

## AN INDEX PROPOSAL FOR THE MEASUREMENT OF CAPACITY AND MATURITY OF SHIPYARDS: SHIPBUILDING MANAGERIAL AND OPERATIONAL CAPABILITY ASSESSMENT MODEL (S-MCM) TO TURKISH SHIPYARDS

Tersanelerin Kapasite Ve Olgunluk Ölçümü İçin Bir İndeks Önerisi: Tersanelerin Yönetimsel Ve Operasyonel Kabiliyet Değerlendirme Modelinin (S-Mcm) Türk Tersanelerine Uygulanması

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### ABSTRACT

Marine transportation has a very crucial role in the World economy. Shipyards have a very significant place in the maritime transportation. For economic development and stability must take a bigger share of shipbuilding. New technologies and trends, this is not possible without being followed. It is important to measure the maturity of a shipyard capacity in all respects. It is important when there is a possible ordering, money lending, or incentives. It is important when developing strategies for the future. It is important when there is a possible cooperation. However, according to George Akerlof's theory have received the Nobel Prize cannot be understood without cutting a decay lemon. Therefore, you cannot get enough information on the financial statements. In the shipbuilding sector, to assess the capability & maturity just by looking at shipyards financial statements is incomplete and even incorrect. In this study, it was tried to develop a level determination and criteria set suitable for the developing and changing needs of the day to evaluate the shipyards in terms of capacity and maturity. It was inspired by the CMMI model, which was originally introduced by the Carnegie Mellon University Software Engineering Institute and is accepted by other sectors today, based mainly on best practices from both manufacturing and management in the software industry. According to the results of the study, 5 basic levels and their criteria have been considered as well as the CMMI model inspired by S-MCM levelling

**Keywords:** S-MCM, CMMI, Capacity and Maturity Measurement Index

### ÖZET

Deniz Ulaşımı Dünya ekonomisi içinde çok önemli bir yere sahiptir. Tersaneler ise deniz ulaşımı içinde çok önemli bir yere sahiptir. Ekonomik gelişme ve istikrar için tersanecilikten daha çok pay almak gerekmektedir. Yeni teknolojiler ve eğilimler takip edilmeden bu mümkün değildir. Bir tersanenin kapasite olgunluğunu ölçmek her bakımdan önemlidir. Sipariş verirken, kredi verirken, teşvik verirken önemlidir. Geleceğe yönelik stratejiler geliştirirken önemlidir. İş birliği yaparken önemlidir. Ancak George Akerlof'un Nobel Ödülü almış teorisine göre, bir limonu kesmeden çürük olup olmadığı anlaşılabilir. Yani mali tablolar yeterince bilgi veremez. Tersane sektöründe de sadece mali tablolara bakarak bir tersanenin kapasite olgunluğunu değerlendirmek eksik ve hatta yanıltıcıdır. Bu çalışmada tersaneleri kapasite ve olgunluk bakımından değerlendirmek için günün gelişen ve değişen ihtiyaçlarına uygun bir seviye belirleme ve kriter kümesi geliştirilmeye çalışılmıştır. Temel olarak yazılım sektöründe hem üretim hem de yönetim tarafında en iyi deneyim örneklerinden yola çıkarak Carnegie Mellon Üniversitesi Yazılım Enstitüsü tarafından ortaya atılan ve günümüzde diğer sektörler tarafından da kabul gören CMMI modelinden esinlenilmiştir. Çalışmanın sonucuna göre S-MCM seviyelendirmesi için de esinlenen CMMI modelinde olduğu gibi 5 temel seviye ve bunlara ait ölçütler gözlemlenmiştir.

**Anahatar Kelimeler:** CMMI, S-MCM, Kapasite Ve Olgunluk Ölçme İndeksi

## 1. INTRODUCTION

Shipbuilding Industry is such a strategic industry for Turkey that it is essential to get a quick jump in the economy. Shipbuilding and shipyard industry allow the foreign exchange input, foreign capital inviting, providing and development drag the supply industry in together. This industry attracts the transfer of technology, because of the service to the country's defense "strategic importance" which supports the commercial marine, 1 to 7 percent of employment with the supplier industry. (GİSBİR, 2014) Obviously a strategic sector requires strategic analysis and strategic management. Strategic management starts strategic analysis. "Strategic management research focuses on the relationships among strategy, environment, leadership/organization; each of these four constructions are multidimensional.

A strategies analysis must cover goals as well as current position analysis. By this mean, how they can achieve those goals can be decided. (Byars et al., 1996) From looking inner side this is the picture that why a company need C&M analysis. Looking with a broader angle; as a developing country, Turkey, with the possibility of new projects in areas with growth potential and capabilities of information technology and knowledge economy to compete with developed countries must develop new investment. Shipbuilding is

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precisely standing in this field, this recognition and proper development and high potential to grow. Furthermore, the investment is considered a high *multiplier effect* regarding the return. However, the field of information technology and the Modern World, it was needed to appreciate the need for countries not regarding the knowledge economy and the fact that the league will not go to a top league regarding competition.

Facts that mentioned above to reveal the objective criteria all the things out of the current situation asked to all parties. So, it is needed a Capability and Maturity (S-MCM) measurement tool. Maturity Models have been proven powerful tools to assess to current state of an organization regarding a certain aspect and drive improvement. However, maturity models are often developed ad hoc, without following a well-documented design and development method, and often do not provide a pathway to extend further and update the model to foster systematic enhancements and extensions. Different kind of work and scales can be used for method improvement. For example, the scale used by the Union of European electronic state preparation 'e-readiness' concept is one of them. The Capability Maturity Model (CMM) and Evaluation Methodology provide a tool and methodology for evaluating the odds of an organization according to some of the existing criteria. Maturity represents the ability to implement and sustain an internet service portfolio of an organization. Investment in human resources, structural capital, relational capital and IT technologies and investments and five maturity stages (web presence, interaction, transaction, integration and continuous improvement). These areas are evaluated using IC management model and CMMI model. The use of IC management intermediaries and processes not only ensures that practitioners manage resources efficiently, but at the same time evaluates auditors objectively. (Kim and Grant, 2010) In chapters it is considered some e-government and e-readiness models and evaluate similarities those projects and this article.

It is widely inspired from CMMI (Capability Maturity Model Integration) system tools in SW area. CMMI is a process model; organization of SW processes the SW planning, development, such as applications assessment of the maturity model. An exciting and excellent example of new generation standard is CMMI. To evaluate and appraisal of SW companies existing standards were not enough. For this reason, SW sector needed a new type standard. This was quite different but overlaps real and necessary demands. Software Engineering Institute (SEI) of Carnegie Mellon University started the approach and now 200 companies and university support CMMI in January 2002. Most of the sectors and fields like SW companies are need capability and maturity level measurements and appraisals. (Krowston and Qin, 2010) So in coming chapters CMMI will be especially irritated. "Since the Software Engineering Institute has launched the Capability Maturity Model (CMM) almost twenty years ago (Paulk et al., 1993), hundreds of maturities models have been proposed by researchers and practitioners across multiple domains at the end of this work, it was proposed an area specific survey method for S-MCM model investigation.

CMMI is a model that guides processes that are constantly evolving. A process definition sequence that can be directly applied to an organization is not a sequence. The actual procedures used by a business depend on many factors, including the application area and organizational structure and size of the plant. CMMI has two dimensions covering product life cycle: products and services. It consists of best practices for the development and maintenance of processes from development to delivery and support. (Safe+, 2015) Here in this work it is also separated a company managerial and production sides and phases of each side. Naturally to propose a well-designed model those are not enough. So it has also been found out machine park maturity, new technology and concept usage and global vision. To use a CMMI model published by SEI, it must be selected from multiple models available according to development needs. For this reason, in order to use the CMMI models published by SEI, it is necessary to know the content of each model and the area required to be developed. But on the other hand, it seems difficult for many users to choose a model from the SEI Web site because they need to prioritize the information bodies they want to address in their organizations and the approach they are taking to the process improvement efforts. In this thesis, it was desired to perform 360-degree investigation including all equipment and legal necessities. Those legal aspects are in not only Turkey but also international regulations.

At the outset, it was not possible to select a specific model to ensure that all the needs were compiled in a job. Requirements define a standard procedure for all CMMI models. It represents, for example, how processes evolve as the organization progresses and basic concepts. Each CMMI model helped to understand the content and decide how CMMI could best meet sector needs. (Ben-Menachem, 2003) One of this work's goal is getting some measurement and appraisal standards for shipbuilding industry. Standards are results of economic, social, technological demands and have historical backgrounds. Today standards are divided into

two groups: Volunteer and regulatory. Standards decided by countries, regions, unions or regulatory foundations. Some of the standard institutes are TSE, ITU, CE, ANSI, ETSI, and IEEE. Some parties to make a standard are consumers, producers, governments, institutes, universities as well as technological developments and social needs. Some standards are known only in a small business and group. Nevertheless, some are effects and widely spread out all over the economic sectors like ISO 9001. Those standards most of the time renamed or coded according to countries. Standards sometimes changes as technological and social demands changes. Some new standards publish or existing standards changes or two or more standards steering under an umbrella with more consensually manner. Another conduct to standards is measuring and appraisals. Measuring and assessments are based on real needs and can be used thousands of goals.

Methods to understand capability and maturity level are same for another sector. At the beginning, there must be white paper, which covers actual needs and real demands. Also, previous standards are must be scanned. At the beginning standards only described goods and by the time services also got standards since economy has two main components as goods and services. It's evident that measurement and appraisals of facilities is also based on actual and real needs. With process orientation being a central paradigm of organizational design and continuous process improvement taking top positions on top-level manager's agendas, maturity models are also prospering in business process management. Although the application of maturity models is increasing in quantity and breadth, the concept of maturity models is frequently subject to criticism. In fact, numerous shortcomings have been disclosed referring to both maturity models as design products and the process of maturity model design. Whereas research has already substantiated the design process, there is no holistic understanding of the principles of form and function that is the design principles maturity models should meet. It should be proposed an area specific, yet well-founded framework of general design principles justified by existing literature and grouped according to illustrative purposes of use. The structure is demonstrated using an exemplary set of maturity models related to business process management. So firstly, it has to be located exact place of shipbuilding sector by the light of historical, economic, technological and regional facts. (Roglinger et al., 2012) Inspiring CMMI in SW sector, it can be built a S-MCM model for shipbuilding sector. Before starting this work, literature have been scanned and there were some examples but no detailed work for shipbuilding sector. SW also can use in shipbuilding sector both in management and production sides. However, this is not the only reason to make S-MCM work. Main reason exists standards, data cannot reveal a shipbuilding company's exact position, and it does not matter from which angle one can watch. But till that time, it also has to be limited capacity to get right answers of questions, which can be asked to understand S-MCM measurement. A large number of items/issues have potentially risked. It can't be sure the answers certainty. Company may avoid to responses some questions because of trading cares. Too long and too many questions can because weariness.

Up to now, it has been revealed the similarity to evaluate S-MCM analysis for a shipbuilding company and IT-CMMI technique. But if it is considered Shipbuilding Company as a technology basement it has to be understood that there should be more relation between Shipbuilding Company and IT usage. Beginning from management with has to be considered all phases of production and not surprisingly now new technologies; new concepts and methods are strongly related with IT technologies with different levels. The issue also shows the need of measurement of S-MCM level in another aspect. Just for this kind needs there is a concept called 'succinct questions' means asking as low questions as reasonably and achievable to reach our goals. Aimed result may only be possible preparing short but reliable questionnaire. Each field and question decided by using previous works, historical, social, economic facts and needs. But if some others standards have common points it is also calculated those facts. After preparing criteria cluster, it was testified whether it works or not. At the end, it was proposed a questionnaire to measure S-MCM level of a shipbuilding company with less effort but maximum precisely manner. To provide this purpose it was eliminated some questions, which give same results or one can be predicted by only looking the other's answer.

## 2. CONCEPTUAL FRAMEWORK

Shipbuilding and marketing, regarding their economic structure are very different industries. Shipyard is a massive engineering business with capability of large and sophisticated product built that requires high level of technical expertise to design and produce a merchant ship. Marketing requires substantial capital investment. Competitor shipbuilding is mainly in industrialized countries of Japan, Europe, S. Korea, China and Taiwan. Shipbuilding industry structure is mainly based on labor-intensive branches of industry. Moreover those are enabling installation of shipyard techniques and capabilities in a capital-intensive industry.

Ship is an item that has great importance. Shipbuilding in World trade; steel industry, machinery manufacturing, electrical and electronics industries, as of many sectors in products such as paint industry and rubber-plastic industry based on scientific and technological base, in particular a systematic and disciplined, brought together in the shipyard are emerging as a result of merging. In this sense, labor-intensive character and created a significant contribution to solving the employment problem is the broad scope of eligibility to be found. Besides this nature of shipbuilding industry; provide input in the development of foreign exchange and supply industry, attracting technology transfer, supporting the national maritime fleet and is an industry that contributes to the country's defense needs. Countries primarily, for the way giving importance to the shipbuilding industry development initiative, initially effortless and relatively easy to mass production, a job that requires systematic discipline and show the need for advanced technology applications are liquid and dry bulk carriers begin construction. To achieve the acquisition of such ships, which do not require advanced technical skills and shipyards are building steel construction that can be performed.

Leader shipbuilding countries also have leader automotive industries. The fact behind is because of technology transfer and heavy industry characteristic. Experiences and knowledge gained from shipbuilding activity is input to increasingly advanced establish a shipyard that has technological capability. A sophisticated and technical equipped shipyard requires a significant investment. On the other hand, due to the shipbuilding industry is labor-intensive industry, in countries where labor costs are lower than US\$ 2000/capita income level to set up new plants easier. To sell more cheaply ship in international markets and to increase the competitive condition, it is more suitable for countries where the income level is lower respectively. States that have completed the development of the shipbuilding industry and the countries have reached the level of economic prosperity, should not migrate easily move their capabilities and qualifications to those developing countries. Developed countries with advanced shipbuilding capacity, despite losing international competition in shipbuilding due to high labor costs, since shipbuilding industry have excellent employment potential, transport and industrial products that also provides other industrial sectors drag and development of significant size, governments prevent from closure of shipyards using subsidies. Shipyards in developed countries, the needs of other industries in other special types of advanced technological and colliding with the shipbuilding and shipbuilding machine, they resist closure undertaking the construction of equipment and steel construction. As long as there are human and technological progress no matter how many years will be needed to move the ship and shipping. In this sense, foreign currency inflow will contribute to the maritime sector of the economy and transport ships built can't be underestimated.

CMMI- Capacity Maturity Measurement Indexing is a model that guides developing processes. It is not a set of process descriptions that can be directly applied in an organization. The actual methods used by an organization depend on many factors, including application domain and organization structure and size. Thus, the process areas of a CMMI model do not typically map one-to-one with the processes used in an organization. Procedures used in an institution depend on various parameters such as work area, organizational structure and size. CMMI models are not processing or process definition is guiding the realization of a process. (A Safety Extension, 2015) CMMI models are composed of process areas. These process areas are used or in that each institution and the process consists in combining the organic bond with each other. Process areas results in any process improvement activities within the institutional structure of the interaction is defined independently of each other, though admittedly must be kept in mind.

Benefits of CMMI Adopting: CMMI technique is not only rates the maturity of companies' process, but it gives a level of assurance that the company being given the work will be able to complete the job in predefined time and price for a project. At the beginning it was used in the US defense sector. CMMI is now being adopted increasingly and widely to all business improvement in very diverse organizations. (<https://resources.sei.cmu.edu>) For the local software development industry to become more competitive on a global scale, it will need to fall into line with international standards, so that local companies seeking international contracts will be able to meet the CMMI level specified by foreign companies. CMMI provides a proven approach that has enabled diverse organizations to drive out real benefits regarding dramatically improved project predictability and consistency. While any or all of the above factors may drive an organization's initial interest in CMMI, the key benefit from implementing the model that executives focus on is consistency in delivery. CMMI driven process improvement also delivers real cost savings such as earlier and more effective error detection, and hence reduced cost of remediation, more effective management of change so you spend less on re-work, reductions in schedule variability and increased cost predictability.



The Need of a Model: Without a model of how an organization work, which functions it need, and how those functions interact, it is challenging to lead efforts to improve. The model gives an understanding of discrete elements in an organization and helps to formulate language and discussion of what needs to be improved and how much improvement might be achieved. The model offers some of the following benefits: Succeed a common framework and language to help communicate, leverages years of experience, helps users keep the big picture in mind while focusing specifically on improvement, trainers and consultants often support it, can provide a standard to help solve disagreements (Vizteams, 2017)

Technology Availability: Over the course of several decades, technology has helped address the needs of industries to implement production increased efficiencies and improve productivity. Shipbuilding industry is faced with an ever-increasing complexity with their products and processes. These complexities are not just from the shipyard product characteristic but also from the environment, safety, regulatory laws and the changing nature of the workforce. Once it is looked at shipyard industries High -Tech ranging from reducing workforce varying forms of technological innovations has been implemented for providing better and more cost-effective products. Lisbon Strategy and e-readiness report also wants to stress the importance of adoption to new method and technologies. In fact, one of them is shipyard and the only way to understand the level of approval is CMMI and maturity level.

Today, World has considerable challenges, IT technologies are an opportunity higher levels of growth but they don't reduce high unemployment rates competitiveness while fighting, especially among the youth them. Same dilemma is in shipbuilding industry. High -Tech is a big chance to grow economy but can't reduce unemployment rate. Smartphone usage in a country gives a data about average person's technology usage ability. And it also implies average shipyard staff can do digital affairs and it means readiness of technology usage in a shipyard is a factor of country global e-readiness. In the future, some new investigations may find out the correlation between smartphone usage (at least in some aspects) and maturity of shipbuilding industry (not entire country) of that country.

### 3. GENERATIONS OF SHIPYARD COMPANIES

Organizational Issues concerning CMMI: In this chapter, it will be look out the types (generations) of shipyards and then how a ship builds up. Therefore, it can be understood application of S-MCM level decision-making processes.

Generations of Shipyard: Shipbuilding techniques used, or intended to be used, production management models, settlement patterns, organizational structure, information and communication technology facilities, a multi-criteria shipyard currently considering such shipyard infrastructure is divided into five main classes from the technological point of view as below.

First Generation Shipyard: It can be easily affected by weather conditions sled, pool, or is it a similar structure as the first shipyard download system made of one-piece masonry way in the field of shipbuilding. To increase the number of annual shipbuilding sled, there are many pools and similar download system area and a large number of labours is needed. The equipment works without almost any boats being launched and then pulled into dock equipment transactions are completed. Equipment and steel construction areas or buildings within the yard looking at the space utilization are remote from each other and there is no communication and information exchange between them. This shipyard on the technological level is seen in the later period in shipbuilding country in the early 1960s. Massive transportation facilities like crane capacity are limited. Mechanization has an infrastructure is not available. Enterprise management systems are elementary, the computer does not have the support and operations were carried out manually procedure. Today shipyards in the technological level, there are not given those who have completed the formation.

Second Generation Shipyard: In shipbuilding particularly production method followed by welding in the shipyard with technology development and adaptation of other sectors in the management mounting units eg. a booster unit and blocks, steel construction, has been used. The most critical change, sled, and so is the number of downloads pool area is bordered by two or at most three and done in a closed space or in large buildings such as factories manufacturing of assembly work.

If the equipment works in the shipyards at this level is still maintained after downloading a large part of the apparatus, the material is only a small amount of work can be done before downloading. Steel construction and shipyard equipment or buildings in residential areas are still far from each other. Now the equipment units are deployed in a heap near the equipment dock. As a result of these technological shipyards in the

level of modernization works of the old shipyard in the late 1960s early 1970s, the leading shipbuilders developed countries and spread. Shipbuilding is a technological level where the first simple computer applications in business management. In today's conditions, technical level is a level well below the norms of the World shipbuilding industry.

**Third Generation Shipyard:** In the third-generation shipyards, equipment and steel building area is still not integrated in the shipyard area. Of the blocks, (steel construction) joining process (erection) has gained importance mechanization. Especially in the medium of the ship (parallel to the body) or the ship's relatively flat block production line (panel line) was initiated applications. Production rate of the steel subassembly and assembly process with this breakthrough has increased. Physical size of the blocks has increased significantly compared to the previous generation, but the construction time is lower. The number of building blocks production centre's relatively less. The equipment has increased the amount of work completed before download. Noteworthy is making the first application in a process of equipping other developments in the block. Third generation shipyard applications, has frequently been seen in the late 1970s. In the US, Europe, S. Korea and Japan were carried out in conjunction with the newly established shipyard modernization efforts. Due to the conditions of the day in this generation has been the mechanization of the principal competitive factors. Especially in ship design and manufacturing, computer utilization rate is higher in all business areas.

**Third Generation Shipyard:** This shipyard type, steel construction and equipment areas are separate from each other. However, transport is disposed to minimize the total cost. Steel erection, fully automated production line and a lot of history (panel line) was established. In many applications, they are united under a single umbrella factory gained view. Blocks were physically growing more than the previous generation. Thus, was born the super and mega blocks. Download the amount of work before the equipment, increased appreciable rate. Modular production has gained importance in the equipment. Production cycle time the period between the deliveries of the ship to be taken to the stockyards first group of steel is quite reduced. Implementation of the most advanced technology, especially at the beginning of 1980, is an embodiment developed with enthusiasm. This shipyard has been given importance in environmental protection. The shipyards are equipped with; sled, pool or other download systems and waste collection systems. Principally, in shipyards: Efficiency, Productivity and Manufacturability. It has been taken into consideration. These indicators were tried to be of the highest value: CAD Computer Aided Design, CAM Computer Aided Manufacturing, CAL Computer Aided Lofting, CAE Computer Aided Engineering, CIM Computer Integrated Manufacturing. Applications and operating systems with specific forms of information technology have been shown conclusively.

**Fifth Generation Shipyard:** scientific studies, arranged in the shipyard are the new generation of ongoing research and development work. The product is targeted to be based production structure. Also, today only increasing efficiency, reducing cycle time and product to be found in a narrow band of targets are abandoned. Fifth generation shipyard; fully tuned to the intermediate product and is an intermediate product of the standardization shipyard structure is provided. The product range can be achieved through this structure, which will be the most advanced shipyard structure. For all ships are aimed at ensuring the integrity of steel and equipment. Fully concurrent execution of these two significant events is planned. Besides the increased product, variety of the most important benefits is that it will fall in the production of the learning curve. Research and development have been initiated in the early 1990s. Automation and the use of robots, it is envisaged the full combination and overlapping levels of the entire system.

**Unclassified Shipyard:** Shipyards in this class, production and management level due to technological differences, and the classification of individual shipyards those are not possible. In any shipyard design, if it is decided to conduct a study of this type will take priority products to be produced. Those are concentrated on a single type of product. There is no flexibility. Production planning is relatively easy; the design process is relatively complicated.

In recent years, the Turkish shipbuilding industry experienced explosive demand and increased investment in shipyards after public shipyards survive in Turkey right now, the second and third generation shipyard. Today the shipyard to determine the technological level is the most critical step that determines all costs and profits of the entrepreneurs. Newly designed or modernized to shipyards productivity, efficiency, effectiveness and efficiency indicators, depends on the technological level. Business plan documents and entrepreneurs when they want to loan, loan documents specifying the technological level of importance shipyard is the most crucial decision that will continue throughout the life cycle. Shipbuilding sector of

production, depending on the complexity of the ships can be divided into three primary segments: Low complex-built vessels; such as tankers and bulk, cargo covers most simple types of boats. Moderately involved built vessels; refrigerated (refrigerated) containers, Ro/Ro, chemical tankers, LPG/LNG ships. Highly complex built vessels; cruise ships, cruise, they are fishing vessels and cargo ships. Looking at the leading ship builders in this respect; ship rather than in the middle and high-end segments of the EU countries, S. Korea and China in low and middle segment ship, while it is possible to say that Japan's significant shipbuilders in all three segments. (Ceceli & Özkılınc, 2008)

**Pre-Existing Accumulation, One Generation to Another:** One of the most critical things is historical background of shipbuilding culture over centuries. Technology usage and dependency have been increasing by the time. Efficient marketplaces are also a heritage. Project library one another. So from past to future, evaluation of shipbuilding generation gives essential data from this point of view.

**Digital Shipyards:** A new upcoming concept is 'digital shipyard'. The motto of this kind shipyard is Better, Faster, Cheaper: Embracing 'Smart' Manufacturing. Industry 4.0 is known as computer and automation combination for entire production. 'Shipbuilding 4.0' model about the adoption of the so-called 'industry 4.0' automation and data-exchange revolution that is sweeping manufacturing in general and those issues become a thing of the past. The digital shipyard replaces the old isolated, disparate technology platforms and their compartmentalized data, with united state-of-the-art planning tools, and a single shared repository of design data that is always current, and available to anyone who needs it. As previously described, past experiences have a significant place in the development of the vision of a shipyard. To get some criteria and to understand what those criteria's mean historical background is essential. From another aspect, the experience is vital and historical knowledge can only provide this.

On the other hand, historical background gives the ability of: Method used in shipbuilding, Master/worker relationship, Project management experience, Design ability, Employment capability, Choosing profitable project capability. Also, corporate vision and culture possibly mean well-established/matured organization. To investigate the minimum age of shipyard it is assumed as five years. Hence, in the first section of questionnaire it is also inquired 'considering last five years, at overall, your company in profit-loss statement: Expertise in the shipyard activities and Last 5 year's approved balance sheet and the profit-loss statement.

**Ship Building Process concerning CMMI: Capability in Shipyard or Maturity in Production;** generally, it can be considered shipbuilding process in 5-20 stages. Three of them are pre-production stages, Bid Proposal, Agreement, and Design. There are 9 production stages. Also, three steps are last things to do up to delivery. Sum up of scenes here in this work can be considered as 16 stages according to S-MCM classification of my proposal. When whole process of shipyard -both management and production – viewed, it is sensible to use the word 'capability'. However, if the only consideration is product, then the word 'capability' more sensible.

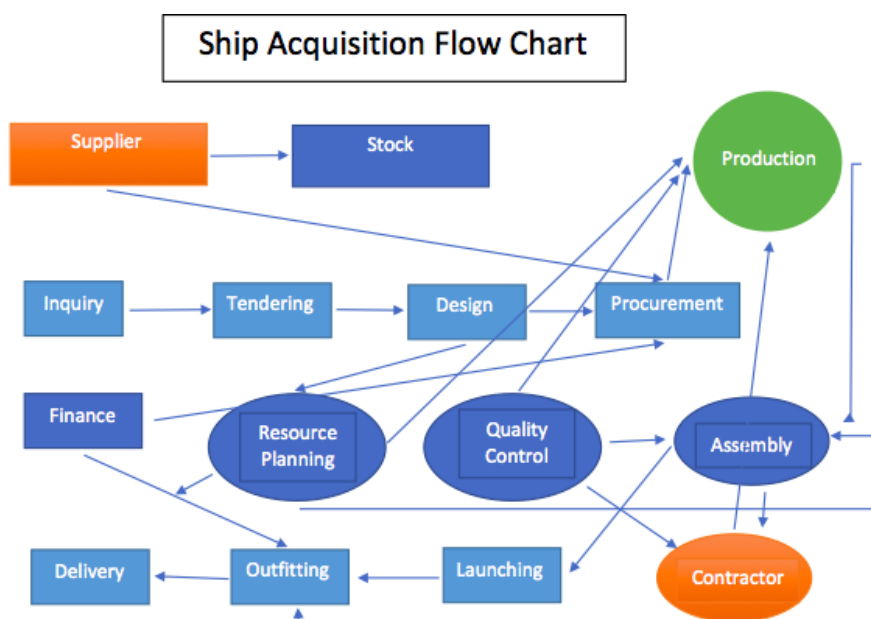


Figure-1. Ship Acquisition Model

If the production process well addressed, then the maturity level can be easily measured using some outputs straightforwardly as follows (Stages gives exact information for future S-MCM inspections):

**Pre-Production: Bid Proposal:** Based on the initial specifications provided by customers. The proposal is a critical step of the business since customers largely depend on this proposal to decide whether to place an order or not. Designers lay out a broad design to get a rough overall picture of the ship and subsequently offer a proposal to the customer. Hence, designers try our best to show our ability to the full. **Agreement:** If the proposal agreed by both side's engineers proceed to discuss the specifications in detail and settle on the final price of the ship. Once the shipbuilding process, ship price, general layout, specs, etc. are determined, a contract can be signed.

**Design and Estimating:** The shipyards must work to minimize or eliminate waste in project and production phases. The integration with the supply chain is essential to develop families of interim products. The production must fabricate using standard work processes in the same way each time using the same equipment. Design phase can be considered as four different sub-titles. Design in/at:

**Performance:** Producing speed is the most significant factor of any ship. By repeatedly adjusting the hull form and tank testing, staff ensures that the ship they are to build can sail at the speed stipulated in the specifications.

**Basic:** There may be various factors that influence ship performance, except for speed. The others can include ship stability, load capacity of cargo, fuel cost and so on. The critical function of primary design is to design the ship so that all those factors comply with the specifications.

**Detail:** The critical point of this step is to work out drawings that are feasible and the accuracy must be enough to facilitate the actual shipbuilding operation on-site without compromising the ability or performance of the ship. Based on the information obtained from the basic design, the detailed plan plays the role of clarifying the design of components and parts of the vessel to be built.

**Production:** The production design enables the field staff to control a large number of components on site meticulously. The production design organizes the design information in the detailed plans into respective component information. The connection between design functions, planning and manufacturing requires precise and sufficiently complete information on all aspects of product, production processes and operations are available. To implement construction, product design and plan must become tightly integrated with development and all weakness in product flow and the flow of engineering information must be minimized.

So, it is expected that in the future; systems design and planning are closely aligned with the manufacturing technology, and future manufacturing systems will require more complete and more accurate when compared to the information available at this time. The design, estimate, building strategy and production plans are produced by shipyard staff initially in outline and then gradually developed in detail involving the production of detailed working drawings and parts lists. Materials account for about 50-60 percent of the cost and labor and overheads for the remainder and a large merchant ship may involve several thousand separate purchase orders. A cost estimate must be prepared, often before the full design has been finalized and materials, particularly 'long lead items' such as the main engine must be ordered.

#### 4. RESULTS AND SUGGESTIONS

After survey and interpreting those collected data, there is now essential information's about Turkish shipbuilding industry. The aim was using minimum or succinct questions to get maximum information of a shipbuilding company. At this point using the S-MCM classification of SEI it can be now done the point. At least it can be classified a shipbuilding company as S-MCM level.

##### S-MCM Level 1-2 or Organizational Metrics

**Historical Background;** This works and some others that are previously performed showed that historical background has great importance for any company. Experiences are also a part of corporate culture. Skills are at least enlightening crisis terms management. After specific shocks only experienced companies remain. Other firms either terminate or suffer from that shock and they field adverse effect of the excitement for a long time. Up to now, there have been peak and bottom levels in this sector and period of the variable. If a shipbuilding company has this knowledge, then they can prevent their shelves from adverse effects of crisis and make smart investment. They also know that this sector is not a beneficial short-term sector. They can quickly see that they need always back up money.



In briefly experiences are essential all sectors. However, it is crucial in shipbuilding sector. It is not the only reason cycles in world shipbuilding sector. Undoubtedly there are some other reasons. There are changing environment of total number of employees in shipbuilding sector. Economic facts are directly affecting total number of employees. However, shipyards order book. Subcontractor or outsourcing models and positions are also some other related factors. However, proper subcontracting and outsourcing are also a part of experiences. One more thing about employment is when you need well-skilled person. Probably others also do. So, employment policy is also relevant companies past experiences. Following world order book gives essential information about a single company's strategy. They can get right position for upcoming orders. They have to watch each other. Hence, they can catch essential laws and other opportunities or vice versa.

Shipbuilding is a matter of time. Most of the time when a ship erects it shows some divergently. Experiences prove this fact. A company that has knowledge and database can guess this and makes suitable preventions. This study shows the importance of historical background of a shipbuilding company. On the other hand, some external reasons affect this evaluation adversely. If it is investigated foundation date of companies, this may be wrong. Because sometimes there have been company merges. Sometimes company's share structure can be changed. Sometimes owner of company can be changed. Sometimes name of company can be adjusted for a necessity. However, any way corporate culture of company remains. Therefore, it can be said that foundation date of a company gives essential data considering historical background and corporate culture. Nevertheless, it has to be noticed that there is a difference between 'historical background' and 'foundation date'. Historical knowledge can give data that are more accurate.

In this work when it was found out the most prominent shipyard company in the world. Such examples have seen. Considering some of biggest shipyard companies' foundation date it can be said they are very young and it can be subjected 'how they can perform such a success' while they are so young. However, the fact is different; they have at least one-hundred year's experiences. Japan shipbuilding company Marine United is such an example. It has been founded 2013 but now it is one of the 10 biggest shipbuilding company. In fact, this is because its name and share structure has been changed. But even though it can be understood that a historical background still exists. Responsibilities and Proficiency Level regarding Legislation; At the very beginning of this study, it was considered obeying local rules is critical and has great importance thinking the potential of breaking rule/rules may cause to terminate of that company and its operations. The information is still valid. However, after study it is understood another point that it could not be got sufficient information of inspection of companies by the authorities.

Even they did not get any punishment or warning by those legal authorities. No one can say 'we didn't get any punishment or warning after a complaint or inspection'. Therefore, as an interpretation for this subject is, when it was wanted to analysis a company it is still essential to understand the obeying level of legislation. However, it has difficulties as if no one wanted to give exact information penalties or warnings. Therefore, in this area the best way is talking about real documents. It is very well known in Turkey that most of the time employers want 'clearance' or 'criminal records' from candidate of employee. Obeying rules and punishment history is critical information for evaluation S-MCM analysis. However, getting information for this section has difficulties. If someone needs those information and sanction, it is strongly advised that they have to want clearness from the record of legal authorities.

OHSAS Law; Comparing other laws and regulations OHSAS law has particular importance. Therefore, this must be specially checked. First, this is related with human life and shipyard accidents has public attention in Turkey. On the other hand, compensations and punishments according to OHSAS Law (article number 6331) are incredible. Some actuating accountings examples are so big that a company can be terminate its operation after a particular accident. Before the mentioned law, sub-contracting may prevent employers from unwanted situations. However, after the OHSAS Law employers responsible all the time. In fact, this is also a regulation and obeying others may be the same comparing this. However, this study shows OHSAS Law and rules have particular importance. Certification of OHSAS is essential but not enough. Nearly all of Tuzla region shipyard companies have OHSAS 18001 certification. However, OHSAS still has enormous risk and potentials comparing other regulations. So, in the future works and detailed investigations OHSAS have to have particular check procedure and new grades.

For example, comparing with tax punishment one can consider this can be a temporary situation. Nevertheless, OHSAS record is essential all the time both human consideration and continuity of compensations and other risks. Physical Situation of Shipyard; The study shows that shipyard companies in Turkey know their potential about repairment or building or mix. They also know their advantages and

experiences about ship types and sizes. It is important because they all have physically what they need. Considering pool observed in the site survey if a shipyard needs a pool, it can have around its location. It is the same for crane. When they need, they redraw their positional project and can reproduce more convenient and useful area. In fact, there is no directly relation coastal length and company S-MCM level and efficiency or profit. Considering closed or open area, it was interfaced the same situation. There are too many alternatives. If open or closed space is not sufficient, they use some other regions. For example, Orhanlı is one of them. Pre-erecting phases can perform over there. Therefore, the need of land closed or open area and some other facilities are decreases in absolute amount.

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