SEMARAK ILMU PUBLISHING
202103268166(003316878-P)

Journal of Advanced Research in Fluid Mechanics and Thermal Sciences

Journal homepage:
https://semarakilmu.com.my/journals/index.php/applied_sciences_eng_tech/index
ISSN: 2462-1943

Design/Engineering For Production (DEFP) and Shipyard: A Review on the Malaysian Technological Aspects and Practices

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ARTICLE INFO

Article history:
Received 2 September 2022
Received in revised form 17 Nov. 2022
Accepted 18 November 2022
Available online 30 November 2022

Keywords:
DEFP; shipyard; shipbuilding industry

ABSTRACT

Design/Engineering for Production (DEFP) DEFP is viewed as a function and strategic resource of the shipyard. More importantly, the ability to strengthen DEFP would enable the shipbuilding industry to gain competitive advantage. This paper examines the role of Design/Engineering for Production (DEFP) as strategic decision in the shipbuilding industry. Incorporating evidence from reviews of relevant literature, this study demonstrates that there were abundant opportunities for DEFP, thus, proves that the role of DEFP was important. Moreover, the current approach focusing on transformation programs which emphasized on enhancement and effectiveness of planning and DEFP functions were justified. The company's investment in this area of concerned eventually would bring up the competitiveness of the company. Indirectly, the effort would also be contributing to the continual growth of the local shipbuilding and ship repair industry.

1. Introduction

The shipyard is the platform of the company which runs the business enterprise [1-2]. According to Strandhagen *et al.,* [3] the shipyard has two distinctive processes that produce the value chain: shipbuilding and ship repair. The internal processes of the shipyard which involves the construction of a complex and highly customized ship or the conduct of repairs and maintenance work of naval ships as well as the provision of technical services can be considered as an excellent base for a specific application of resources or market-based concepts to examine a company's sustainable competitiveness strategy [4-5].

The first part of the review explores on DEPF. The search seeks to explain the mechanics of DEFP within the context of an enterprise from theoretical perspective, in particularly in the environment of a big construction business involving complex design and many processes. This paper aim is to focus on the information regarding DEFP as a resource of the company. Furthermore, the intent is to comprehend the position and depth of DEFP in influencing the strategy and contribution to the company's competitive advantage position.

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https://doi.org/10.37934/araset.28.3.336350

1.1 DEFP

In many of resources employed by the shipyard, or currently being possessed by the company, it is essential to select and define significant resources that may have potential to be deployed and achieved the desired outcome of the firm to sustain competitive advantages. Design/ Engineering for Production (DEFP) is achieved through the execution of knowledge-based design synthesis centered on scalable multi-objective optimization [6-7]. According to Corporationi [8], Integration DEFP should have as its main objectives: 1) Produce a design that represents an acceptable compromise between the needs of a shipowner and a builder (Functionality versus Producibility); 2) Produce a design that exhibits characteristics consistent with the known characteristics of the shipyard facilities (Availability versus Producibility); and 3) Produce a design that facilitates the integration of equipment effort with the effort of fabricating and assembling structural steel (Integrability versus Producibility). Engineering for ship production is the use of production-orientation technique to transmit and communicate design and engineering data to various users in the shipyard [9-10].

The function determines the best methods of transmission and communication of design and engineering information Vidal-Balea *et al.*, [11]. On the other hand, according to [12], isolated engineering is the approach in which, although the design details are shown, they do not integrate any input or production decision such as block boundaries, piping flange or weld breaks, preferred details to suit production methods etc. It normally took a long time to develop the engineering and then the production planning to organize the information into a production-compatible form [9-10].

Meanwhile, Pérez [13] stated that it is necessary to make a clear distinction between product design capability and production design capability. In shipbuilding practices, the design process begins with the conceptual design, the baseline design, and ultimately the detailed design phase of the product [14-15]. On the other hand Mio *et al.*, [16] argued that this work by nature is classified based on the outcome as a product, so the entire design process involves product engineering work. However, the focus on this review is to investigate the design for production organization and related process flows. Therefore, the context is expressed as either Production Engineering (PE) or Design/Production Engineering (DEFP). In conclusion, the company's DEFP resource is selected to be potentially the resource used by the company to achieve a sustainable competitive edge and in this review, it is in the Malaysian Shipbuilding and Ship Repair (SBSR) sector.

2. Methodology

A detailed and extensive literature search and study was undertaken by the authors on the concept and definition of Design/Engineering for Production (DEFP), shipbuilding and ship repair industry, resource-based view, competitive advantage, and concurrent engineering and serial engineering and various process and design in shipyards. The history and theory of shipbuilding, competitive advantage, resource-based view concept and technological developments have been critically examined and analysed in this review paper. The reviewed papers were presented and can be found in the next section.

3. Result

3.1 Process Design and Technology in Shipyard

The product of the shipyard consisting of building and repairs of ships [13]. It is characterized by low volume and high margin business [1]. According to Mio *et al.*, [16], in the context of this shipyard, the products are not identical in the way it is produced, even if the design is for a class of ships. Similar situation in shipbuilding, ships entered the shipyard for repairs do not have the same design and engineering requirements, although they were built in the same class of ships [3]. In the process selection, according to Hayes and Wheelwright [17], the following Figure 1.0 illustrates the choices for selection of production process on items to be produced in-house. The best process strategy is projects for the shipyard [18].

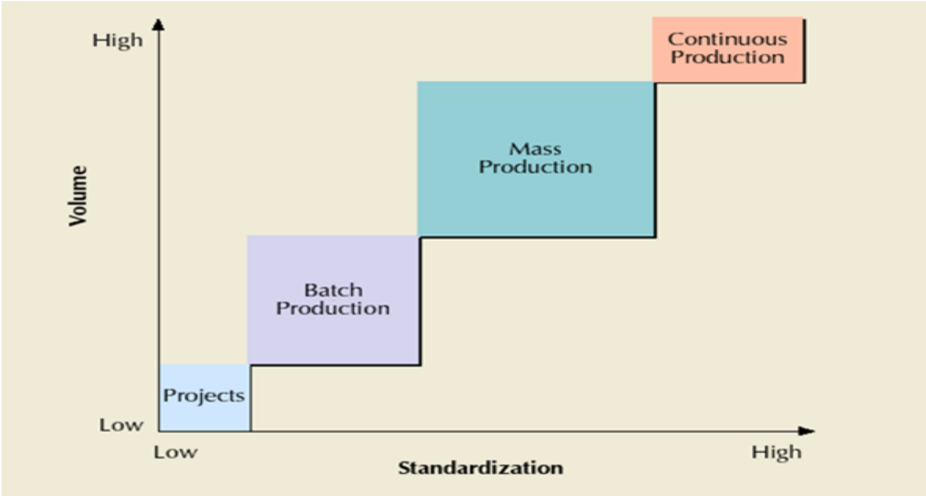

Fig. 1. Product-Process Matrix

According to Russell *et al*., [19] as the company moves from project to continuous production, the volume of demand rises, products are becoming more standardized, systems are getting more capital intensive, more automated and not as flexible and clients become less engaged. This resulted in substantial savings in the sales process and increased productivity at the same time [20].

Shipyard runs projects as its product, whether build or repair ships. Due to its specialized contract for most of its projects, the selection of process design in dealing with projects need to take into consideration of 1) high skill level of craftmanship and expertise, 2) dealing with customized works with latest technology and 3) non-repetitive, small customer base and expensive [21]. The products produced by the shipyard are characterized by a low level of standardization and volume [22.] Consequently, the product-process matrix corresponding to the product characteristics leads to the selection of a project's production process [23]. The items will take a lot of time to fill, will require a significant investment of funds and resources and will produce one item at a time to consume the order [12].

To understand projects being implemented in the shipyard by the characteristics of a project, the construction or repair process could be done as a process or product layout. The following Table 1 illustrates the features of product vs process layout and applied to the current setting in the shipyard. This understanding is vital in order to 1) establish the position of DEFP from the perspective of the literature and 2) correlate with the gaps in the production process [24].

A process layout is a functional layout that groups similar activities within departments or work centres according to the process or function to be performed Mio *et al*., [16] added, in a different way, product layout arranges activities in a line as according to the sequence of operations that need to be performed to assemble a particular product. Based on the above framework, the features of the functionality of DEFP in the shipyard are probably a mix between process and product layout. Moreover, the DEFP is arranged sequentially in Ship Building (SB) and Ship Repair (SR) which is entirely a function of Production. But at the same time, the specialization and expertise are managed by using the process layout, including DEFP. This is reflected in the organization charts of both

Shipbuilding and Ship Repair. Design, Engineering and Production entities including the works are separately being set-up as the centre to do its specialization and operate independently in the shipyard.

Within this structure, the shipyard encounters gaps in its delivery system, evidenced by delays of ships being delivered and erosion of its profitability. Searching for specific areas of design and engineering functionalities with the firm, the researcher seeks the explanation from the review on the gaps in process layout, in particularly the DEFP. One of the explanations on the gap within the framework discussed earlier is a situation recognized as 'Over the Wall Phenomenon'

Table 1
Production process

Elements	Product Layout	Process Layout
Arrangement	Sequential Activities	Functional group of activities
Type of process	Continuous, mass production, mainly assembly	Intermittent, job shop, batch production, main fabrication
Product	Standardized, made to stock	Varied, made to order
Demand	Stable	Fluctuating
Volume	High	Low
Equipment	Special purpose	General purpose
Workers Inventory	Limited skills Low in process, high finished goods	Varied skills High in process, low finished goods
Storage space	Small	Large
Material Handling	Fixed path	Variable path

3.2 Over the Wall Phenomenon

During the Industrial Revolution, technology increased in complexity. Lipis *et al*., [25] argued that the complexity forced employees of the companies to specialize in different areas of product design process. No longer could one person be responsible for the design, manufacture, and sales of a product [23]. According to Jurabek *et al*., [26], the era of craftsmanship has been replaced by the era of the specialist. Large corporations have begun to organize themselves in departments with different responsibilities [27]. Each department worked on a product until they have completed their tasks and then handed off the project to the next department. The scenario of over the wall approach as depicted in Figure 2 can be illustrated in the following example, based on the client brief the architect produces an architectural design, which is given to the structural engineer, who on completing the structural design phase passes the project to the quantity surveyor to produce the costing and bill of quantities. Additionally, Song *et al*., [2] stated that this goes on until the project is then passed on to the contractor who takes responsibility for the construction of the project. This sequential process is very slow and causes many issues when communication between departments fails [27]. The breakdown of communications led to projects being thrown back over the walls that divided the departments for rework [28-29]. This process is commonly referred to as 'Serial Engineering'.

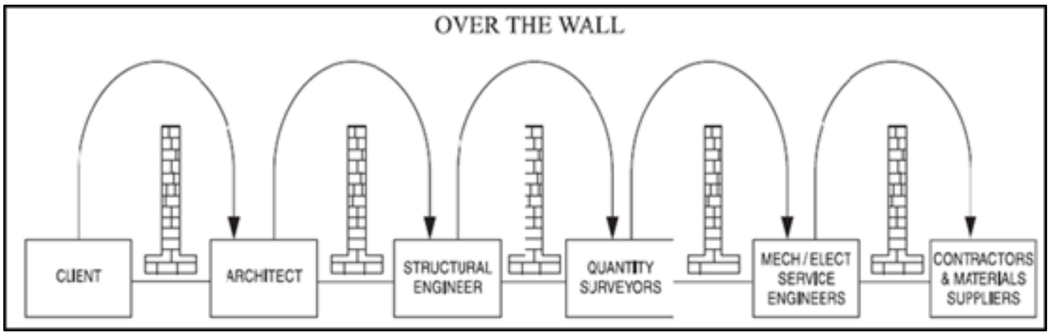

Fig. 2. Over the Wall Phenomenon

3.2 Concurrent Engineering vs Serial Engineering

According to Malek *et al*., [30], key disadvantages of the traditional approach in serial engineering process include 1) Fragmentation of different participation in the construction project, leading to misconceptions and understandings; 2) Fragmentation of design and construction data, leading to design clashes, omission and errors; 3) Occurrence of costly design changes and unnecessary liability claims, occurring as result of the above; 4) Lack of true life cycle of the project, leading to inability to maintain a competitive edge in a changing market; and 5) Lack of communication of design rationale and intent, leading to design confusion and wasted effort.

In Serial Engineering, each design phase starts mostly when the previous one is completed [31]. During this process, any incomplete data is passed through a function or phase and augmented with new data only to be passed on to the next phase [2]. According to Prasad [32], the serial approach to product design, development, manufacturing, and marketing has produced several other shortcomings, consisting of 1) It is based on the premise that a new phase cannot start until an old phase is completed and signed off. This usually means lengthening the product development cycle time; 2) The linear input to product development implies that significant portion (50% to 80%) of manufacturing cost may be committed before manufacturing engineers have a say in product design; and 3) Due to the time loss, the final product may not remain suitable or viable for the market that was initially targeted at product launch.

On the contrary to Serial Engineering process, Concurrent Engineering (CE), which emerged in 1990s, focuses on tasks' timing and duration across its entire organization with the goals of reducing task's time without any apparent loss in value to the finished product or services [33-35] It includes involvement of personnel from all required disciplines: engineers or non-engineers [36] In CE, all major parties involve in getting the product to market and contribute to the development of the product [37] The approach requires a parallel interactive (managed) and cooperative multidisciplinary team approach to product and process development. In short, CE is leveraging the teamwork to handle information and make informed decisions [27]. According to Olajoyegbe [38], CE is directed towards utilizing the team's intellectual power, the team consisting all parties that are involved in the production realization process.

3.3 Model for Sustained Competitive Advantage

Traditionally, various researchers have suggested that companies get a sustained competitive edge by implementing strategies that leverage their internal strengths by responding to environmental opportunities while neutralizing external threats and avoiding the weaknesses [39-42]. The study on sources for sustained competitive derives from the perspective of isolating a firm's opportunities and threats [43]. Further works within this view makes the efforts to describe the environmental conditions that favour high levels of firm performance [44-47]. More importantly, the renewal energy potential can be explored more extensively in the shipbuilding and ship repair industry. In addition, [48] stated the opportunity of solar and marine renewal energy in Malaysia.

The Porter Five Forces model describes the characteristics of an attractive industry and therefore suggests that the opportunities be greater and that the threat be less in these types of industries. Two basic assumptions intrinsic to this which basically differs from Resource-Based View (RBV). First, the environmental models of competitive advantage assume that firms within an industry (or within a strategic group) are identical in terms of strategic relevant sources they control and the strategies they pursue [43,49-50]. Second, these models assume that should resource heterogeneity evolve in an industry or group (perhaps through new entry), this heterogeneity will not be sustained for a long period of time because the resources that firms use to implement their strategies are highly mobile [51-53]. This means that these resources can be acquired by buying or selling in the factor markets [54-55]. Conclusively, in pursuing the implementation of their strategies, companies must analyze their competitive environment, decide on their strategies, and then acquire the necessary resources to execute the processes [56-57]. This is based on the notion that companies have the same resources to implement those strategies or have the same access to those resources.

Alternatively, RBV approaches on resources that contribute to the sustained competitive advantage differ from the standpoint of Market-Based View (MBV). These long-lived differences in firm profitability cannot be only attributed to the differences in industry conditions by virtue of the link between firm’s internal characteristics and performance [58-60]. In arriving at sustainable competitive advantage, the model to analyse sources of competitive advantage from the perspective of RBV, propose two alternate assumptions. Essentially, RBV assumes that firms within an industry or group may be heterogeneous with respect to strategic resources they control, and these resources may not be perfectly transferable nor interchangeable across firm. Effectively, heterogeneity can be sustained over a long period of time [61].

While the objective is to deliberate on the terms under which the resources of this company can be under a sustained competitive advantage, the company is seen to have a sustainable competitive advantage when it meets two conditions [62-63]. First condition is when the firm executes a value creating strategy which is not simultaneously being implemented by any current or potential competitors; and secondly, when other firms are unable to duplicate the benefits on this strategy [64]. In order to maintain a competitive advantage, the first requirement is that the company must compete not only with its existing competitors, but also with potential competitors, who want to enter an industry in the foreseeable future [51-52]. As a result, the latter condition requires a sustainable competitive advantage to depend on the possibility of competitive duplication. It is not the passage of time that contributes to the existence of a sustained competitive advantage, but the inherent situation of existing and potential competitors who are unable to replicate this competitive advantage strategy is maintained.

Based on the work of [65], it is not proposed that there should be industries where there are elements of perfect homogeneity and mobility. With the rapidly developing Internet of Things (IoT), this seems to be the case [66]. On the other hand, most industries can be expected to have at least a certain degree of heterogeneity and immobility in resources [67]. Furthermore, Tedja [68] added that RBV takes this perspective that considers exploring the possibility of acquiring sources of sustained competitive advantage under the condition of the industry where firm resource is heterogeneity and immobility. Accordingly, it is not viable for firms to achieve a sustainable competitive advantage under homogeneous and mobile industrial conditions [42]. This means that in executing the strategy, identical companies are designed with the same resources to implement a similar strategy [69]. Referring to this statement, the question remains whether a pioneer is a benefit that requires the company to be in a sustainable competitive advantage. To position itself with respect to the homogeneity and mobility of resources, it seems favourable for the company to ensure that the advantage is primarily in the implementation of the strategy. Nevertheless, this is not the case because in homogeneous and mobile industry, other firms are also able to conceive and implement similar strategy and it can be done in parallel with the first mover firm. They can do so because identical firms become aware of the same opportunities in the same way.

In a heterogeneous industry in terms of the resources it controls, the first mover will have the advantage [70]. According to Huo *et al*., [71], another constraint is in the idea of requirement that firm resources are to be immobile for barriers to entry to exist that influences the firm condition in order to be on the advantage. For a barrier to entry or mobility to exist, companies protected by this barrier must implement different strategies than those of companies seeking to enter this protected competition zone [72]. Due to this discrepancy in approach, as suggested by McGee *et al*., [73], the inability of companies looking to enter an industry as well as the company within the industry to implement the same strategies should not have the same strategic resources as firms in the industry. Therefore, if resources are fully mobile, any resource that allows some businesses to implement a strategy that is protected by barriers to entry or mobility can be easily acquired by companies interested in entering this industry [46]. Thus, these strategies are not a source of sustained competitive advantage.

3.4 Issues in Interpreting the Value of DEFP in the Sustainability of Shipyards

This review seeks to understand DEFP's role in the company within the shipbuilding and ship repair industries in Malaysia. Accordingly, the review will use the underlying theories of RBV and the Gestalt to uncover problems related to the relationship between DEFP and shipyard operations. DFP is the preproduction phase in the shipyard business enterprise, primarily work after the completion of the ship's conceptual and basic design [74].

The research gap seeks to answer whether DEFP is the resource that contribute to the sustainable competitive advantage of the firm. According to Barney *et al*., [75], they proposed that in order to apply RBT, it is pertinent to research deeply in the firm through more appropriate methods. The strategic resources that are identified as a resource of economic value can vary significantly from firm to firm. In research, a qualitative case study approach is often more appropriate as the mere deliberation of statistical data does not help concrete understanding.

Furthermore, Barney [51] proposes a theoretical model to be used in understanding sources of sustained competitive advantage based on the assumption of the firm resources may be heterogeneous and immobile. This model offers the framework to analyse resources in order to qualify and meet the conditions contributing to the firm’s sustained competitive advantages [60]. There are four attributes to define and qualify these resources.

3.4.1 Valuable Resources

Firstly, the company's resources need to be valuable in order to be the source of a sustained competitive advantage. Firm attributes can only be sources for sustained competitive advantage when they exploit opportunities or neutralize threats in a firm’s environment [64]. Moreover, [98] stated that these resources are valuable when they enable the company to develop and implement strategies that increase its efficiency and effectiveness.

3.4.2 Rare Resources

Firm resources which are valuable possessed by large number of competing or potentially competing firms do not qualify to be sources of sustained competitive advantage [63]. This is because when they implement a value creation strategy, simultaneously the strategy is carried out by many other companies. It must be valuable and rare, and firms at least could achieve a competitive advantage position when the firm possess the valuable resources which are entirely distinctive among the competing firms [42].

3.4.3 Imperfectly Imitable Resources

Valuable and scarce resources could be sources of sustained competitive advantage if businesses without these resources cannot acquire them [76]. Firm meet the requirements of having imperfectly imitable resources when it meets one or a combination of the following conditions. First, RBV recognizes the notion of the firm's unique historical conditions that precedes the condition of being imperfectly imitable [77]. This view asserts that businesses are, by their very nature, historic and social entities. Hence, the company's ability to acquire and collect resources depends on their place in time and space. Hence, [78] highlighted that once this particular and specific period in history has passed, companies that do not have space- and time-dependent resources cannot simply obtain them.

Second, the relationship between the resources possessed by a firm and a firm's sustained competitive advantage is casually ambiguous [77]. Additionally, [79] added that it occurs when the relationship between the resources controlled by the firm and the firm's sustainable competitive advantage is not understood or understood very imperfectly. Under this condition of causal ambiguity, it is not clear that this resource that can be interpreted as the same resource that produces a sustained competitive advantage, or whether that advantage originated from other firm's resources which are not defined [42,80].

Faced with causal ambiguity, imitative firms do not know what measures they should take to copy the strategies of firms with a lasting competitive advantage. Both the imitator and the companies with these resources need to be at the same level of causal ambiguity in order to be a source of competitive advantage [81-82]. Moreover, all competitors must have an imperfect understanding of the relationship between the resources controlled by a firm and a firm's competitive advantage [83].

Finally, a final basis for a firm's resources to be imperfectly imitable is the notion that they may be very complex social phenomena beyond the ability of firms to systematically manage and influence [76,77]. This leads to a situation to which other firms to imitate remains uncertain.

3.4.4 Substitutability

The final requirement for a firm resource to be a source for sustained competitive advantage is at no circumstances a firm shall have strategically equivalent valuable resources whether it is not rare or imitable [83,84]. According to [85], by possessing two strategically equivalent resources, the firm can each use these resources independently to implement the same strategies. If one of firm's strategic equivalent resources is rare and imperfectly imitable but the other is not, these circumstances open the possibility other current or potential competing firms to implement these same strategies but in different ways and using different resources [77,84]. In addition, if these alternative resources are not scarce and reproducible, other companies could be able to generate and implement the same strategies [86]. As a result, these strategies will not generate a sustainable competitive advantage even if they use valuable, rare, and imperfectly imitable resources.

In conclusion, this study may confirm the notion that that DEFP is the source of sustainable competitive advantage of the firm. Subsequently, the company may be able to develop strategies that put further investment in the enhancement of resources related to the function of DEFP. The firm may enhance its role and function in the shipyard delivery system. It is anticipated that the depth of this study may provide the focus of the company or the shipyard to adopt more concentration of strategies in enhancing this resource.

3.5 Additional Factors that Make Shipyards Sustainable

Sustainability of the company operating within the local SBSR industry is crucial as it contributes to the national agenda of military significance. Consequently, this review was conducted to understand which resources are essential and important to local shipyard operators. The performance of Malaysian shipyards is well behind the path that has been taken by Korean shipyards as the Koreans have transformed and developed as one of the world's top performers in this industry. As a result, the study identified few other success factors that should be addressed by local shipyards in order to make them sustainable and profitable.

3.5.1 Green shipbuilding technology

Various aspects of environmentally friendly shipbuilding technologies, with a view to greening the industry by reducing emissions in shipbuilding. According to [4], green shipbuilding technology assists with diminishing dangers to human wellbeing, natural perils, and property risks by reducing emissions to air, water, and land, saving energy, and working on financial and social advantages. In addition, green initiatives can also help determine the effectiveness of the Industrial Revolution (IR 4.0) [87], lean manufacturing practice [88], shipbuilding 4.0 [3] and Malaysian government participation in Green Supply Chain Management (GrSCM) [89]. Based on these arguments, shipyard operators should consider green practice to ensure corporate sustainability and profitability. The relationship between suppliers and shipbuilder also can be improved in order to maintain corporate sustainability and profitability through effective enterprise content management (ECM) system. Salleh *et al*., [90] highlight that ECM may help strengthen the relationship with suppliers. However, the supply chain risk management must not be forgotten as important aspect as well. The supply chain risk management has been shown to improve supply chain resilience and performance outcomes [91].

3.5.2 Organizational Commitment

Organizational commitment illustrates the level of organization involvement in ensuring safety culture and safe workplace practices [92]. In addition, [93] highlighted that the organization safety culture regulation in the maritime industry was established due to the mandate given to The International Maritime Organization's (IMO) by The International Safety Management (ISM). IMO defines safety culture as “*a culture in which there is consideration informed endeavor to reduce risks to the individual, ships and maritime environment to a level that is ‘as low as is reasonably practicable”*. According to [94], there are two types of organizational safety management (OSM). Firstly, the general description of safety, *"how things should be done"* which is embedded in processes, flowcharts, routines and other documents. Secondly, it is an informal matter of *"how things are actually done"* [92]. The attitudes, behaviours, beliefs, values and perceptions of workers about managing safety in the workplace constitute a safety culture [95]. There is a positive relationship between safety culture and corporate performance as safe working conditions will result in employee job satisfaction [96]. Therefore, this factor is also considered a critical sustainability factor for shipyard operators.

3.5.3 Job satisfaction

Exposure to environmental risk, particularly psychosocial risk in the workplace, is one of the greatest challenges to the occupational safety and health of shipbuilding workers [97]. Furthermore, da Silva *et al*., [98] stated that shipyard workers are subjected to particularly difficult working conditions that are characterized, among other things, by demanding physical activities and extreme temperatures (high or low). Work engagement and job satisfaction can deteriorate if shipyard workers have been working at the same company for a long time and if their working conditions have been neglected [99]. The primary goal of each business organization is to find effective ways to motivate employees to achieve and provide higher work productivity as well as increase the competitiveness of the organization. To do so, a highly satisfied workforce is required to achieve a high level of performance that will lead to the advancement of the organization [100]. Employee job satisfaction can sustain and support organizational competitiveness in today's highly competitive global era. Managers need to be aware that creating a satisfied workforce is a recipe for organizational success [101]. In the case of the shipyard industry, employee job satisfaction is a decisive factor for a sustainable and profitable company [96]. Moreover, Masrom *et al*., [102] assert that employees that have been exposed to TVET education which focused on physical and practical activities such as focus on how to handle tools, safety measures, operational check etc. can be very useful in the shipbuilding and ship repairing industry.

4. Conclusions

Based on the discussions resulting from the literature’s claims, it has been identified that the transformation agenda is being implemented in many critical areas of shipyard management, especially in project management, design, engineering, and production. In addition, this review concentrated on the domain of DEFP. For many periods in the shipyard, a concerted effort was made to address the issue of delays in ship delivery, whether it was a Maintenance, Repair and Operations (MRO) or a shipbuilding project. Successive management consultant companies were hired to arrive at the solution to the problem, but none came up with a complete and thorough solution fits in to the environment inside the shipyard. The pressure and threats to affect change increases by passes of time, mainly in the form of severe penalties due to the delay in delivery and ultimately touching on the fundamental issue of company continuing concern as a profit-making enterprise.

The causes of delays of the delivery of ship are to be established in direct connection to the dysfunctional of DEFP. Through transformation drive, DEFR will be created and nurtured to a resource critical to the performance of the shipyard. Based on the expected findings of the study, DEFP qualifies to be the resource that is valuable, rare, imperfectly imitable and no substitutability. Therefore, based on study, the pattern of adoption of DEFP in the organization of Ship Repair and Shipbuilding and correlating it with the shipyard performance is expected to be clear. Consequently, DEFP may make a significant contribution to the shipyard's continued competitive advantage

The findings of this study may suggest the relevance and growing importance of DEFP as a shipyard asset, especially when the evidence from the findings may indicate a huge difference in results in the adoption of DEFP between ship repair and shipbuilding. If this is the case, it will point to a profound divergence in strategic thinking between two production entities. The former is open to a change, but the latter would opt for the status quo. Design and engineering constitute an "engineering wall" apart from production. The study may indicate a strong conclusion suggesting DEFP as the resource that would not be entirely outsourced by the shipyard, other than design or production. Otherwise, the shipyard would lose its character and core resources that differentiate it from other shipyards. a resource that is difficult to copy and cannot be copied in its entirety from one to the other. In summary, this finding could form the basis for any review or consideration of a future capital expenditure program for the shipyard.

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