risks can lead to project failure. That is why effective and efficient RM requires a systematic methodology that is based on knowledge and previous experiences [28].

A case study from the naval defense industry is analyzed here for its representativeness. National defense organizations are particularly complex (because of their size, the variety of projects they undertake, as well as the potentially national-level safety implications of mishandled risks, among others). Naval organizations are also highly specialized, professionally train all its employees, have high level objectives, and, at the same time, they usually document most of their procedures and work processes. The public sector of the naval defense industry is also in a constant need of updating its strategic plans and information systems to carry out complex projects. This is so, not just because of the number of people involved in these projects, but also because of the uncertain contexts and risks under which these projects are developed. Efficiency, accountability, and transparency are other essential requirements, as a large amount of public resources are usually involved in defense projects [29]. In this context, KM is a must, and so is RM. Indeed, these are possibly the most important intangible assets of this type of organizations [30].

If the organizations and companies involved in the naval defense industry do not engage in a process of continuous innovation, they may become quickly outdated and compromise their ability to carry out their fundamental mission (protect their country) [31]. However, due to the large amount of data generated in these projects, it is necessary to identify, define and develop tools and procedures that handle this information [32]. However, these organizations are usually complex, large and boast hierarchical structures that make it difficult to implement a single KM structure [33]. That is why the KM model proposed in this paper is intended to help these organizations to optimize their processes and reduce resource wastage while taking advantage of the capacity and potential of their highly specialized technical and human resources.

3. Literature Review

Both private and public organizations are showing interest in KM to increase their innovation capacity and to create competitive advantages [34,35]. This growing interest has led to the generation of different KM models. A KM model is a tool that enables representing in a simplified manner how information and knowledge is handled within an organization. It also allows one to describe (and redefine if necessary) the organization structures and the processes that convey different types of information. Finally, it also describes how the information can be transformed from data to knowledge [36]. A KM is at the service of a company and, if successfully implemented, it will allow organizational growth [37]. Table 1 presents a brief review of the main KM models (e.g., [38–43]). The major features of each model are described in the rightmost column.

Table 1. Knowledge management (KM) models.

Reference	**Storage, Access, and Transfer Models**
Wiig	Building and Using Knowledge (Building, Holding, Pooling, and Applying)
[44]	Completeness, Connectedness, Congruency, and Perspective Dimensions
Nonaka and Takeuchi	Knowledge Creation: Socialization, Externalization, Combination, and Internalization
[45]	Tacit–Explicit Interaction (Epistemological–Ontological Content)
Bustelo and Amarilla	Management: Documentation, Information and Human Resources
[46]	Monitoring: Intangibles Assets
Reference	**Socio-Cultural Models**
KPMG Consulting	Focused on: Learning
[47]	Based on: Systemic-Organizational Approach
Skandia Navigator	Interaction: Human-Intellectual Capital
[48]	Permanent Value: Continuous Renewal, Innovation and Transformation
APQC (KMAT)	Individuals: Share and Explain
[49]	Organization: Capture, Analyze, Synthesize, Apply, Assess, and Distribute
Arthur Andersen	Pillars:
[50]	Information, Environment, People, and Technology
IADE (Intellectus)	Human, Structural, and Relational Capital
[51]	Interaction: Components, Elements, Variables, and Indicators
Galbraith Consulting	Elements: Strategy, Structure, Processes, Incentives, and Human Resources
[52]	Behavior: Performance and Culture
Reference	**Technological Models**
BSC	Purpose: Viability and Durability of the Business over Time
[53]	Perspectives: Finance, Business Processes, Learning and Growth, and Clients
IAM	Categories: Staff Competences, Internal Structure, and External Structure
[54]	Indicators: Growth–Innovation, Efficiency, and Stability
PTCC	Strategy for Assimilation, Utilization and Transfer
[55]	Management Process, ICT, Intellectual Capital, and Organizational Culture
Technological	Layers:
[56]	Acquisition, Refining, Storage, Recovery, Distribution, and Presentation
Reference	**Holistic Models**
Dynamic-Rotational	Actions: Acquire, Socialize, Structure, Integrate, Value, and Detect (Opportunities)
[57]	Recursiveness: People Knowledge, Processes–Systems, and Market Technology
Organizational	System of Relationships and Connections
[58]	Flows of Knowledge in Interaction Directions
Generational	1st Generation: Integration (Distribution, Dissemination and Use)
[59]	2nd Generation: Production (Supply, Demand)
Integrated-Situational	Architecture: Collaborative Communities, Culture, Memory, and Networks
[60]	Processes: Acquisition, Storage, Transformation, Distribution, and Use
Holistic	Comprehensive, Dynamic, Complex, Integral, and Inexhaustible Vision
[61]	Processes: Socialization, Creation, Adaptation, Dissemination, and Application

From Table 1, it is straightforward to appreciate the four major groups in which current KM models can be classified:

- Storage, access, and transfer models focus on the development of methods, strategies, and techniques for storing the organizational information in accessible repositories that facilitate subsequent knowledge transfer.
- Socio-cultural models focus on the development of an organizational culture that allows the improvement of knowledge management processes. Hence, they are aimed at promoting changes in attitudes, building trust, stimulating creativity, and raise awareness of the importance of knowledge. They also promote communication and collaboration.
- *Technological models* focus on the development and use of systems (as data warehousing, intranets, expert systems, and web information systems, among others) and technological tools that facilitate decision-making.
- Holistic models which consider the integration of human (staff), organizational and technological approaches, as well as learning processes that capture and transfer knowledge to daily company operations.

In this paper, holistic models are focused on as they are the only ones capable of dealing with all aspects of complex PM. This type of model is intended to support the company with achieving its organizational objectives and a higher level of competitiveness.

A holistic KM model is a relational model that frames the KM cycle by the integration of three elements [62]: human (accumulating the knowledge and experience they put into practice through their activities); technological (not only contributing to its productive process, but also facilitating the means for sharing); organizational (allowing the standardization of actions aimed at building organizational learning). However, this integral vision considers the specific context and characteristics of each organization in the knowledge-related processes [63]. This implies creating proper conditions that facilitate and encourage workers to take part in the knowledge retrieval and transfer processes. Additionally, this tacit knowledge (which is specific to people) must be combined with the organizational explicit knowledge (processes, technology, culture, values, vision, mission, objectives) [64] to represent the company's know-how [65].

Holistic KM models promote a competitive development through sectorial analysis. It also promotes the establishment of stakeholder networks and innovation processes in organizations [66,67]. Yet, holistic models give room for adopting new approaches that can be identified and proposed by all members of an organization [68]. These models can also link the company's cultural and technological components, align the organization's activities with the company's strategy, and integrate key performance components (as processes, metrics, objectives, ICT, etc.) in a systematic way [69]. These are interesting features due to their wide spectrum applicability [70], including PM environments [71].

The generation of knowledge building processes can be used to analyze and influence risk scenarios too [72]. These contexts can take advantage of local knowledge (perceptions, historical memories, etc.), expert knowledge (scientific and technical knowledge), and emergent knowledge (collective, creative relationships, etc.). In fact, in order to design RM strategies that respond to particular project factors and company dynamics, the contribution of local and emergent knowledge is enriched with technical and scientific knowledge. This truly becomes an interdisciplinary approach after its successful integration. However, this aspect has not yet been addressed by current KM models.

Actions and responses included in the RM plan describe how RM processes will be performed and integrated with other PM activities [73]. This allows the project manager to identify, evaluate, record, respond, control and review risks in a compatible manner with project technical requirements [74]. In addition, these processes are based on the same three pillars of the holistic KM models: people, technology and organization [75]. This enables the introduction of the project context, methods, roles, as well as the level of risk tolerance. However, the successful integration and implementation of the KM, RM and PM processes depend on:

- Value recognition: KM feeds RM, and RM minimizes negative impacts and prevents unforeseen occurrences in PM settings.

- Individual commitment: KM and RM are the responsibility of all members of the organization.
- Open and honest communication: attitudes and actions that interfere in the communication among stakeholders precludes KM, reduces RM effectiveness, and eventually impacts PM performance.
- Organizational commitment: RM and PM must be aligned with the organizational values, culture, and be actively supported by all areas of the organization.
- Proportional effort: KM, RM and PM must be consistent with the value that a project delivers to the organization, especially in terms of dedication (time) and costs (money).

All these aspects will be included in the proposed model in order to bridge the gap between KM and PM in complex projects. For such a purpose, we will introduce a case study in the next section.

4. Research Methodology

This research resorts to three case studies from a single shipbuilding company. The programs (groups of projects) selected, despite being at different stages of the KM- and RM-based model implementation, share the following characteristics:

- Sector (Defense industry);
- Client (Spanish Navy);
- Location (San Fernando shipyard in Spain);
- Management team (the same projects staff team);
- Supply chain (suppliers and subcontractors).

Case studies are a common research method frequently used by qualitative and quantitative researchers [76]. Case studies are particularly insightful when they address complex research objects (a holistic KM model in this case) in their real scenarios (complex shipbuilding projects) [77], especially when object and context are difficult to separate [78]. Additionally, the capability of case studies as a research methodology to build or refine theories in explanatory studies is of particular interest in the area of business organization [79,80]. In the uncertain and dynamic scenarios in which contemporary organizations operate, case studies are also appropriate for understanding the complex phenomena affecting organizations. Finally, case studies can also include the points of view of many agents involved [81].

According to the type of questions addressed, there are four main types of case studies: descriptive, exploratory, illustrative and explanatory [82]. Descriptive studies analyze how a phenomenon occurs within a context. Exploratory studies seek to examine a situation in which there is no well-defined theoretical framework. Illustrative studies show outstanding practices of organizations. Explanatory studies describe how and why a phenomenon occurs. The case studies used in this research can be classified as descriptive-explanatory, and to a lesser extent, illustrative. This is because they will propose a theoretical (holistic) model anchored in a real context (complex PM) and we will observe how the organization performs better after its implementation. Particularly, the organizational context is described later, as well as the strategic vision and management model of the shipbuilding company.

However, to favor the triangulation of evidence, this research combines a series of data collection and analysis techniques. Namely, the following stages were followed in the field work:

- Collection and analysis of the organization's available documents and information.
- Analysis of previous results and data correction.
- Elaboration of a preliminary KM theoretical model based on the needs and shortcomings detected in the document analysis of previous and ongoing company's projects.
- Triangulation of available sources of evidence.
- Refinement and proposal of the final KM theoretical model.

In this work, the three cases (which are complex projects in risky contexts as described in the following section) are selected for their potential to integrate the KM, RM and PM concepts described earlier. This also facilitates the theoretical model validation. Namely:

- For internal validation, a triangulation of the sources of evidence is carried out by means of confronting the participants' opinions with the results obtained in the research. These pieces of evidence were obtained with a comprehensive 360° review of the case studies, including the opinions of suppliers, providers, users, and the shipbuilding company's relevant departments. However, as there were conflicting interests among the projects' stakeholders, negotiation in project monitoring meetings was frequently necessary. In these meetings, the work packages and project activities progress and risk data were also objectively evaluated.
- For external validation, considering that the sector, organization, client, staff, and supply chain were the same in all case studies, three shipbuilding projects in the defense sector were selected. They allow comparisons to be made and conclusions to be drawn on the relevance of the issues raised in the proposals.

As for information collection, archives, contract documents, planning chars, progress reports, risk lists, risk analysis, corrective actions and procedure manuals were analyzed from all projects. Due to the type of sensitive information handled by the authors (as much data concern national and/or international security), only publicly available data are explicitly commented on in the paper. Other sources of complementary information were publications from the websites of the Spanish Ministry of Defense, the Spanish Navy and the Spanish Institute for Strategic Studies (IEEE). Figure 2 summarizes the complete research process of building the holistic KM model described in this section.

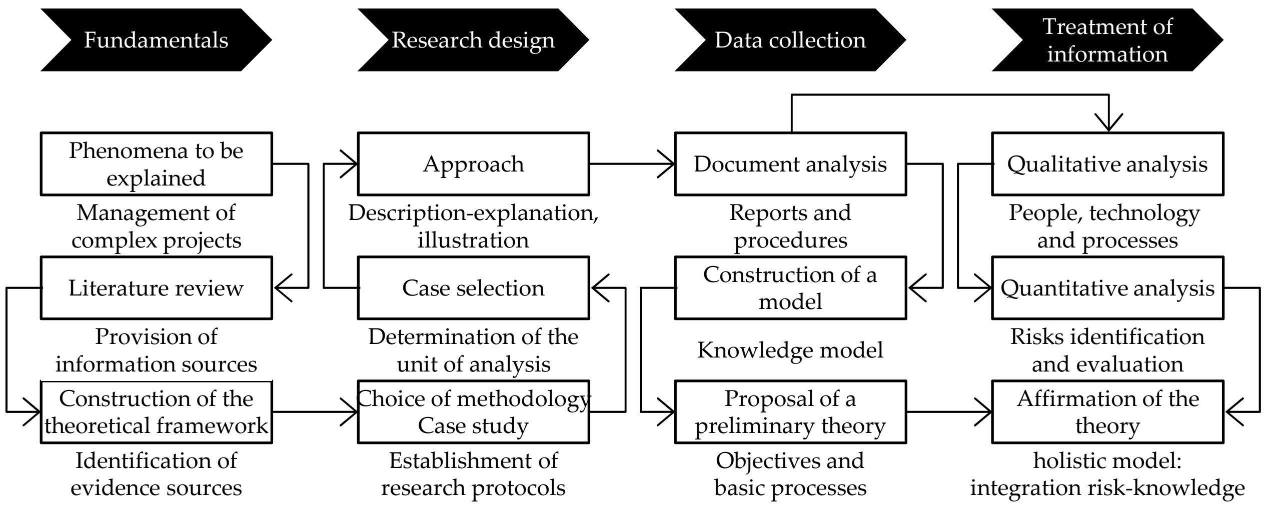

Figure 2. Research context by stage.

5. Case Study

5.1. Projects

Three programs are considered to study the implementation of the KM- and RM-based model. These case studies were carried out for the Spanish Navy at the San Fernando's shipyard. The number and variety of stakeholders, contractual conditions, high specialization and demanding product specifications contributed to their complex nature.

Case study 1 is the Cantabria A-15 combat supply ship [83]. The construction of this supply ship began in 2005 and was commissioned in 2010. This was the second of the two logistic supply ships of the Spanish Navy whose function was to provide other ships with fuel, provisions, ammunition, and spare parts. In addition, this combat supply ship is prepared to support a landing force, and to provide logistic support in non-military operations, such as environmental fight or humanitarian aid actions. Case study 2 is twelve landing mechanized crafts [84], whose mission was to deploy a landing force on a beach from other amphibian ships as quickly as. Their construction began in 2011 and their service lives began between 2014 and 2015. Case study 3 is two maritime action vessels named "Audaz" and "Feroz" [85]. They are patrol ships whose construction started in 2014 and was completed in 2018. These vessels were built as part of a modernization process of the Spanish Navy. This client needed more versatile platforms that allowed a more flexible use of resources, and a reduction in the ship's life cycle cost [86]. In Table 2, a series of indicators describing each case study are presented. They have been selected for their relevance and representativity in the shipbuilding sector.

Table 2. Case study indicators.

Indicators	Case 1	Case 2	Case 3
Number of Units (projects)	1 U	12 U	2 U
Tons of steel (per unit)	5500 Ton	45 Ton	825 Ton
Tons of steel (total)	5500 Ton	540 Ton	1650 Ton
Hours of production (per unit)	1,750,000 h	35,785 h	915,000 h
Hours of production (total)	1,750,000 h	429,420 h	1,830,000 h
Hours of engineering (per unit)	470,000 h	97,450 h	45,000 h
Hours of engineering (total)	470,000 h	97,450 h	45,000 h
Production lead time (per unit)	32 months	2 months	22 months
Production lead time (total)	32 months	24 months	40 months
Time from design to delivery (of the last unit)	48 months	30 months	52 months

Each unit is treated as an individual project. Each group of relatively homogeneous projects as a program. In this study, each case study corresponds to a program.

5.2. Company

Navantia is a Spanish state-owned shipbuilding company. With over 5500 employees, it is the top Spanish company on military naval technology. Navantia manufactures 24% of military shipbuilding-related exports in Europe and 13% of the world exports. Navantia is becoming a world-renowned company in the design, construction and integration of high technology military warships (frigates, aircraft carriers, amphibians, submarines and patrol vessels, among others), but also for civilian naval platforms (logistic ships and wind power parks, among others) [87].

Navantia is involved in the design, engineering, manufacture, and project management of products (platform systems, fire control systems, command and control systems, and propellers) and services (lifecycle support, repairs, maintenance, modernization, training, and simulation) of naval platforms and ships [88]. The company also owns one of the very few shipyards with full capacity for the design and production of fully operational ships, as well as for integrated logistic platforms support, propulsion and naval combat systems. It currently has shipbuilding facilities in Spain and Australia. It also has subsidiaries in Brazil, India, Norway, Saudi Arabia, Turkey, and the USA.

Since 2005, Navantia and the Spanish Navy have been working together on ship design and shipbuilding projects of almost any kind. However, until 2015, Navantia was mostly a hierarchical (vertical) organization in which heads of functional departments were part of the project team and assigned tasks to their own staff on a regular basis. By then, only a few people were allocated full time to a single project. A description of Navantia's functional departments of that time is described in Figure 3.

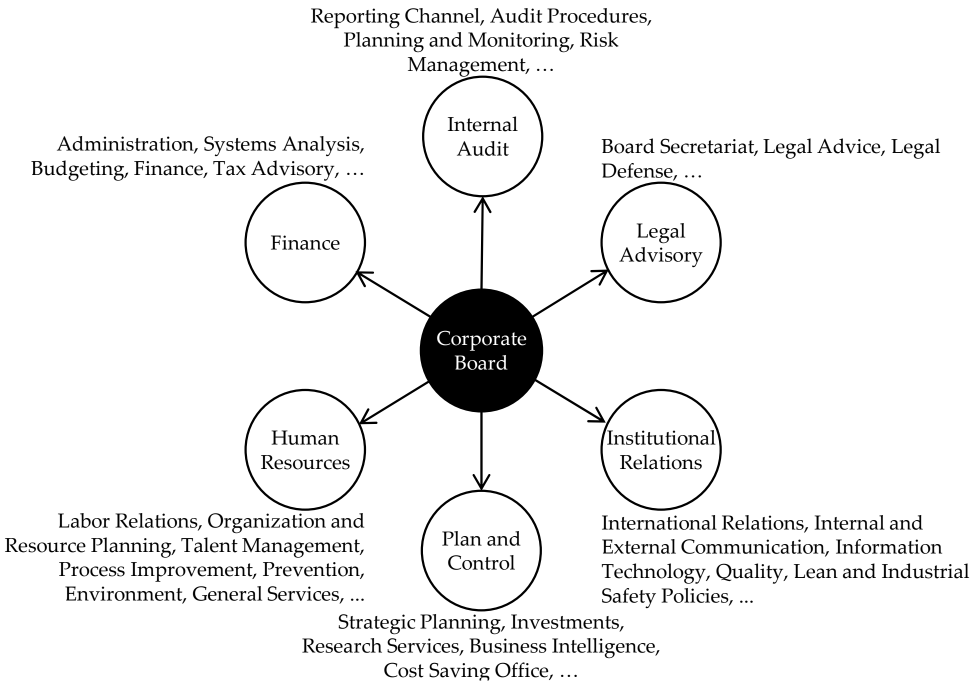

Figure 3. Functional departments in Navantia.

Additionally, Navantia also had a series of operational departments whose units were more directly involved in the shipbuilding production processes. Figure 4 provides a description of Navantia's major operational departments. It is plain to see in Figures 3 and 4 that, by 2015, there was not any reference to KM.

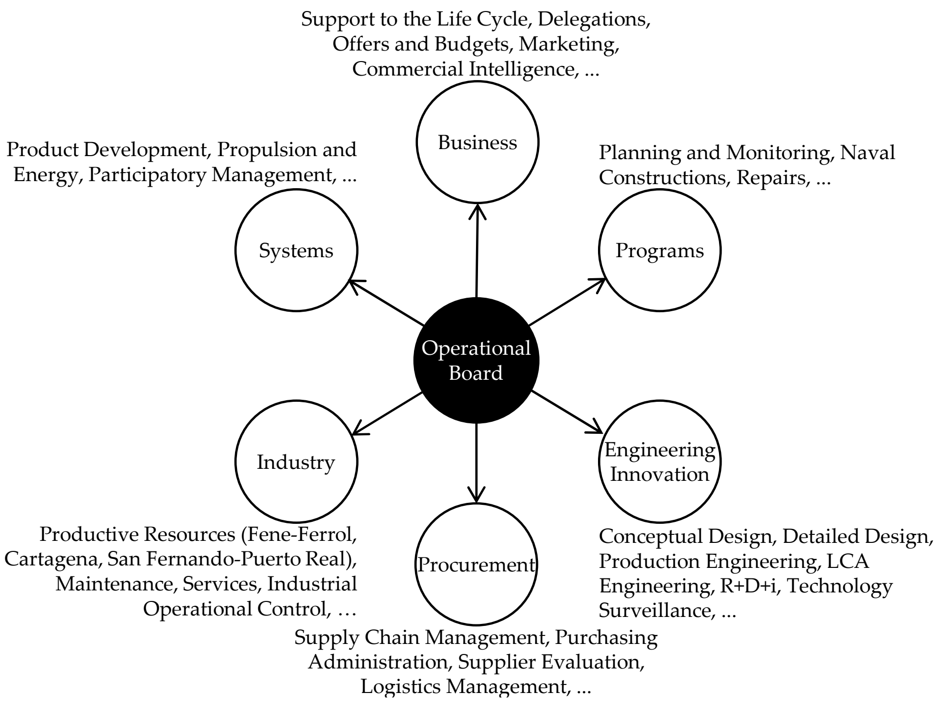

Figure 4. Operational departments in Navantia.

However, from 2015 onwards, Navantia was immersed in a major transformation spanning all areas of the organization. This transformation was aimed at increasing Navantia's business and production processes sustainability [89]. Since then, Navantia has been involved in increasingly complex and larger projects involving all engineering specialties [90].

The challenges of Navantia's transformation involved not just the implementation of innovative solutions, but also deep changes in all organization's areas and processes. Among other changes, the transformations tried to create a more agile organization that favored an interactive management culture, and that rewarded employees' talent [91]. The implementation of a KM model would also serve as a guiding thread for enhancing its value chain and improving productivity. The plan was to design tailored and highly-specialized products while keeping a tight cost and delivery times control [92].

The transformation process in which Navantia is still immersed has also radically changed the way it manages complex projects. Navantia started by complying with NATO's AQAP 2110 standard [93]. This standard proposes a model that focuses on configuration management (CM). CM ensures product integrity and consistency regarding some pre-specified design and information requirements throughout a ship life cycle [94]. More precisely, AQAP 2110 model adoption by Navantia meant that it started to ask all its defense-related product and service suppliers to at least state and document their technical and management processes [95]. In addition, AQAP 2110 CM model supported the Navantia's processes of service management, mainly during the operational shipbuilding production stages [96]. The CM model adopted by Navantia presented in Figure 5, provided, among others, the following benefits and helped alleviating project stakeholders tensions [95,97–99]:

- It ensured project documents integrity and consistency;
- Minimized the risk of project failure;
- Allowed tracing project components, reducing confusion and increasing productivity;
- Minimized project rework in design and development phases;
- Increased confidence in the delivered product;
- Allowed drafting as-built plans, drawing, and documents;
- Allowed product performance reviews and perform routine maintenance operations.

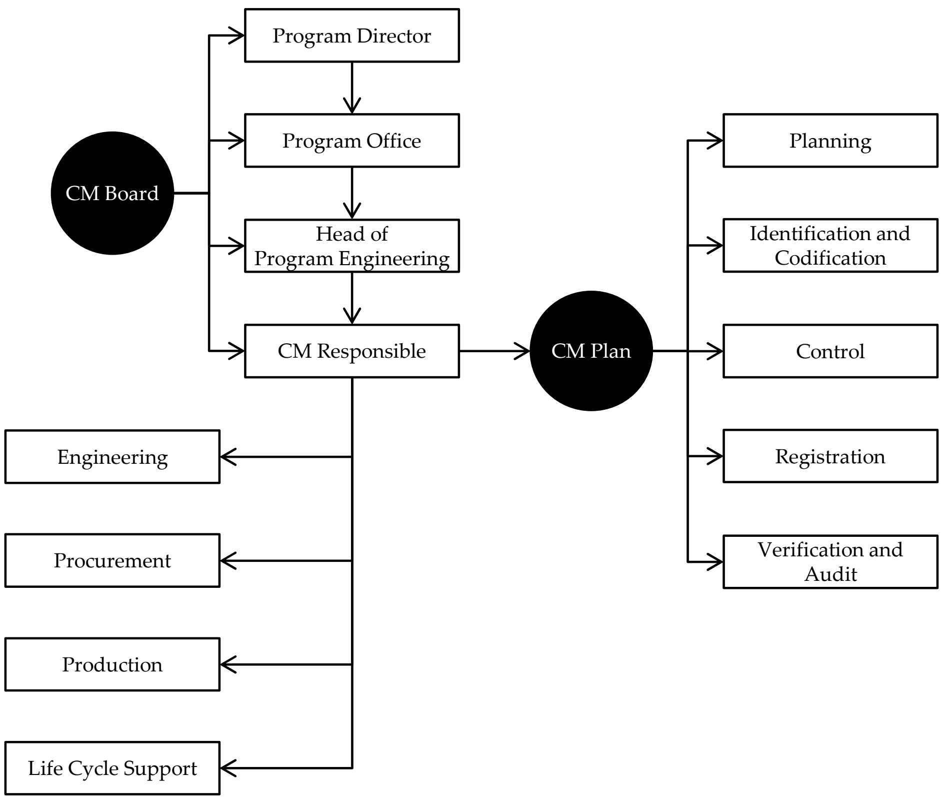

Figure 5. Navantia's configuration management (CM) model.

Naval constructions generally produce very short manufacturing series. There are usually no prototypes, and the shipbuilding process usually has extensive design and development periods overlap. This is generally because of the great number of systems to be integrated, in which standardized and customized solutions coexist, and whose suppliers come from different contexts. In addition, shipbuilding companies have continued presence on the whole project life cycle (LC). This includes not just the design and construction, but also maintenance, logistics and the as-built documentation draw-up. These operations are performed under very tight contract requirements [95]. In this context, the CM model consolidated a change management culture, optimizing software interfaces from which complex projects are still nowadays highly dependent. This model also improved the integration of purchasing, engineering, production, and LC support [97].

Navantia has also been equipped since 2011 with a corporate tool for RM. This RM tool includes all civil and military programs from the commercial stage to the end of the guarantee period. Broadly speaking, at the beginning of each project, an RM plan is prepared by Navantia to be accepted by the interested parties. These parties are briefed in detail about the potential risks the project they are paying for may encounter. Navantia is capable of producing this risk list because they have already been documenting previous experiences in similar projects. Then, clients agree with Navantia on the actions to be taken in case those risks arise. These processes are also aligned with the holistic KM model. Hence, the model oversees the total set of factors that may impact project performance, adapts to its level of complexity and facilitates interactions with all project stakeholders. Many of these capabilities are not possible in other projects when managed in a compartmented way.

Navantia's RM model is summarized in Figure 6. First, the model relates the processes of learning, knowledge capture and transfer with daily activities. This is achieved by clearly defining the roles and responsibilities of the staff involved. Second, the model associates the technological resources with project planning activities. This technological infrastructure is a powerful facilitator. It does not just contribute to Navantia's productive processes, but also is the mean for sharing knowledge and experience. Third, the model links the organizational processes with the risk analysis, standardizing actions aimed at building organizational learning, as well as reviewing, refining, and making available the projects knowledge.

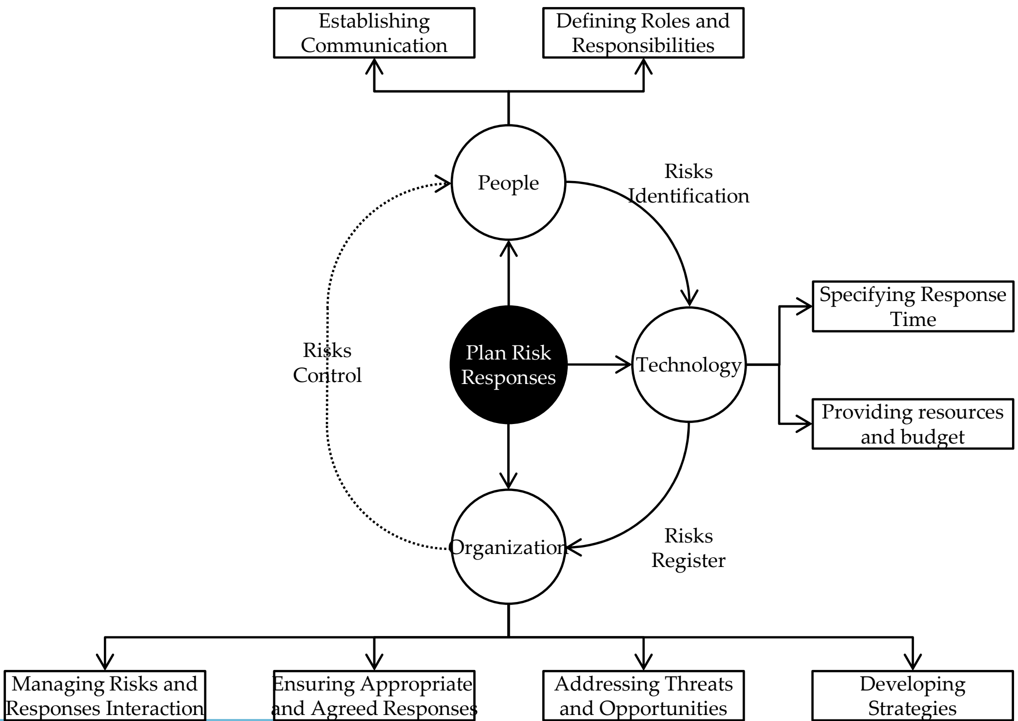

Figure 6. Navantia's risk management (RM) model.

Namely, phase 1 includes the communication processes and the roles and responsibilities definition. There are two major actors in this phase: the project manager and the risk managers, although other stakeholders are also listed. The project manager will assume full responsibility for the project RM. He/she will also ensure that all risks are identified, understood and managed in a satisfactory manner. The project manager will also ensure that all project personnel are aware of their responsibility to report current or future risks without delay. The project manager will also make sure that subcontractor's RM is appropriate according to the tasks they perform. The project manager will also chair periodic risk review meetings, ensuring that assigned actions are completed as planned.

In turn, the risk managers will collaborate with the project manager in the risk control process. They will be responsible for monitoring RM activities with the rest of project areas. They will also act on behalf of the project manager in the execution of the activities included in Table 3. Additionally, department and area managers will ensure that their staff are familiar with the potential project risks and the procedures to be followed in case some risks arise. They will also see into it that all subcontractors are provided with the necessary risk information and manage them appropriately. Finally, the project manager's team must be familiar with the procedures of the RM plan and provide advice especially to department and area managers on any impending or materialized risks. Particularly, they will provide guidance on monitoring and risk assessment and help adopting the pre-agreed risk contingency plans.

Table 3. Activities deployed by risk managers on behalf of the project manager.

Areas	Activities
RM policy and procedures	• Draft, maintain, and review risk management plans. • Coordinate the identification and assessment of risks. • Develop an appropriate procedure for the management of each risk. • Obtain and report estimates of all project risks. • Ensure the staff is prepared to manage risks at the appropriate level.
Risk identification and assessment (qualitative and quantitative analysis)	• Coordinate the identification and assessment of risks. • Advise and collaborate with staff if necessary. • Lead the risk identification sessions. • Identify critical risks. • Identify probability and impact in collaboration with risk owners.
Risk control and mitigation	• Agree on the risk monitoring method with risk owners. • Integrate actions to avoid risks in the project control stage. • Define alternative plans due to risks in the project control stage. • Organize follow-up meetings of the risk management plan. • Indicate which risks are terminated in agreement with risk owners. • Ensure that any new risk is incorporated into the plan. • Ensure that collaboration with external stakeholders is appropriate.
Reports	• Maintain the risk control register database. • Issue risk reports. • Present details of the risk program strategy. • Issue the risk progress reports.

In Phase 2, alarms and data provided by each risk control manager are agreed with the project manager and the other risk managers. This allows monitoring them more easily and, in case they arise, call a meeting. When a risk is materialized it is also necessary to monitor its impact on the project cost, time and requirements. If necessary, suppliers, collaborating organizations, customers and/or end users will be called to these meetings. The risks status will also be reported in project monitoring meetings in addition to progress reports. Finally, all meetings, changes, remarks and/or comments will eventually appear in project records to ensure a proper CM.

During Phase 3, once some risks have already been identified and entered the register, it is necessary to identify the probability of occurrence and their consequences. Information about risks will be as clear, explicit, and quantifiable as possible. In addition, the risk code, type, description, review, and responsible manager must be indicated. This is achieved through the application of structured interviews, documentation, meetings with departments and suppliers (if necessary), investigations and brainstorming sessions. These actions will allow classifying them into technical risks (relating to quality, execution, new technologies, technological changes, etc.), organizational risks (time, resources and facilities), management risks (costs, time and requirements), and external risks (new legislation, labor conflicts, climate, etc.). Once a risk has been identified, it will undergo an evaluation process whose outline is summarized in Figure 7.

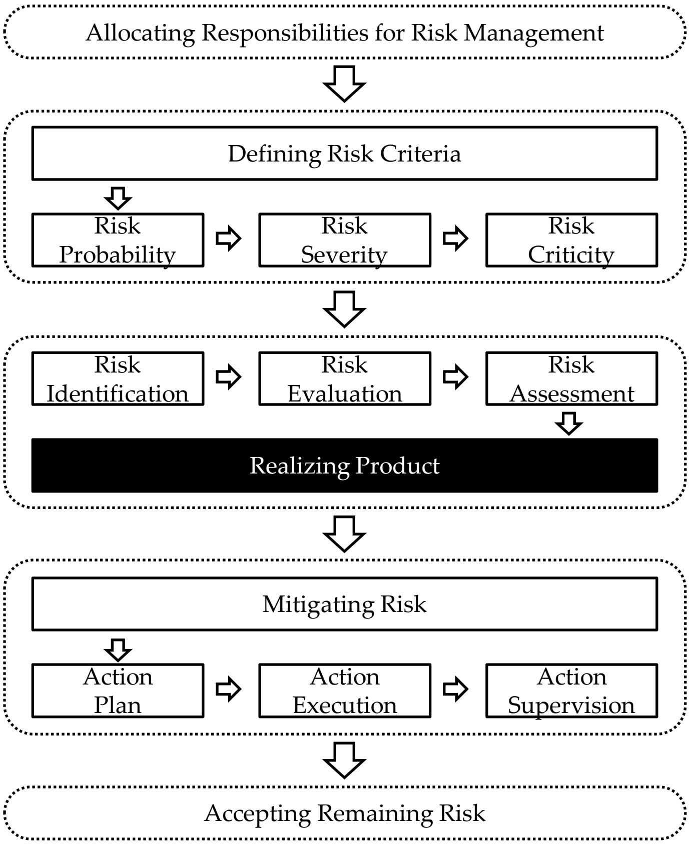

Figure 7. Risk assessment process.

The risk contingency plan must then propose new options to reduce potential problems impacting the project objectives, as well as identify possible actions to grasp (positive) opportunities. Planning must be in accordance with the risk severity mostly in terms of cost impact. This planning will also state when risk avoidance or correction measures are to be implemented. For each risk, a list of potential responsible parties will be made during the risk identification period. The response strategies are classified as follows:

- Avoidance by modifying the project plan to eliminate the risk or protecting the objectives against its occurrence. This can be achieved by increasing the material, technical or human resources related to the risk, improving communications between the departments involved, receiving expert assistance, or avoiding unqualified/unexperienced suppliers.
- Transfer by sharing the consequences of a risk with a third party. This action does not eliminate the risk but transfers its management and minimizes its potential impact.
- Reduction by lowering the probability or consequences of the risk to acceptable thresholds. At this point, it is better to minimize probability than consequences.
- Validation by not modifying the project because there is not a feasible alternative strategy.

6. Results

KM in complex projects in the shipbuilding industry must support a culture of knowledge creation, valorization and sharing. A pre-requisite is being able to take advantage of the company's intangible assets. Only this will improve planning and control tasks when it comes to reducing the probability, impact and errors relapse in shipbuilding projects. It also has to identify opportunities in the organization's processes, requirements management, suppliers' management and internal communication. These, within the company, but also with partners, customers, and suppliers. To do this, Navantia has to establish strategies that enable these improvements to be effectively implemented, though. Among other actions, this will involve encouraging and facilitating the information exchange between departments and shortening access times to relevant information.

Companies in the naval sector must constantly innovate and update their products, processes, or management systems faster than the competition to keep a competitive advantage. The complexity of the projects they handle stems from the technologically advanced and innovative products they must create. With this purpose, Navantia must align its management policies with good KM practices. The main objective of this management model is, therefore, to ensure a highly competitive position in international markets. Our proposal is based on a holistic vision, including a systemic point of view, and identifying relevant and timely knowledge, appropriate technology, and critical success factors. The proposed model is based on the main strengths of existing KM holistic models. This offers an integral KM approach that allows combining the internal company factors and the specific needs of naval companies. Table 4 shows the basic processes of the KM model and the strategies suggested to achieve the organizational objectives while trying to improve competitiveness.

Table 4. Critical processes in Navantia's KM model.

Critical Process	Suggested Strategies
Organizational context:	• To formally promote the development and use of knowledge as a valuable asset for achievement better results. • To identify the elements of the organizational environment that can promote the development and use of knowledge. • Create a KM office that works in a coordinated manner with the CM and RM areas, articulating and centralizing sensitive and critical information from other areas (Engineering, R+D, or Purchasing, among others).

Table 4. *Cont.*

Critical Process	Suggested Strategies
Technological platform:	• To improve the current technological platform with customized solutions that contemplate the specific needs of the shipyard's corrective, adaptive and developmental maintenance tasks. • To allow the documentation elaboration and update that includes all the tasks carried out as well as the protocols for future actions. These are in order to ensure both the outputs quality and knowledge transfer. • To keep the systems documentation updated. • To document the steps in pilot tests and during production stages, so that a guide is available to guarantee process success. • To draft periodic reports of work carried out, summary of all communications received (incidents, requests, changes, etc.) classified according to their origin, and the commitments acquired with their degree of compliance. • To update the necessary information for the provisions of tasks and their control, as well as the adoption of improvement measures.
Limiting factors to increase competitiveness:	• To review previous project experiences to use them as a learning source. • To identify technical factors that limit productivity, especially related to project planning and control. • To identify financial factors that limit competitiveness, especially those related to costs and financing. • To identify potential shortages of qualified human resources, materials and inputs that can affect project performance. • To identify potential gaps and deficiencies in knowledge, data, procedures, or innovations that may affect project development.
Risks and consequences:	• To identify public, economic, labor, and fiscal policies that may affect project performance. • To identify potential consequences of conflicts with clients and their impact on the image and credibility of the organization. • To identify possible legal consequences of non-compliance and delays in project delivery.
Quality practices:	• To verify the basic elements of the quality system that support the assessment and use of knowledge. • To identify and implement the use of indicators for critical processes that support competitiveness. • To identify and implement mechanisms for knowledge dissemination and lessons learned. • To identify and strengthen the basic elements of the quality system that promote organization's resilience and adaptation to environment changes.

In addition, Table 5 compiles the main implementation phases of the proposed holistic KM model in Navantia.

Table 5. Implementation phases of the Navantia KM model.

Phases	Purpose
Familiarization:	• To familiarize the management board with the general and basic principles of the proposed KM model. • Facilitate the opening of a KM office as a transversal departmental support to other areas (especially those related to CM, Construction, Repair and Maintenance, Engineering, R+D and RM areas).
Comprehensive organizational diagnosis:	• To evaluate the degree of presence of the organization's KM activities and the relationship of these activities with its competitive capacity.
Awareness of knowledge management:	• To train all the relevant people involved in the implementation of the KM model. • To jointly evaluate the benefits, limitations, and difficulties of the model implementation.
Design of a knowledge management program:	• To design a KM program, adapting the proposed model to the particularities and specific needs of the organization.
Implementation and monitoring:	• To define the staff responsible for guiding the KM processes, incorporating a specific area into the organizational structure, and defining its hierarchy (Board, Department, Office) in accordance with the organization's policies. Assign enough resources to this area. • To monitor, according to a periodicity defined by the organization, the results obtained from the program implementation, document the information obtained in each phase, and make the necessary adjustments.

7. Conclusions

In the advent of the industry 4.0, the management of complex projects involves multiple challenges, many of which are related to how knowledge and risks are handled by an organization. Namely, despite the existence of some knowledge management (KM) models, none has been satisfactorily adapted to the needs of organizations in the naval defense industry. This is because of the complexity and unique nature of the projects these organizations handle. Additionally, the success of shipbuilding organizations relies on robust risk management (RM) plans, an aspect that is not present in hardly any KM model either. Hence, by means of a representative case study of a shipbuilding company, this paper has proposed a holistic KM model that includes KM and RM aspects. In this model, RM becomes a source itself of organizational knowledge, which in turn allows organizational growth and higher maturity levels. The KM model also allows discovering potential competitive advantages and market opportunities for the company when they are managing complex projects.

The proposed KM model has been designed to be easily integrated with the organizational procedures of a shipbuilding company. The model takes into account the organizational structure which may be functional (vertical) or project-based (horizontal). Additionally, the model includes a configuration management (CM) approach which is possible thanks to a preliminary list of risks and responses agreed between the company and the project client. Hence, the model is also suitable for dynamic environments, which involve constant information and requirement updates. Learning from the actual risks encountered in each case and from the enhanced information retrieved along successive project experiences, organizational processes and KM practices can be gradually refined. This allows the company to be prepared for current demanding, uncertain and rapidly changing environments. Finally, the model also promotes the development of the organizational and staff competences; it focuses on the personnel as the major organizational asset.

Overall, the model's implementation does not involve significant additional costs, nor special (dedicated) organizational structures. Conversely, the model's scope encompasses the whole project life cycle and easily integrates with the organizational documentation. This promotes all project component's traceability and allows easier (more efficient) project monitoring and control. Eventually, this is translated into continuous improvement and more sustainable business practices. This is also indispensable for the management operations in environments in increasingly complex and demanding projects.

Last but not least, the proposed model allows for the alignment of the organization's mission and strategy with the project objectives. This is also partially achieved by means of ensuring the project components' quality through tight supply chain management actions. These actions involve, among others, engaging product and service suppliers with the projects' RM plan.

The major limitation of the study is the limited extent of the validation provided. Some evidence has been provided suggesting that the holistic model works well and is profoundly changing the organization's best practices. Many process examples and work procedures have also been reported. They support the conclusion that KM, RM and CM integration is perfectly possible and arguably the easier approach for handling complex projects. Yet, a thorough validation including other case studies and project environments remains necessary. This will hopefully be addressed in future research. In this regard, the proposed model is also being successfully implemented in another five-corvette project for the Royal Saudi Navy, which began in 2018 and will be commissioned in 2022.

Author Contributions: Conceptualization, F.R.-P. and A.C.-N.; methodology, A.P.-F. and M.O.-M.; validation, P.B.-P.; formal analysis, A.C.-N. and P.B.-P.; investigation, F.R.-P., A.P.-F. and M.O.-M.; resources, F.R.-P.; data curation, A.C.-N.; writing A.C.-N. and P.B.-P.; original draft preparation, F.R.-P., A.P.-F. and M.O.-M.; writing—review and editing, A.C.-N. and P.B.-P.; supervision, A.P.-F. and M.O.-M.; funding acquisition, A.C.-N. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data available on request due to Navantia's confidentiality.

Acknowledgments: All authors acknowledge the help received by the research group TEP-955 from the PAIDI (Junta de Andalucía, Spain). The first author also acknowledges the research stay at the Engineering Projects Department at Universitat Politècnica de València (Spain). The fourth author also acknowledges the Spanish Ministry of Science and Innovation for his Ramon y Cajal contract (RYC-2017-22222) co-funded by the European Social Fund.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Smith, J.U.M.; Chapman, C.; Ward, S. Project Risk Management: Processes, Techniques, and Insights. *J. Oper. Res. Soc.* **1998**, *49*, 7. [CrossRef]
2. Cerezo-Narváez, A.; Otero-Mateo, M.; Rodríguez-Pecci, F.; Pastor-Fernández, A. Digital transformation of requirements in the industry 4.0: Case of naval platforms. *DYNA Ing. Ind.* **2018**, *93*, 448–456.
3. Carayannis, E.G.; Grigoroudis, E.; del Giudice, M.; Della-Peruta, M.R.; Sindakis, S. An exploration of contemporary organizational artifacts and routines in a sustainable excellence context. *J. Knowl. Manag.* **2017**, *21*, 35–56. [CrossRef]
4. Eriksson, P.E.; Larsson, J.; Pesämaa, O. Managing complex projects in the infrastructure sector—A structural equation model for flexibility-focused project management. *Int. J. Proj. Manag.* **2017**, *35*, 1512–1523. [CrossRef]
5. Project Management Institute. *A Guide to the Project Management Body of Knowledge, PMBOK Guide*, 6th ed.; PMI: Newtown Square, PA, USA, 2017; ISBN 978-1628253825.
6. AXELOS. *Managing Successful Projects with PRINCE2®*, 6th ed.; AXELOS: London, UK, 2017; ISBN 978-0113315338.
7. Alhawari, S.; Karadsheh, L.; Talet, A.N.; Mansour, E. Knowledge-Based Risk Management framework for Information Technology project. *Int. J. Inf. Manag.* **2012**, *32*, 50–65. [CrossRef]

8. Koskinen, K.U. Recursive view of the project-based companies' knowledge production. *J. Knowl. Manag.* **2010**, *14*, 258–268. [CrossRef]
9. Organisation for Economic Co-operation and Development. *The Significance of Knowledge Management in the Business Sector*; Organisation for Economic Co-operation and Development: Paris, France, 2004.
10. Kordab, M.; Raudeliūnienė, J.; Meidutė-Kavaliauskienė, I. Mediating Role of Knowledge Management in the Relationship between Organizational Learning and Sustainable Organizational Performance. *Sustainability* **2020**, *12*, 10061. [CrossRef]
11. Spender, J.-C. Getting value from knowledge management. *TQM Mag.* **2006**, *18*, 238–254. [CrossRef]
12. Woodhead, R.M.; Male, S.P. The conditioning effect of objective decision-making on the client's capital proposal. *Eng. Constr. Archit. Manag.* **2000**, *7*, 300–306.
13. Emblemsvåg, J. The augmented subjective risk management process. *Manag. Decis.* **2010**, *48*, 248–259. [CrossRef]
14. Khallaf, R.; Naderpajouh, N.; Hastak, M. A systematic approach to develop risk registry frameworks for complex projects. *Built Environ. Proj. Asset Manag.* **2018**, *8*, 334–347. [CrossRef]
15. Grant, R.M. The Knowledge-based view of the firm. In *The Strategic Management of Intellectual Capital and Organizational Knowledge*; Choo, C.W., Bontis, N., Eds.; Oxford University Press: New York, NY, USA, 2002; pp. 133–148. ISBN 978-0195154863.
16. Drucker, P.F. The Coming of the New Organization. *Harv. Bus. Rev.* **1988**, *66*, 45–53.
17. Kutsch, E.; Hall, M.L. Deliberate ignorance in project risk management. *Int. J. Proj. Manag.* **2010**, *28*, 245–255. [CrossRef]
18. Grant, R.M. *Strategic Management: Concepts, Techniques and Applications*; John Wiley & Sons: Hoboken, NJ, USA, 2019; ISBN 978-1119576433.
19. Taylor, P. Complexity of projects. In *Real Project Management: The Skills and Capabilities You Will Need for Successful Project Delivery*; Kogan Page: London, UK, 2015; pp. 104–118. ISBN 978-0749471217.
20. Singh, G. *Use of Knowledge Management Techniques for Risk Management, Application at the Initial Project Stages*; Chalmers University of Technology: Gothenburg, Sweden, 2012.
21. Ballesteros-Pérez, P.; Sanz-Ablanedo, E.; Soetanto, R.; González-Cruz, M.C.; Larsen, G.D.; Cerezo-Narváez, A. Duration and Cost Variability of Construction Activities: An Empirical Study. *J. Constr. Eng. Manag.* **2020**, *146*, 04019093. [CrossRef]
22. Geraldi, J.; Maylor, H.; Williams, T. Now, let's make it really complex (complicated). *Int. J. Oper. Prod. Manag.* **2011**, *31*, 966–990. [CrossRef]
23. Baccarini, D. The concept of project complexity—A review. *Int. J. Proj. Manag.* **1996**, *14*, 201–204. [CrossRef]
24. Saunders, F.C.; Gale, A.W.; Sherry, A.H. Responding to project uncertainty: Evidence for high reliability practices in large-scale safety–critical projects. *Int. J. Proj. Manag.* **2016**, *34*, 1252–1265. [CrossRef]
25. Remington, K.; Pollack, J. Tools for complex projects. In *Aspects of Complexity: Managing Projects in a Complex World*; Cooke-Davies, T., Crawford, L., Patton, J.R., Stevens, C., Williams, T.M., Eds.; Project Management Institute: Newtown Square, PA, USA, 2011; pp. 29–40. ISBN 978-1935589303.
26. Ballesteros-Pérez, P.; Rojas-Céspedes, Y.A.; Hughes, W.; Kabiri, S.; Pellicer, E.; Mora-Melià, D.; del Campo-Hitschfeld, M.L. Weather-wise: A weather-aware planning tool for improving construction productivity and dealing with claims. *Autom. Constr.* **2017**, *84*, 81–95. [CrossRef]
27. Ballesteros-Pérez, P.; Smith, S.T.; Lloyd-Papworth, J.G.; Cooke, P. Incorporating the effect of weather in construction scheduling and management with sine wave curves: Application in the United Kingdom. *Constr. Manag. Econ.* **2018**, *36*, 666–682. [CrossRef]
28. Qazi, A.; Quigley, J.; Dickson, A.; Kirytopoulos, K. Project Complexity and Risk Management (ProCRiM): Towards modelling project complexity driven risk paths in construction projects. *Int. J. Proj. Manag.* **2016**, *34*, 1183–1198. [CrossRef]
29. Briones-Peñalver, A.J. The economics of security and defence. Transfer of knowledge and innovation related to the defence industry. *J. Span. Inst. Strateg. Stud.* **2013**, *2*, 1–22.
30. Arredondo-Gonzalo, P. Knowledge management and new technologies. *J. Span. Army* **2014**, *879*, 102–105.
31. Sáiz-Pardo-Lizaso, M. Knowledge management in the direction of research, doctrine, organic and materials. In *Military and Security Studies at the Dawn of the 21st Century*; University of Granada: Granada, Spain, 2017; pp. 503–531. ISBN 978-8433860859.
32. Casermeiro-Anta, R.Á. Tools for knowledge management. In Proceedings of the 1st International Congress on Military Studies, Granada, Spain, September 17–19 2014; University of Granada: Granada, Spain, 2014; pp. 1–16.
33. Brosz, F.J. Operational knowledge management in the Argentine Navy and its influence on officers' tactical training. *J. Argentinian Nav. War Coll.* **2012**, *58*, 103–130.
34. Donate Manzanares, M.J.; Guadamillas Gómez, F. Knowledge management strategy and innovative posture in Castilla-La Mancha companies. An exploratory study. *Eur. Res. Manag. Bus. Econ.* **2010**, *16*, 31–54.
35. Mohamad, A.A.; Thursamy, R.; Lo, M.-C. Sustainable Knowledge Management and Firm Innovativeness: The Contingent Role of Innovative Culture. *Sustainability* **2020**, *12*, 6910. [CrossRef]
36. Sánchez-Díaz, M. Brief inventory of models for knowledge management in organizations. *Comput. Sci.* **2005**, *13*, 1–18.
37. Reich, B.H.; Gemino, A.; Sauer, C. Knowledge management and project-based knowledge in it projects: A model and preliminary empirical results. *Int. J. Proj. Manag.* **2012**, *30*, 663–674. [CrossRef]
38. Avendaño-Pérez, V.; Flores-Urbáez, M. Theoretical models of knowledge management: Descriptors, conceptualizations and approaches. *Intersci. Knowl. Dialogues* **2016**, *4*, 201–227.
39. Mohajan, H. The Impact of Knowledge Management Models for the Development of Organizations. *J. Environ. Treat. Tech.* **2017**, *5*, 12–33.

40. Stroińska, E.; Trippner-Hrabi, J. Knowledge management models as a source of employee and organization's efficiency. *Èkon. Prawo* **2018**, *17*, 233–245. [CrossRef]
41. Sensuse, D.I.; Cahyaningsih, E. Knowledge management models: A summative review. *Int. J. Inf. Syst. Serv. Sect.* **2018**, *10*, 71–100. [CrossRef]
42. Ghasabeh, M.; Provitera, M. Transformational Leadership and Knowledge Management: Analysing the Knowledge Management Models. *J. Values-Based Leadersh.* **2018**, *11*, 8. [CrossRef]
43. Mittal, S.; Kumar, V. Study of knowledge management models and their relevance in organisations. *Int. J. Knowl. Manag. Stud.* **2019**, *10*, 322–335. [CrossRef]
44. Wiig, K.M. *Knowledge Management Foundations: Thinking about Thinking: How People and Organizations Create, Represent and Use Knowledge*; Schema Press: Arlington, VA, USA, 1993; Volume 1, ISBN 978-0963892509.
45. Nonaka, I.; Takeuchi, H. *The Knowledge Creating Company: How Japanese Companies Create the Dynamics of Innovation*; Oxford University Press: Oxford, UK, 1995.
46. Bustelo-Ruesta, C.; Amarilla-Iglesias, R. Knowledge management and information management. *PH J.* **2001**, *34*, 226–230.
47. Tejedor, B.; Aguirre, A. Logos Project: Research on the learning capacity of Spanish companies. *Econ. Stud. Bull.* **1998**, *53*, 231–249.
48. Edvinsson, L.; Malone, M.S. *Intellectual Capital: The Proven Way to Establish Your Company's Real Value by Measuring its Hidden Brainpower*; Piatkus: London, UK, 1998; ISBN 978-0749918507.
49. de Jager, M. The KMAT: Benchmarking knowledge management. *Libr. Manag.* **1999**, *20*, 367–372. [CrossRef]
50. Dutta, S.; de Meyer, A.; Malhotra, Y. Knowledge Management at Arthur Andersen (Denmark). In *Knowledge Management and Business Model Innovation*; IGI Global: Hershey, PA, USA, 2001; pp. 384–401.
51. Bueno, E.; del Real, H.; Fernández, P.; Longo, M.; Merino, C.; Murcia, C.; Salmador, M.P. *Model for the Measurement and Management of Intellectual Capital: The Intellectus model*; Autonomous University of Madrid: Madrid, Spain, 2011.
52. Galbraith, J.R. The STAR Model. 2012; Available online: https://www.jaygalbraith.com/images/pdfs/StarModel.pdf (accessed on 17 January 2020).
53. Kaplan, R.S.; Norton, D.P. strategic learning & the balanced scorecard. *Strateg. Leadersh.* **1996**, *24*, 18–24.
54. Sveiby, K.E. The Intangible Assets Monitor. *J. Hum. Resour. Costing Account.* **1997**, *2*, 73–97. [CrossRef]
55. Arellano-Morales, F. Development of strategic model for assimilation, utilization and knowledge transfer in oil organizations. In *Proceedings of the XVIII International Congress of Accounting, Administration and Informatics, Málaga, Spain, 23–25 July 2014*; National Association of Accounting and Management Faculties and Schools: Albuquerque, NM, USA, 2013; pp. 1–16.
56. Kerschberg, L. Knowledge Management in Heterogeneous Data Warehouse Environments. In *Lecture Notes in Computer Science*; Springer Science and Business Media LLC: Berlin/Heidelberg, Germany, 2001; Volume 2114, pp. 1–10.
57. Goñi-Zabala, J.J. *Model and Management of Innovation Capital in Companies*; University of Navarra: Pamplona, Spain, 2001.
58. Bueno-Campos, E. Main approaches and trends in knowledge management. In *Knowledge Management: Theoretical Developments and Applications*; La Coria: Trujillo, Spain, 2003; pp. 21–54. ISBN 978-8488611277.
59. McElroy, M. Second-Generation Knowledge Management. In *The New Knowledge Management*; Elsevier BV: Amsterdam, The Netherlands, 2003; pp. 3–32.
60. Riesco-González, M. Knowledge management in business environments. In *Integrated-Situational Model from a Social and Technological Perspective*; Pontifical University of Salamanca: Salamanca, Spain, 2004.
61. Angulo, E.; Negrón, M. Holistic Model for knowledge management. *Sci. Journal Manag. Sci.* **2008**, *11*, 38–51.
62. Collison, C.; Parcell, G. *Learning to Fly: Practical Lessons from One of the World's Leading Knowledge Companies*; Wiley: Hoboken, NJ, USA, 2001; ISBN 978-1841121246.
63. Magnier-Watanabe, R.; Benton, C. Management innovation and firm performance: The mediating effects of tacit and explicit knowledge. *Knowl. Manag. Res. Pr.* **2017**, *15*, 325–335. [CrossRef]
64. Battistutti, O.C.; Bork, D. Tacit to explicit knowledge conversion. *Cogn. Process.* **2017**, *18*, 461–477. [CrossRef] [PubMed]
65. Alvarenga, A.; Matos, F.; Godina, R.; Matias, J.C.O. Digital Transformation and Knowledge Management in the Public Sector. *Sustainability* **2020**, *12*, 5824. [CrossRef]
66. Barragán-Ocaña, A. An approach to taxonomy of knowledge management models. *Intang. Cap.* **2009**, *5*, 65–101.
67. Tang, H.; Ma, Z.; Xiao, J.; Xiao, L. Toward a more Efficient Knowledge Network in Innovation Ecosystems: A Simulated Study on Knowledge Management. *Sustainability* **2020**, *12*, 6328. [CrossRef]
68. de Freitas, V.; Yáber, G. Holistic model of knowledge management system for institutions of higher education. Venez. *J. Inf. Technol. Knowl.* **2014**, *11*, 123–154.
69. Valmohammadi, C.; Sofiyabadi, J.; Kolahi, B. How do Knowledge Management Practices Affect Sustainable Balanced Performance? Mediating Role of Innovation Practices. *Sustainability* **2019**, *11*, 5129. [CrossRef]
70. Viswanathan, S.K.; Tripathi, K.K.; Jha, K.N. Influence of risk mitigation measures on international construction project success criteria—A survey of Indian experiences. *Constr. Manag. Econ.* **2019**, *38*, 207–222. [CrossRef]
71. Ekemen, M.A.; Şeşen, H. Dataset on social capital and knowledge integration in project management. *Data Brief.* **2020**, *29*, 105233. [CrossRef]
72. Hernández-Peña, Y.; Vargas Cuervo, G. Toward the construction of emerging knowledge for local risk management. *Geogr. Quad.* **2015**, *24*, 15–34.

73. Hillson, D. Managing overall project risk. In *Proceedings of the PMI Global Congress 2014—EMEA, Dubai, United Arab Emirates, 5–7 May 2014*; Project Management Institute: Dubai, UAE, 2014.
74. Institute of Risk Management. *A risk Management Standard*; Institute of Risk Management: London, UK, 2002.
75. Project Management Institute. *The Standard for Risk Management in Portfolios, Programs, and Projects*; Project Management Institute: Newtown Square, PA, USA, 2019; ISBN 978-1628255652.
76. Platt, J. What can case studies do? *Stud. Qual. Methodol.* **1998**, *1*, 2–23.
77. Rodríguez-Sabiote, C.; Lorenzo-Quiles, O.; Herrera-Torres, L. Theory and practice of qualitative data analysis. General process and quality criteria. *Int. J. Soc. Sci. Humanit.* **2005**, *15*, 133–154.
78. Yin, R.K. *Case Study Research: Design and Methods*, 3rd ed.; SAGE: Thousand Oaks, CA, USA, 2003; ISBN 0-7619-2552-X.
79. Eisenhardt, K.M.; Graebner, M.E. Theory building from cases: Opportunities and challenges. *Acad. Manag. J.* **2007**, *50*, 25–32. [CrossRef]
80. Grunow, D. The Research Design in Organization Studies: Problems and Prospects. *Organ. Sci.* **1995**, *6*, 93–103. [CrossRef]
81. Vargas-Hernández, J.G.; Arandia-Pérez, O.E.; Cordova-Rangel, A. A review of research methods in strategic management. What have been done, and what is still missing. *J. Knowl. Manag. Econ. Inf. Technol.* **2016**, *6*, 1–42.
82. Yin, R.K. *Case Study Research: Design and methods*, 5th ed.; SAGE Publications: Thousand Oaks, CA, USA, 2013; ISBN 978-1483322247.
83. Navantia CSS Cantabria. Available online: www.navantia.es/en/products-and-services/logistic/css-cantabria/ (accessed on 30 December 2020).
84. Navantia ARENA 65 LCM. Available online: www.navantia.es/wp-content/uploads/2018/05/Arena-65-LCM-.pdf (accessed on 30 December 2020).
85. Navantia Navantia Delivers BAM "Furor" to the Spanish Navy. Available online: www.navantia.es/en/news/press-releases/navantia-delivers-bam-furor-to-the-spanish-navy/ (accessed on 30 December 2020).
86. Naval Engineering. Naval Construction Maritime Action Vessel, BAV. *Nav. Eng.* **2011**, *893*, 19–28.
87. Ramsay, S. A Case for a New Warship-Building Strategy. *Marit. Aff. Natl. Marit. Found. India* **2012**, *8*, 150–156. [CrossRef]
88. Navantia Products and Services. Available online: https://www.navantia.es/en/products-and-services/ (accessed on 30 December 2020).
89. Sotano, A.J.S.; Cerezo-Narváez, A.; Abad-Fraga, F.; Pastor-Fernández, A.; Salguero, J. Trends of Digital Transformation in the Shipbuilding Sector. In *New Trends in the Use of Artificial Intelligence for the Industry 4.0*; IntechOpen: London, UK, 2020; pp. 1–23.
90. Gosling, J.; Naim, M.M. Engineer-to-order supply chain management: A literature review and research agenda. *Int. J. Prod. Econ.* **2009**, *122*, 741–754. [CrossRef]
91. Recamán-Rivas, Á. Navantia's Shipyard 4.0 model overview. *Sh. Sci. Technol. J.* **2018**, *11*, 77. [CrossRef]
92. Coz-Fernández, J.R. *Knowledge Management Model for Economic Impact*; Application to the Defense Sector, Complutense; University of Madrid: Madrid, Spain, 2016.
93. NATO. *AQAP 2110: Quality Assurance Requirements for Design, Development and Production*; NATO Standardization Office: Brussels, Belgium, 2016.
94. Perrault, T.J.; Hylton-Bilbrey, J.; Wall, C.T.J.; Belke, T.J.; Read, C.G. *Configuration Management (CM) Compliance Validation. Critical Review & Technology Assessment (CR/TA) Report*; IATAC: Falls Church, VA, USA, 2001.
95. Sánchez-Villegas, J. Configuration management in shipbuilding for Defence. In Proceedings of the Conference on Configuration Management by the INTA, Madrid, Spain, 4 October 2012; Spanish Quality Association (AEC): Torrejón de Ardoz, Spain, 2012; p. 10.
96. García-Romanos, J. Configuration management and asset management as a knowledge management. *Spanish J. Innov. Qual. Softw. Eng.* **2008**, *4*, 18–35.
97. Cárceles, Á. Integrated Configuration Management for Navantia. In *Proceedings of the Conference on Configuration Management ISDEFE, Madrid, Spain, 3 September–10 December 1932*; Spanish Quality Association (AEC): Madrid, Spain, 2015; p. 12.
98. Öberg, C.; Dahlin, P.; Pesämaa, O. Tension in networks. *Ind. Mark. Manag.* **2020**, *91*, 311–322. [CrossRef]
99. Pesämaa, O.; Dahlin, P.; Öberg, C. Reduction of tension effects on partner evaluation. *Mark. Intell. Plan.* **2018**, *36*, 425–439. [CrossRef]