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Asset Management Performance Benchmarking: A Maturity Model Review

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***Abstract*—** *Asset management is a structured approach to the development, maintenance up to the physical asset discharging. Maturity models are one of the benchmarking methods capable of revealing the main performance elements of organizations. Maturity model is a method for evaluating companies' efficiency in managing its business process consisting of many primary process areas and multiple maturity levels. This study seeks to review the maturity model benchmarking in asset management. To achieved the above aim, the objectives were; (1) To review the asset management principles and concept (2) To review the maturity model in asset management. This study was adopted primary source of data as methodology. Asset management maturity is an organization ability towards predict and respond to its environment by managing its asset whereas continuing to meet the needs of its stakeholders. Adaptation of maturity in asset management will help the asset managers in understanding their level of performance, competence, complexity, and capability, which will help them in delivering outcomes such as customer satisfaction, safety, assurance and profit with the resource's allocation within the appropriate delivery period.*

***Keywords*—** *Asset, Management, Maturity, Asset Management Maturity, Organization, Benchmarking, Performance.*

I. INTRODUCTION

Asset management is a structured approach to the development, maintenance up to the physical asset discharging (British Standards Institute, 2004). The critical drivers for maximizing an asset portfolio including value maximation and risks reducing (Moon et al., 2009). Asset management strives to improve asset-intensive industries' overall performance via making and implementing organized and highest-value decisions concerning uses and care of asset (Brint, Bridgeman, & Black, 2009; Campbell, Jardine, & McGlynn, 2010; Quak, 2007).

As a benchmark for organizations, several techniques are built to enhance their performance, such as six sigmas', performance benchmarking, maturity models, etc. out of all these, maturity model are easiest in use. Maturity models are one of the benchmarking methods capable of revealing the main performance elements of organizations. Organizations may represent their current results by using a maturity model, and prepare strategies to achieve the next maturity stage (Harpham, 2006).

Maturity model is a method for evaluating companies efficiency in managing its business process consisting of many primary process areas and multiple maturity levels (Meng et al., 2011). Recently, maturity models received much attention in asset management profession (Volker, Vander lei & Ligtvoet, 2011). Paulk et al., (1993) explained that maturity models were created using the Carnegie Mellon University capability maturity model as a guide. The main aim of creating this methodology is to evaluate software development initiatives. It has regularly expanded to incorporate a wide range of processes, including collaborative processes, system engineering, knowledge management, and human resources management (Curtis, Hefley, & Miller, 1995; Magdaleno, De Araujo, & Da Silva Borges, 2009, Volker, Vander lei & Ligtvoet, 2011).

Due to this the research is aimed at reviewing the maturity model in asset management.

II. OBJECTIVES OF THE STUDY

- To *review* the asset management principles and concept
- To review the maturity model in asset management.

2.1.0 Asset, Management, and Asset Management Concept

2.1.1 Asset: - Fernholz (2006) define Asset also define as any tangible or intangible that can be owned or produce positive economic value. It can be capital/fixed, currency, building, cars, lands human capital etc.

2.1.2 Management: - it can be defined as a process of planning, decision making, organizing, leading, motivation and controlling the human resources, financial, physical and information resources of an organization to reach its goals in an efficient manner.

2.1.3 Asset Management

The word Asset management defined by various scholars, among them includes: -

Singh (1996) defined asset management as an activity that seeks to control interests in property taking into consideration the short- and long-term property owner objectives and particular purpose which property is held.

It also defined by Lyons (2004) as business planning key part that connects about an organizational business need strategic level decisions, its assets development and its investment feature need.

Loong (2004) explained asset management as an asset initiation acquisition guiding process, use, maintenance and disposal, and to make the most of their services delivery potential and manage the related risks and cost over the full life of an asset.

According to University of leeds (2006) explained it as

holistic, structured, and integrating approach for aligning and managing property asset performance and services delivery requirement overtime so as to meet objectives of business and diverse within a central government organization.

Asset management as a continues procedure enhancement strategy for improving the availability, safety, reliability and longevity of assets which is system amenities, equipment and process (Davis, 2007).

The British asset management institute explained asset management as a systematic and coordinated activities and practices where as an organization manages its assets and asset system optimally and sustainably, their associated performance, risks and expenditure throughout its lifecycle with a drive of achieving its organizational strategic plan. Accordingly includes the varieties of asset maintenance, reconstruction and renovation.

2.2 Asset Management Principles and Function

Malona, Chien and Turral (1999) explained that the function and principles of asset management includes; monitoring of performance, planning of an asset and creation strategies, maintenance and operation, accounting and economics, audit analysis, and renewal.

2.3 Concept of Asset Management Maturity

Asset management maturity is an organization ability towards predict and respond to its environment by managing its asset whereas continuing to meet the needs of its stakeholders (Asset Management Council, 2014).

Asset management maturity is an organizational assurance, capabilities, performance and ongoing to fit its aim to meet the present and future needs of its stakeholders, that include the organization ability to foresee and respond to its operating context.

In an asset management maturity, it requires an organization to deliver outcomes such as customer satisfaction, safety, assurance and profit with the resource's allocation within the appropriate delivery period. It's the dynamic process which is able to answer both the stakeholder and business environment changing in a way an organization will be compatible with other functions (AMBoK).

Asset Maturity management also means a degree to which asset management is coordinated and integrated into an organization.

As described by AMBoK (2014) an asset management maturity can be seen as;

a) *Organizational elements set;* which include structuring, governance, and business asset structured.
b) *Maturity lenses selection that focusses on and asset* management analyzation in all four companies' components. These maturity lenses are used to evaluate asset management important aspects.
c) The set of qualities which help the organization in the description of the essential nature of the asset management maturity.

2.4 Overview of Maturity Model by AMBoK

Maturity model can be seen as features, indicators, and attributes collection or patterns which indicate an ability and sequence in a particular displine (Rea-Guaman et al., 2017). Therefore, maturity model provides a reference point for an organization to evaluate its existing activities, procedures and methods at a level and establish objectives and priorities for improvement.

Generally speaking, maturity models (MMs) are structured to determine maturity based on more or less a set of parameters, together with competency, capability and complexity. MMs was developed to assist administrations by way of basis for evaluation and comparative degree for organizational enhancement (de Bruin et al., 2005).

MMs described a specific entity evolution in the organizations over time, so that organizations recognize the types of activities in each area and wish in achieving potential results. It is also argued that MMs are normative and informative, and not prescriptive. This defines any degree of maturity, without prescribing how to get there (Tapia, 2009).

Röglinger, (2012) mentioned that the organization capabilities assessment in application domain can be analyzed easily using maturity model. Several methods of maturity process can be form via these logical paths. In the maturity model, organizational capabilities assessment both in the process and specific application domain are indicated through the maturity level.

In a situation where an organization aimed to achieve higher maturity level, maturity model can be used to assess its maturity level and the result can be use as reference (White, 2011).

The maturity model series of levels starts since at preliminary state and the level ends in a mature state (U.S. Department of Energy, 2014). An organization's degree of maturity will be determined using maturity model by evaluating certain principles and rating the capabilities of the elements. An action may require in increasing elements maturity level (Hansen, 2016). In a maturity model, the total number of levels are varying from each model, the difficulties of providing a description for each level are depend on the level that maturity is (U.S. Department of Energy, 2014).

De Bruin et al., (2005) explained that the theories of the involvement of an organization's capability that is done in a step-by-step approach along with desired, predictable, or logical maturation path can be represented using maturity models. An organization's current maturity level represents the capabilities of the organization in terms of specific processes or application domains (Wendler, 2012).

According to Wendler (2012), improvements of the levels in maturity is sequential by nature, and need to occur hierarchically. With the ultimate goal of achieving the maximum level of maturity, an organization has to satisfy the preconditions for each of the previous maturity stages in the maturity model, and that is why it also known as stage models, stage-of-growth models or stage theory models (De Bruin et al., 2005). The maturity model is used as a scale to measure the criteria and characteristics necessary to achieve each level of maturity on its journey to achieve the maximum level of maturity. The criteria needed to evaluate the capabilities can be processes, there is need for the measurable of application targets or conditions (Becker, et al., 2009; Wendler, 2012).

CMM usually has five phases of logic where an organization manages its processes. The Stage representation of CMM include

- Initial
- Repeatable
- Defined
- Managed
- Optimizing

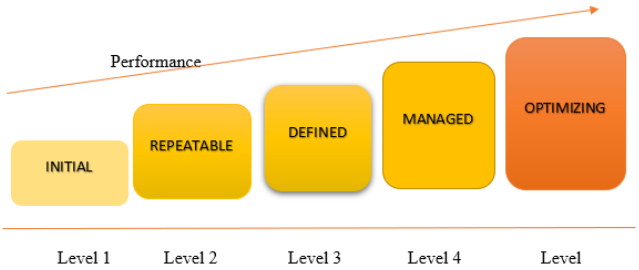

Fig. 1. Stage's representation of CMM

III. Types of Maturity Model

Mehravari (2014) consider that the types of maturity model are of three categories; (a) progression maturity models, (b) capability maturity models and (c) hybrid maturity models.

(a) *Progression Maturity Models (PMM):* This refers to Simple succession or scaling of an attribute, prototype, follow or characteristic (Mehravari, 2001). In PMM level explain the upper states of accomplishment, progression, completeness, or advancement. Higher levels can be described as "tool-enabled" while lower levels can be described as "primitive"

(b) *Capability Maturity Model:* The Carnegie Mellon University developed the first Capability Maturity model (CMM) (Paulk et al., 1993). It was used as a tool for assessing contractors' abilities which operated for the department of defense US. Capability maturity model has evolved from an appraisal method for software processes to other areas, such as human resources, systems engineering and acquisition of software; generally, it can be viewed as a set of structured guidelines describing in what way different domains of an organization can be contributed to a set of organization predetermined outcomes (Volker et al., 2011).

The Capability Maturity Model (CMM) was created by Carnegie-Mellon University's Software Engineering Institute (SEI) in 1989 as a method for improving the software process (Kaur, 2014). The underlying impetus behind the use of CMM is to determine the maturity of software development processes and to identify the key activities that are critical for developing those processes. Furthermore, the rates in a CMM indicate an important state of organizational maturity for process maturity, such as the CMM framework's basic maturity approach may be applicable to other domains such as the Cybersecurity maturity capacity model (Butkovic & Caralli, 2013). The benefit of the Capability Maturity Model as defined by Mehravari (2001) includes; allows for core competency estimation, provides detailed capability measurement and provides a route to quantitative estimation. Although the drawback includes; sometimes it is difficult to comprehend and use (i.e., high cost of implementation), it does not transform into real results and eventually, possibly, false sense of achievement (Mehravari, 2001).

De Bruin et al., (2005) explained that in 1993 when the Capability Maturity Model (CMM) for software was first introduced, the use of the model has widely adopted by the software development industry. On maturity model, CMM was the beginning of many researches, and since then several efforts have been made in applying the framework in other application domains.

(c) *Hybrid Maturity Model:* This model can be formed through the overlay of progressive model features with capability characteristics from capability maturity models (Saco,2008). Smart Grid Interoperability Maturity Model (SG-IMM) and Electricity Sub Sector Cybersecurity Capability Maturity Model (ESC2M2) are examples of hybrid maturity models (Saco, 2008). It reproduces conversions amongst level which are similar to a capability model but architecturally use the patterns, features, attributes, or progression model indicators (Caralli, Knight, and Montgomery, 2012).

Among the advantage of the hybrid maturity model is that, while picking up the ease of use and clarity of the progression models, it provides the thoroughness of a capability maturity model (Caralli et al. 2012). While the disadvantage of this model as identified by Mehravari (2001) includes "Maturity" theory is approximated (i.e., not as accurate as CMM) and the combination of qualities at each stage with institutionalizing uniqueness may be unreasonable.

3.3 Components of Maturity Model

Regardless of the disparity between maturity models, in terms of basic structure, almost all of them have certain similarities. This structure is essential as it provide connection among objectives, assessments and best practices and helps associations between present capabilities and progress road maps at linking them to business goals, standards and other criteria;

a) Level

Levels signify the intermediate states in a model of maturity (Butkovic & Caralli 2013). Depending on the structural design, the level of a model may convey a progressive step, or may characterize an expression of capability or some other attribute that the model may precise (Butkovic & Caralli, 2013). Levels are significant because they represent the maturity model measuring component, and where the scaling is inaccurate or incomplete, the model itself may not be able to validate or generate poor or contradictory results (Butkovic & Caralli, 2013).

b) Domains

Model Domains basically describe a capacity of a maturity model (Butkovic & Caralli, 2013). In CMMs, the models are regularly denoted to as process areas (but optionally), since they are a group of processes that make up a larger process (Butkovic & Caralli, 2013). Model such as the CMMI, could have a representation that requires a prescribed progression through the domains to achieve the intended outcome (U.S. Department of Energy, 2014).

c) Attribute

Attributes represent the model's core content, and are grouped by level and domain (Butkovic & Caralli, 2013). Typically, they are based on experimental practice, principles, or other knowledge of experts and will be expressed as attributes, indicators, practices, or processes. In CMMs, attributes are essential to support process enhancement regardless of the process being modelled (Butkovic & Caralli, 2013).

3.4 Limitation of Maturity Model

Maturity models have some limitations and may not be able to accurately measure the maturity models which may offer the user inaccurate data. The maturity models may offer an inaccurate result, as explained previously. Therefore, it not only raises the cost of implementation, but the benefit is also decreased, for example the resulting process that has been improved based on an inaccurate maturity model may not be compliant with the overall process (Idi, 2019).

An organization that has achieved a higher level of maturity for the elements it evaluates may feel more confidence in its current plan, but in fact, if the outcome is incorrect, trust will be put at the wrong place (Mehravari, 2001).

According to Röglinger et al., (2012), maturity models lack an empirical foundation and are going to oversimplify reality. They said that some maturity models may ignore the number of other paths of possible result maturation. They also believed that instead of concentrating on the elements that can actually help evolution and change, they have preferred to concentrate on the series levels predefined 'end state' (Röglinger et al., 2012).

Also because of the existence of being step-by-step and over-simplified, maturity models fail to recognize the complexities of the domain used by maturity on Therefore, maturity models do not provide meaningful information to their users (De Bruin et al., 2005).

3.5 Importance of Using Maturity Model

It is important to use maturity models in order to evaluate the capabilities of certain elements within the organization. For their safety the maturity models can be used as a benchmark. Organizations may define the gaps in certain elements by using maturity models, and come up with proposals to strengthen the gaps.

It is also important to use maturity models to identify the current state of the organization or its future state, and the attributes that the organization must achieve to attain the future state (Butkovic & Caralli, 2013).

IV. CONCLUSION

The paper was on review of the maturity model on asset management, where various stages on maturity model where reviewed, by adopting it in asset management, it will help the asset managers in understanding their level of performance, competence, complexity, and capability, which will help them in delivering outcomes such as customer satisfaction, safety, assurance and profit with the resource's allocation within the appropriate delivery period. And also help them to come up with the strategies where they have lapses in managing asset.

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