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Original Article

Minimum Personnel and Organizational Structure Proposal for Obsolescence Management in a Wellhead Equipment Supplier in the Aftermarket Phase

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Abstract - *The purpose of this article is to specify the minimum personnel and organizational structure, appropriated to the context of a wellhead equipment supplier in the aftermarket phase, meeting the obsolescence management requirements according to the Obsolescence Management for Subsea Production Control Systems - 3428A V1.5 and the Recommended Practice for Obsolescence Management - 3428B V1.5 reference models* [1], [2]. *The opportunity to perform this study is understood through a literature review, mainly on the concepts of obsolescence and obsolescence management. A Design Science Research – DSR – methodology was conducted and adapted to the context of this study and was applied to specify the minimum personnel and organizational structure in the studied company. It was shown that it is possible to use the existing organizational structure in the wellhead equipment supplier with the proper training of key people for obsolescence management, depending on the workload that should be assessed against the Obsolescence Management Plan. In other words, it is possible, to some extent, to use the existing organizational structure to meet the operators' obsolescence management requirements.*

Keywords - *Obsolescence, design science research – DSR, organizational structure, minimum personnel, wellhead equipment supplier.*

I. INTRODUCTION

Oil exploration equipment has a long service life, which in many cases exceeds 25 years [3]. As such, it is expected that the assemblies, particularly those containing electronic parts, will become obsolete before the end of equipment's life and can lead to serious replacement problems that pose risks to production, to people's safety and to the environment [3]. Reference [4] estimates that between 10% and 15% of electronic items enter into the obsolescence phase in the first 5 years after installation, and in some cases, this happens even before the equipment starts working.

Considering obsolescence as a risk to the oil and gas industry, a Joint Industry Project (JIP) was created in 2011 consisting of BP, Chevron, Total, Inpex, Shell, Statoil [now Equinor] and Woodside with the objective of addressing the obsolescence of subsea control systems equipment in a consistent manner.

This Joint Industry Project (JIP) has created the Obsolescence Management for Subsea Production Control Systems - 3428A V1.5 [1] and the Recommended Practice for Obsolescence Management - 3428B V1.5 [2] - documents to serve as reference models for operators, both based on the IEC 62402: 2007 - Obsolescence Management – Application Guide.

In accordance with [1], at least electrical and electronic assemblies with their respective firmware and software, where applicable, for surface equipment (platform), subsea equipment (Wellhead), and testing equipment should be considered critical and be within the scope of the supplier's Obsolescence Management Plan.

In this sense, this article reviews the concepts of obsolescence and obsolescence management and then instantiates the organizational model proposed in [2] to be applied to the company object of this study, a wellhead equipment supplier in the aftermarket phase, with the purpose of defining the minimum personnel and organizational structure for Obsolescence Management.

II. OPPORTUNITY

References [1] and [2] are reference models created by Operators, based on the IEC 62402 - Obsolescence Management - Application Guide. They are generic enough to be applied to suppliers of the various types of equipment used in subsea oil exploration and production (E&P). Thus, an opportunity is seen to instantiate the proposed organizational structure for the context of a wellhead equipment supply company in the aftermarket phase. The Research Question (RQ) posed is: What are the minimum personnel and organizational structure to meet the Obsolescence Management requirements at a wellhead equipment supplier in the aftermarket phase?

III. OBJECTIVES

The main objective of this article is to present the minimum personnel and organizational structure appropriate to the context of an aftermarket wellhead equipment supplier that meets the requirements of reference models [1], [2], and thus, answer the research question (RQ).

In order to achieve the main objective, some secondary objectives, such as the literature review of the theme, the understanding of the organizational structure presented in the reference model and the development of the minimum personnel and organizational structure to be proposed, must be achieved.

IV. JUSTIFICATION

The minimum personnel and organizational structure to be specified will be appropriate to the context of wellhead equipment suppliers in the aftermarket phase and will meet the requirements of reference models [1], [2], which is a requirement of the Joint Industry Project (JIP) composed of BP, Chevron, Total, Inpex, Shell, Equinor (formerly Statoil) and Woodside. Thus, a better understanding of the minimum personnel and organizational structure necessary to meet the requirements of the above-mentioned operators should facilitate and accelerate the restructuring of wellhead equipment suppliers in the aftermarket phase as part of the Obsolescence Management process implementation, which justifies this study.

V. DELIMITATION

Minimum personnel and organizational structure will be specified based on the organizational structure proposed in [2] and will be limited to wellhead equipment suppliers in the aftermarket phase. Moreover, the organizational restructuring of the company studied in this article will be limited to the theoretical proposition, based on the author's experience in the oil and gas area, due to the time required to have the appropriate resources to implement the proposed organizational structure in the company object of this study.

VI. LITERATURE REVIEW

This literature review will cover Wellhead Equipment as well as Subsea Control Systems (SCS) that are used in conjunction with Wellhead Equipment. In addition, the concepts of Obsolescence and Obsolescence Management, which according to [1], are related to risks, are addressed. Finally, the concept of organizational structure will be approached with the positions and roles involved as a basis for specifying the minimum organizational structure necessary to support the Obsolescence Management process in Wellhead Equipment suppliers in the aftermarket phase.

A. Wellhead Equipment

A typical Subsea System includes (1) Wellhead, Tubing Hanger, Wet Christmas Tree; (2) Production Control System; (3) Umbilical; (4) Intervention System; (5) Subsea Structures and Piping Systems; (6) Flow Lines; and (7) Subsea Processing, Booster, Separation, etc. [5].

Considering only item (1) above, Subsea Wellheads support Well Casings, resist to Riser stresses and provide sealing to the Blow Out Preventer (BOP). In the production phase, they serve as housing, locking and sealing for the Tubing Hanger and the Wet Christmas Tree [6]. Usually, the Wet Christmas Tree (WCT) is composed of: Flow Lines Base, also called the Production Adapter Base or PAB; Production Column Hanger (Tubing Hanger - TH); Flow Lines Termination, also called Vertical Connection Module or VCM; Wet Christmas Tree itself; and Tree Cap [6], and it is aligned and fixed onto the Wellhead at the bottom of the ocean [7].

The Surface Production Equipment is installed on the Production Platform, and the Subsea Control Equipment are installed on the Christmas Tree [8].

The Subsea Control Module (SCM), which is the main equipment of the Subsea Control System (SCS), is installed on a subsea production equipment structure, such as a Christmas Tree. The SCM is used to acquire data from subsea equipment and send it to the Master Control Station (MCS) located on the Production Platform, as well as to receive commands from the MCS to control the subsea equipment [9].

The Subsea Control Module Mounting Base (SCMMB) provides the connection point between SCM and subsea Christmas Tree functions and Monitoring Equipment [10].

B. Control System

To ensure the sustainable development of the world energy supply, a new approach to dealing with the subsea exploration of oil and gas had to be found. Therefore, the Subsea Production System (SPS) was introduced, which comprises the Subsea Control Module, the Christmas Tree, Manifold, Riser, Pipeline, Umbilical, etc. [8].

The core of the Subsea Production System (SPS) is the Control System (CS) which plays a critical role in subsea production activities [8]. According to [8], currently, most Subsea Control Systems use Multiplexed Electrohydraulic Control. This is essentially a subsea computer that controls hydraulic pilot valves through a communication system with surface control equipment. The surface equipment of Multiplexed Electrohydraulic System consists of Hydraulic Power Unit (HPU), Electrical Power Unit (EPU), Master Control Station (MCS), Umbilical Termination Assembly (UTA), etc. And the subsea equipment consists of Umbilical, Subsea Control Module (SCM), Subsea Distribution Unit (SDU), Interconnection Lines, etc. The main features of Multiplexed Electrohydraulic Control are real-time system response, increase in the distance between surface and subsea equipment, reduction of the umbilical size and high level of operational flexibility, which makes this control technique very important for development of the oil and gas industry [8]. It is worth noting that the Control System (CS) for Subsea Production System (SPS), as exposed above, is quite different from Industrial Control Systems as discussed in [11], for example.

For management purposes, the reference model [1] includes, but is not limited to, electrical and electronic equipment for surface application (platform), subsea application and test equipment, as well as software and firmware installed on any equipment.

C. Obsolescence

The International Standard IEC 62402, first issued in 2007, states two complementary definitions for obsolescence: (1) transition from availability from the original manufacturer to unavailability and (2) permanent transition from operability to non-functionality due to external reasons, as transcribed by [1]. The definition (1) above is adopted in this article, as it best applies to equipment used in oil exploration and production (E&P).

Obsolescence is inevitable, but according to [1], the negative impacts of obsolescence can be mitigated and controlled. Early identification of the risk of obsolescence, as per [2], allows a wider range of options to be considered and consequently reduces the actual cost of resolution as well as the attribution of responsibility for problem resolution.

Among the main systems most likely to experience obsolescence in the Subsea Production System (SPS) is the Subsea Production Control System (SPCS). It is more prone to obsolescence because its main components, which are electronic, have much shorter life cycles than the life cycle of the Subsea Production System (SPS). And among the main items of a Subsea Production Control System (SCPS), the main concern of obsolescence management is the Subsea Control Module (SCM) [12].

D. Obsolescence Management

The International Standard IEC 62402 states the following definition for obsolescence management: "Co-ordinated activities for direct and control of an organization with respect to obsolescence", as transcribed by [1].

Aligned with this concept, [1] aims to describe a proactive Obsolescence Management (OM) process that applies to Subsea Production Control Systems (SPCS) and details the minimum requirements of subsea equipment suppliers to manage obsolescence risks through the activities associated with prevention, prediction and resolution of obsolescence problems. According to [13], the way to incorporate risks into the decision-making process is to get the Senior Management involved in the discussion.

In addition, according to [1], subsea equipment suppliers must ensure that the proactive Obsolescence Management is fully integrated into its internal processes and procedures and that relevant knowledge, experience and skills are maintained and available.

Reference model [2] recommends a general process that should be implemented between Operators and Suppliers to understand, mitigate, resolve and report obsolescence risks. Figure 1 graphically shows the details of this process.

Reference model [2] also recommends the use of two systemic documents: The Obsolescence Management Governance and the Obsolescence Management Plan.

The Obsolescence Management Governance should be a general and short document according to [2]. It should address the company Obsolescence Management policy aimed at maintaining the ideal balance between product availability and cost ownership. For this purpose, it should cover topics such as organization and appointment of obsolescence manager, risk management, product scope and control, among others.

As proposed by [2], the Obsolescence Management Plan should be an extensive document or a compendium of smaller documents that should cover at least the following elements: objectives; document details; product details; scope of the plan; organization of obsolescence management; project obsolescence management; risk assessment; obsolescence monitoring; resolution process; supplier arrangements; obsolescence management reports; product life cycle diagrams; performance management; and transition planning.

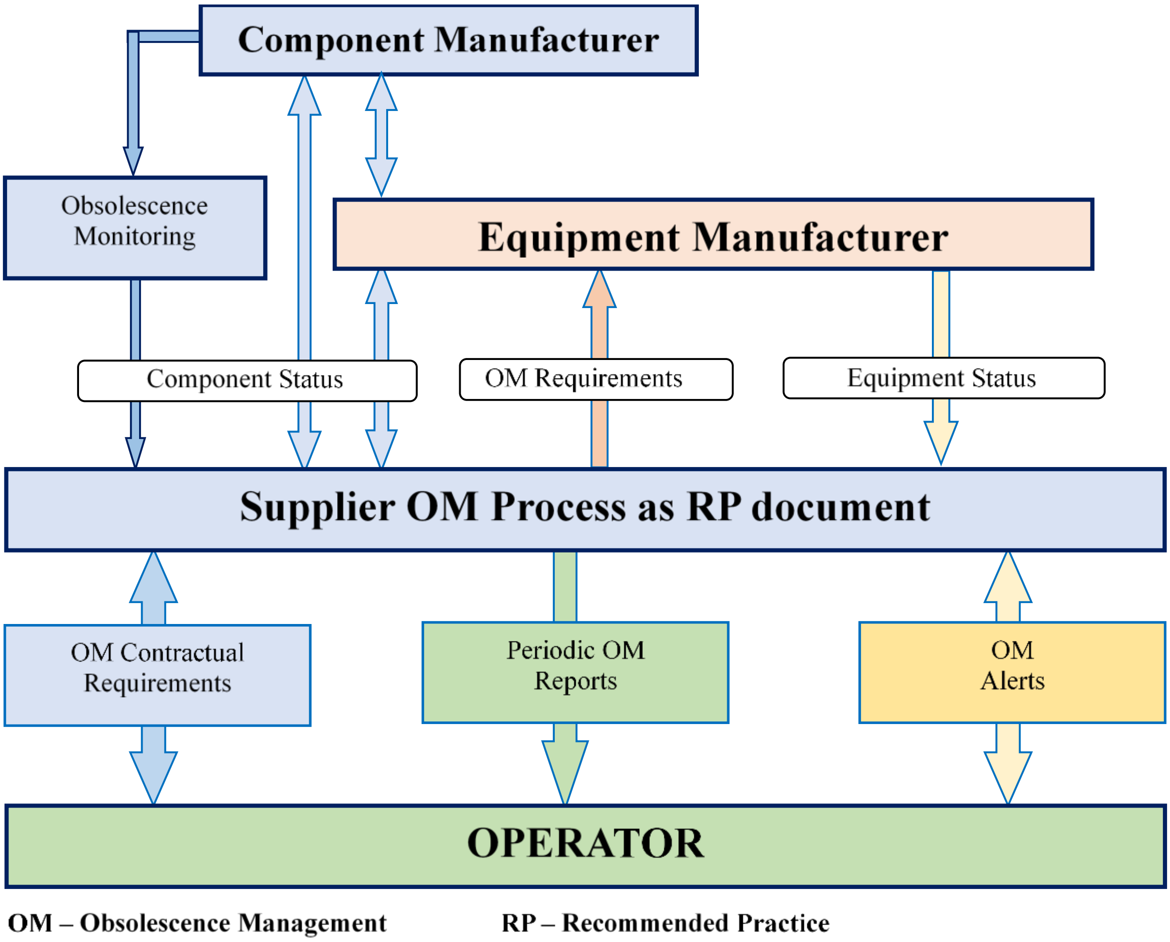

Fig. 1 General Obsolescence Management process [2]

Obsolescence Management involves all activities, strategies and resolutions applied in the treatment of obsolescence problems [12].

E. Obsolescence Management Organization

To run the Obsolescence Management Process, [2] recommends the organizational structure shown in Figure 2.

The obsolescence team should be dedicated to monitoring specific "risk" items and providing advice and guidance to the Operator on all matters related to obsolescence and equipment issues.

In the structure presented in Figure 2, the key people and the areas involved have different roles, as described as follows [2]:

The Operator is the Customer and has the role of providing the Requirement Specification to manage the obsolescence of a Product/Project/Asset to the supplier, establish the Obsolescence Management contracts with the supplier and ensure suppliers' compliance with the established contracts.

The Product Program Manager has the fundamental roles of appointing the Obsolescence Manager, ensuring that the Obsolescence Management (OM) is practised throughout the product life cycle and providing appropriate resources to manage obsolescence issues.

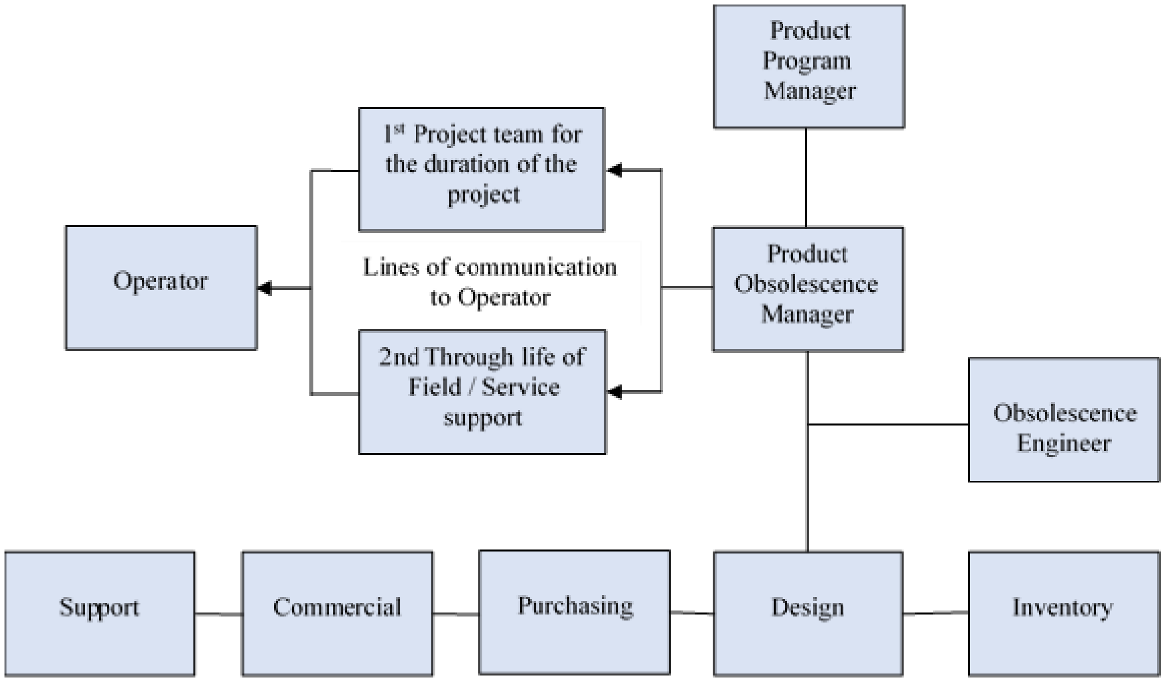

Fig. 2 Organizational structure for Obsolescence Management process [2]

The Obsolescence Engineer has the role of continuously monitoring and reporting the issues and concerns regarding Obsolescence Management through first level risk analysis and mitigation; recording all assessments and decisions in the obsolescence risk recording system; ensuring management of obsolescence alerts and reporting of obsolescence management as per contract and other requirements; make sure that new components entered into the supplier's database are approved for an agreed level of availability, both in terms of time and legislation and manufacturing; work throughout the supply chain to help to identify and resolve obsolescence issues/concerns, and record appropriate actions taken.

The Commercial area has the role of agreeing with the Operators the contractual requirements for Obsolescence Management; complying with Operators the appropriate Key Performance Indicators (KPI) regarding obsolescence resolutions and cost reduction, and internally transmitting the contractual conditions applicable to the company products.

The Purchasing area has the role of negotiating with suppliers to ensure that the requirements for Obsolescence Management are transmitted and defined within the terms and conditions included in orders; include Obsolescence Management requirements in the vendor selection; ensure that components and parts to be purchased are not yet obsolete and unavailable, and be aware of approved aftermarket suppliers.

The Inventory area is responsible for provisioning and managing the inventory in accordance with the Product Obsolescence Management Plan and in conformity with the Supplier Obsolescence Management Policy; reporting any suspected counterfeiting (if applicable), and informing the Obsolescence Management of any life issues that affect availability from the perspective of obsolescence.

The Design area has the role of selecting the parts to be used in the development and life of a product, including checking for obsolescence when selecting a part; maintaining configuration control, reflecting changes caused by resolving an obsolescence issue/concern; approving obsolescence status reports for each phase of product lifecycle management; ensure that any changes to a product from an obsolescence standpoint are properly addressed and that the product can be fully assembled and tested to the required standards; and ensure that all test equipment is available and properly certified to meet product requirements and be a company team working to optimize the mitigation of obsolescence issues/concerns.

The Support area has the role of contacting other functional units to reach a resolution agreement that is practical to support once a product has been delivered; keep spare parts failure and consumption rates as an input to managing the total considerations when an obsolescence problem/concern is identified; advise the Obsolescence Manager of deployed configurations for a project so that a complete understanding of the impact can be obtained (depending on whether a support contract is in place); analyze returned product failures and subsequent repairs for use in obsolescence assessment, and maintain documentation to support the configuration of a project and/or asset (depending on whether a support contract is in place) and be the service support for the field’s life.

VII. METHODOLOGY

The methodology to be used is the *Design Science Research - DSR*, as proposed by [14], with the necessary adaptations and simplifications to the context of this article. The *Design Science Research* methodology consists of 12 steps, as shown in Figure 3.

The *Design Science Research* establishes and operationalizes research when the desired goal is an artefact or a recommendation. In other words, *Design Science Research* is the most appropriate research methodology when the objective of the study is to design and develop prescriptive artefacts and solutions in a real or simulated environment [14].

In the context of this article, steps 1, 2, 3 and 4 are implicit in the early parts of the text, when an opportunity was identified, when this opportunity was understood through the literature review and when the organizational structure was presented by [2].

Step 5 will be the proposition of adopting the organizational structure presented by [2] to the context of a wellhead equipment supplier, using the abductive method, which consists of studying facts and proposing theories to explain them.

Steps 6 and 7 constitute the design and development of the new structure that will basically correlate the proposed structure with the existing structure of the wellhead equipment supplier, taking into account the existing areas and functions. In these two steps, the deductive method, which consists in studying universal premises to arrive at a specific conclusion, can be used.

Step 8, evaluation of the organizational structure to be proposed, will not be performed in the context of this article as time limitations.

Step 9 will basically be a summary of the learning achieved during the development of the new organizational structure with its peculiarities. Step 10 will be the presentation of the conclusions.

Step 11, generalization for a class of problems, will not be performed in the context of this article, but it will be performed later in the continuation of the research. However, while the study is being developed, there is a tendency to the generalization for a class of "*equipment suppliers for subsea oil exploration and production*". The generalization for a class of problems, when performed, can use the inductive method, which consists in studying specific facts to reach the general conclusion. Step 12, communication of the results, will be the submission of the article for publication.

VIII. ORGANIZATIONAL STRUCTURE OF THE WELLHEAD EQUIPMENT SUPPLIER

In order to meet the Obsolescence Management requirements, as proposed by [2], detailed in section “E” above, the minimum organizational structure to be proposed shall use the existing areas at the wellhead equipment supplier, with the addition or not of personnel to be assessed on a case-by-case basis, clearly assigning the roles to be played by the people involved (step 5).

Considering the Company object of this study, used as a reference in this article, we can deduce the organizational/functional structure as shown in Figure 4.

In the minimum organizational structure proposed for the company, the roles of the Senior Management will be performed by the Operations and Services Manager. The Obsolescence Manager roles will be performed by the Contract Manager with the help of the Contract Officer, who will act as the Operator (Client) Communication Interface. In addition, the contract area is always supported by the Legal Department.

Considering that the minimum organizational structure proposed is for the Obsolescence Management in the aftermarket phase, the development/product engineering area will not be involved, but two key engineering people will be required, here called Upgrade Engineer and Obsolescence Engineer. The Upgrade Engineer is responsible for validating all product modifications due to process improvements, material changes, modifications in operation, changes in standards and legislation, and new health, safety and environmental (HSE) requirements. This professional should be trained in obsolescence issues and work closely with the Obsolescence Engineer to ensure compliance with the Obsolescence Management requirements. The Obsolescence Engineer will be a professional who should perform all the roles prescribed by [2] for the Obsolescence Engineer.

The Materials area should have a Purchasing Professional and an Inventory Professional, and both trained to support the Obsolescence Management process. A trained Professional from the Sales area and a trained Professional from the Field Service area will also be required.

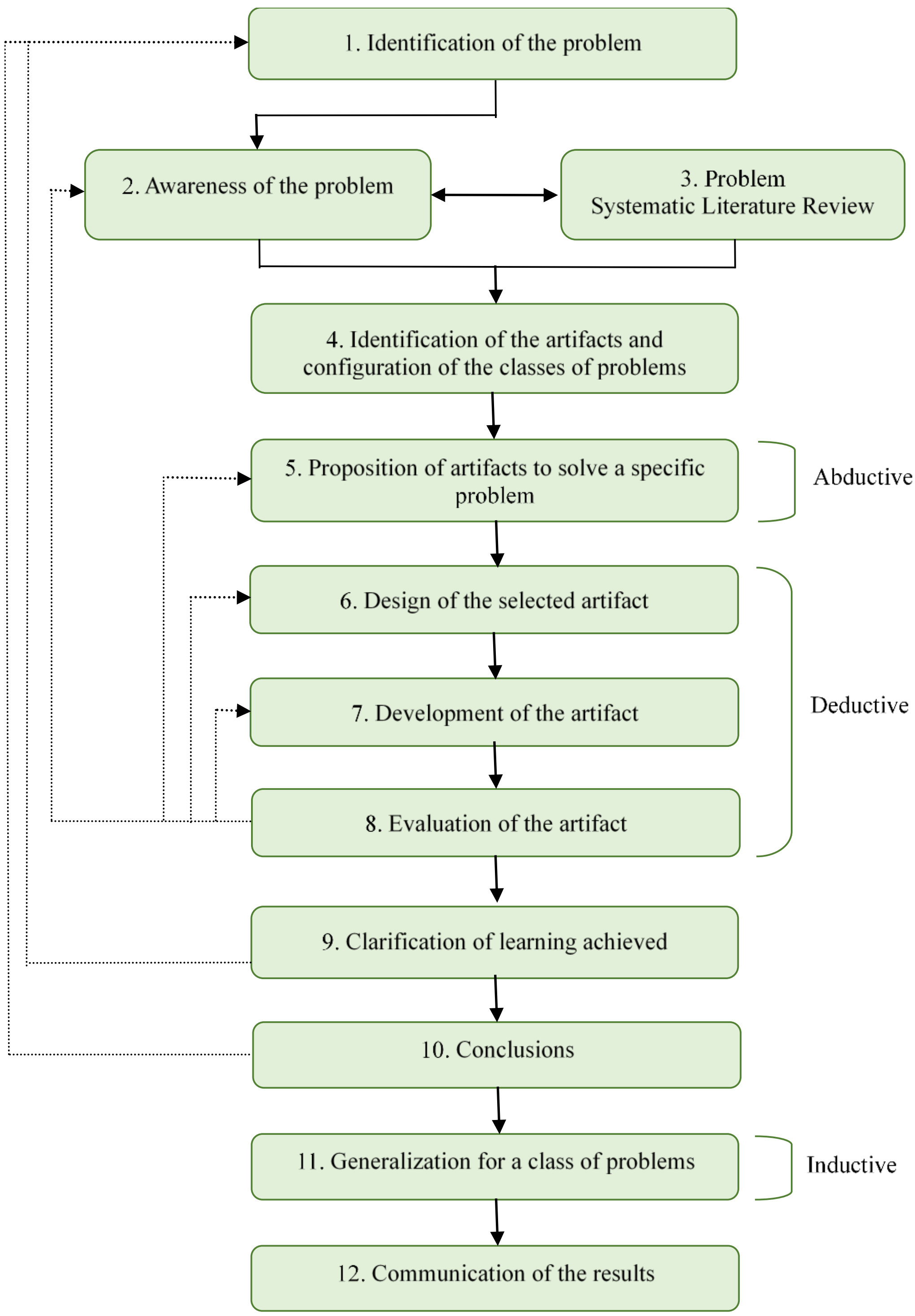

Fig. 3 Design Science Research methodology [14]

With this minimum organizational structure is possible to perform the Obsolescence Management, provided that the workload is properly evaluated based on the amount of equipment included in the Obsolescence Management Plan (steps **6** and **7**).

The evaluation or validation of the proposed organizational structure will not be done in the context of this article. To do so, it would at a minimum be necessary to evaluate the organizational structure proposed in a simulated environment, or ideally, to deploy the proposed organizational structure in the company to verify its operation in real condition for a determined period of time (step **8**).

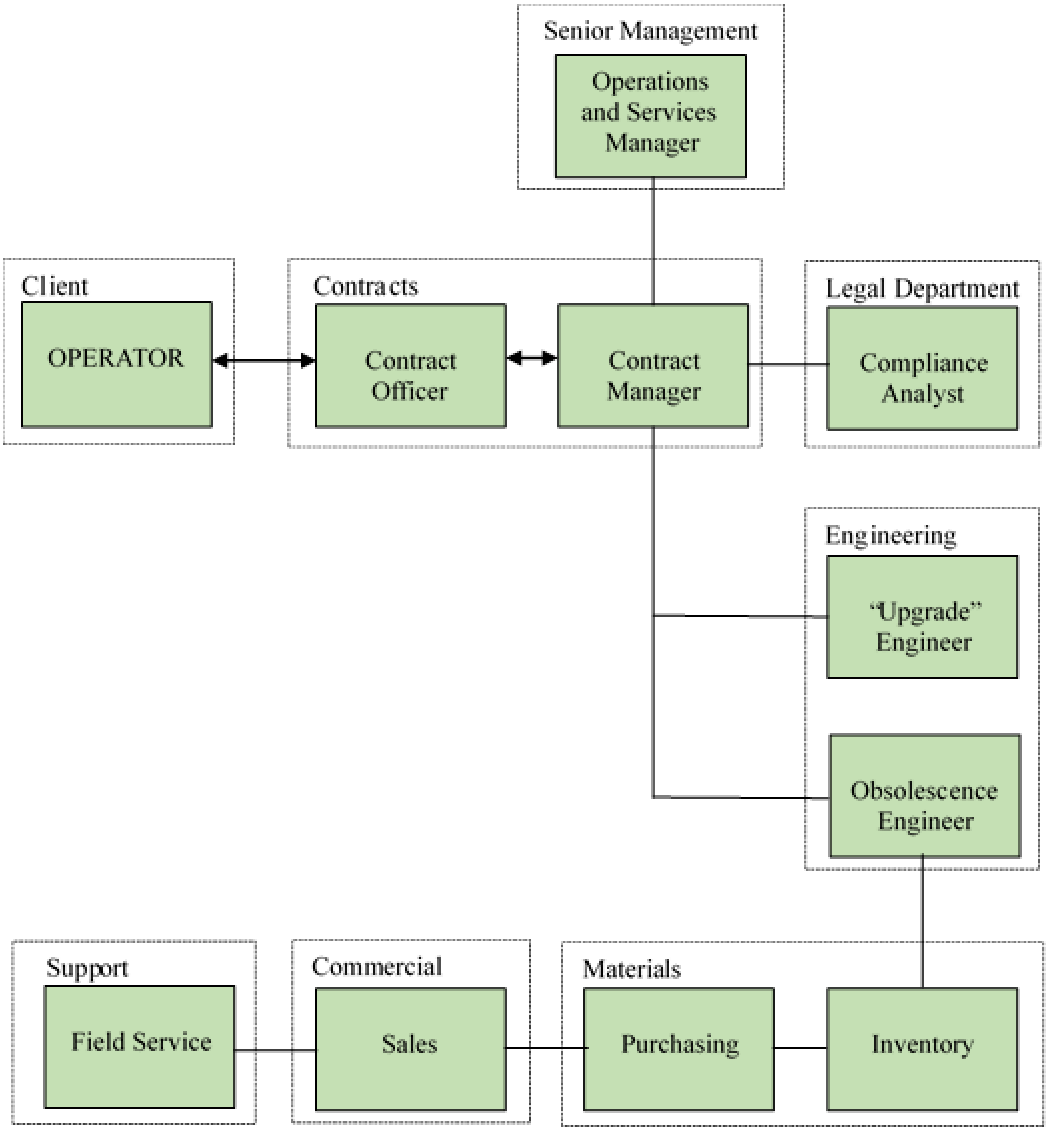

Fig. 4 Organizational structure of the wellhead equipment supplier (proposed by the authors)

In summary, the following learning was achieved during the development of this article: Obsolescence Management is characterized as **risk management** that may be required by the client, in this case, the **Operator**; the minimum personnel and organizational structure to meet the customer requirements in accordance with [1], [2] can be inserted into the existing wellhead equipment supplier structure, depending on the workload that should be assessed against the Obsolescence Management Plan and appropriate training for people who will be key in the Obsolescence Management process is required (step **9)**.

IX. CONCLUSION

The objective of this article was to present the minimum personnel and organizational structure appropriate to the context of an aftermarket wellhead equipment supplier to meet the requirements of reference models [1], [2]. For this purpose, a review and application of the *Design Science Research* (DSR) method adapted to the context of the company object of this study has been conducted

It was concluded that with the minimum personnel and organizational structure presented in section VIII, it is possible to meet the Obsolescence Management requirements, as prescribed in [1], [2], at a wellhead equipment supplier in the aftermarket phase. In this way, the main objective of specifying the minimum personnel and organizational structure required and the secondary objectives necessary to achieve the main objective have been achieved, as well as answered the research question (RQ).

For further research, it is recommended the evaluation of the organizational structure proposed in this article in the studied company, as well as extend this research to others Wellhead Equipment Suppliers.

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