

A Framework for Implementing Value-Based Approach in Asset Management

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Abstract

ISO 55000 puts ‘value’ at the core of asset management. This paper provides a framework to help production companies implement value-based Asset Management (AM) in a way that it contributes to operational excellence. Value-based AM is achieved when the value delivered by assets is used by the organization as the key decision criterion to choose between different AM options (both at tactical and operational level). Given this perspective, it is vital that organizations are able to quantify the value delivered by their assets and manage that value through informed and coherent decision-making. Value-based AM is still a concept more quoted in theory than described in practical terms. A clear understanding about the main elements that are needed to enable it is still missing in industrial practice. The framework presented in this paper provides the key elements needed for successful integration of a value quantification model with the AM system to ensure the effective implementation of value-based approach in AM.

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1. Introduction

Asset Management (AM) is a value-adding process to the core business of an organisation and should be considered so by companies (Liyanage and Kumar 2003; Amadi-Echendu et al. 2010; El-Akruti et al. 2013; ISO 55000:2014(E) 2014). Indeed, AM has a key role in strategy development and implementation. This strategic role is maintained based on planning and control of the asset-related activities (El-Akruti et al. 2013).

As stated in the ISO5500x series of standards on AM (released on January 2014), the concept of value is at the heart of Asset Management. AM is in fact defined as the coordinated activity of an organization to realize value from assets (ISO 55000:2014(E) 2014). Value is obtained through providing assets that allow an organization to fulfil its strategic intent (El-Akruti and Dwight et al.

2013). No single detailed definition of ‘value’ delivered by assets can be found in the literature. In fact, its specific definition is very much dependent on the company’s purpose, the nature of its assets, its objectives and the expectations of its stakeholders. It can be tangible or intangible, financial or non-financial (ISO 55000:2014(E) 2014). What is agreed is that the realization of value involves balancing costs, risks, opportunities and benefits arising from the way assets are specified, procured, deployed, used, maintained and disposed. Each company has to define its own conception of value, given the specific context in which it operates. Despite the increasing body of academic literature and industrial interest on AM process and systems and the strategic role of AM (El-Akruti et al. 2013), value-based AM is still a concept much more quoted in theory than described in practical terms. A clear understanding within companies about the key elements needed to enable it is still required. The assumption is that value-based AM is achieved when the value delivered by assets is used as the decision criterion to choose among different AM options (both at tactical and operational level). The aim of this paper is to provide a framework that drives production companies towards the implementation of value-based AM contributing to operations excellence.

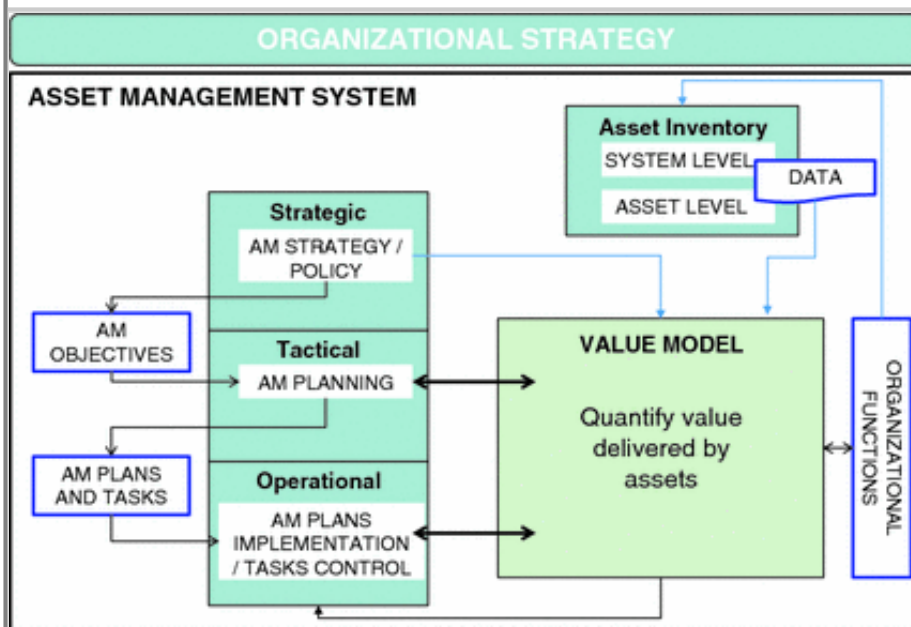
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2. Value-Based AM Framework

The idea that proper lifecycle management of physical assets is an essential activity to contribute to the value delivered by an organization is becoming more widely accepted nowadays. The AM perspective is set on the management of an asset in a way to create and/or sustain value during each life-cycle stage, and throughout the asset’s life. Therefore, to ensure value-based AM, it is important that value delivered by assets along its life cycle is used as the decision criterion to choose among various AM options. Hence, a model able to quantify such value is required. The “value-model” is intended to be used whenever an AM decision has to be taken. Several value-models have been proposed so far depending on the specific interpretation given to value in different contexts (e.g. Total Cost of Ownership (Roda and Garetti 2015), Value Mapping (Srinivasan et al. and Parlikad 2015). Figure 1 shows how the value-model sits within the AM System.

Fig. 1

The value-model integrated in the AM System



The expected main functions of the value-model are:

- To enable and control AM planning and implementation by supporting decision making and

options/scenario analysis;

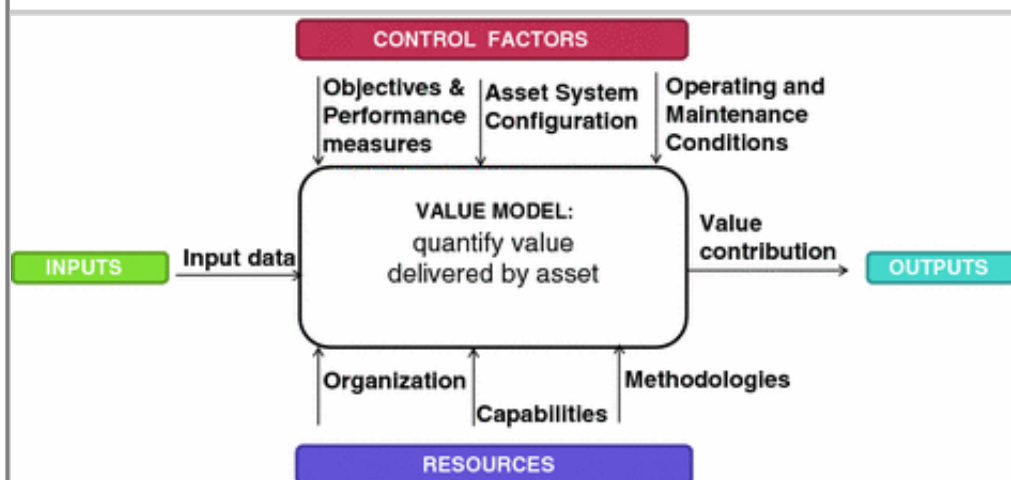
- To support communication of asset value contribution internally and externally to the organization enhancing commitment and continuous improvement;
- To control alignment between the AM plans and operations and the AM strategy.

This paper aims at providing a vision of the key elements needed for a successful integration of a value-model with the AMS to ensure the effective implementation of value-based approach in AM.

Our research reveals that there are some key elements needed to ensure proper value-based decision making in general for any company, independent of the definition given to value. Those key elements have been categorized and outlined within a framework as shown in Fig. 2. The framework was depicted in line with the IDEF0 standard. The seven key elements are represented under the following categories—control factors, inputs and resources—in the context of the asset value model. We will now describe each of these in detail in the next section.

Fig. 2

Value-based Asset Management framework



3. Key Elements of Value-Based AM

3.1. Control Factors

Control factors are the conditions to the value-model affecting the outputs.

3.1.1. Objectives and Performance Measures

As stated in ISO55000, AM involves the balancing of costs, opportunities and risks against the desired performance of assets, to achieve the organizational objectives. Therefore, the first requirement for proper value-based AM implementation is that AM objectives are clearly identified and that they are SMART (Specific, Measurable, Achievable, Realistic and Timely) and aligned with the organizational objectives. Alignment should exist between the company's fundamental strategic objectives (what the company wants to be), the plant-specific strategic objectives (what the company aims in operating the plant) and the AM objectives (what is the aim of the company in managing the production assets) (Liyanage and Kumar 2003). The overall alignment should be checked periodically to ensure that the value-model is actually based on the value drivers of the company (may

it be for example profit, environmental impact, safety, customer satisfaction, etc.).

In addition, the organization (or its AM function) needs to identify the desired performance targets and measures for each asset as well as for the AM system (~~Wang et al.~~ Parlikad and Wang 2015). The AMS performance measures need to encompass technical (at system level and equipment level), economical and organizational dimensions reflecting the holistic characteristic of AM.

3.1.2. Asset System Configuration

An asset system such as a production plant must be viewed as a collection of assets that interact, and interdependencies between the assets can affect the systemic value contribution. For instance, interdependencies imply that failure/deterioration of any asset within the system can have knock-on effects throughout the system and might create additional costs or risks, and this might not be clear when managing each asset independently.

While individual asset-level analysis estimates performances with respect to a single component (OEE is the performance measure best representing this concept), system-level analysis allows considering systemic value contribution arising from components' interdependencies (Xu et al. 2013; Liang and Parlikad 2015a, b). Depending on the objectives and the AM KPIs and value drivers, specific kinds of interdependencies are to be considered in order to evaluate the value contribution of a local intervention at the system level. Possible kinds of interdependencies among assets can be economic, stochastic and structural dependencies (Nicolai and Dekker 2008), and functional—logical interdependency (assets jointly contribute to the delivery of a function as required). In most cases, a subset of interdependencies are modelled depending on the problem at hand, and the resources the organization wants to spend on modelling. This is essential to strike the right balance between modelling complexity and accuracy. It is essential to use a reasonable model of the system to control and influence the value-model's output.

3.1.3. Operating Conditions & Maintenance

Different operating conditions and maintenance management policies affect the level of value provided by the assets. Operating conditions include the specific function executed by the system, the environment in which it works, the available working time for it to produce etc. In any of these cases, it is clear that in the event of a change, that influences the value contribution realized by the system, hence the value-model should integrate it. The same is valid for maintenance policies implemented in the system. For example, the execution of pure corrective maintenance or the implementation of preventive and predictive maintenance directly affect the way the system can generate value. It is then essential to ensure that these control factors are integrated in a value-model that is used to support decision-making. It allows setting the proper operating condition and maintenance activities to increase value contribution, given the AM objectives.

3.2. Inputs

Inputs are the data transformed/consumed by the value-model to produce outputs.

3.2.1. Input Data

Data is a critical asset in today's organizations (Borek et al. 2014) and the availability of useful data is paramount to making the best decision in AM. Bringing all of disparate data together into widespread asset-centric information is yet a key challenge facing asset users today; an integrated asset information management strategy would be required (Ouertani et al. 2008). When considering which data are needed for supporting informed AM decision making, it must be taken into account that the data that are required can vary from case to case depending on the definition given to value.

What is generally recognized is that both technical and financial data are needed. The major challenge in obtaining the required data is that they are heterogeneous, hence they are usually scattered among separate information systems (administrative IT systems, industrial IT and non-automatic sources) (Moore and Starr 2006; Kans and Ingwald 2008). May it be at IT level or not, it is widely agreed that integration must facilitate the bi-directional flow of data and information into the decision-making at all levels (Moore and Starr 2006). The core idea is that, a *common asset database* should be developed where for each asset, at different aggregation level different data can be stored all together. The asset database would provide basic reference to information regarding assets' properties for strategic decisions (Kans and Ingwald 2008; Tam and Price 2008).

Data quality is also a critical aspect to consider to ensure proper decision-making. The first step towards high quality data for any organisation is the Data Quality (DQ) assessment (more information on this can be found in Borek et al. (2014)).

3.3. Resources

Resources are the means that support the execution of the value-model.

3.3.1. Organization

The application of the value-based AM concept in a company calls for an organizational architecture and culture that promote the concept of whole-life value-based system-wide asset management and its reception as an effective process (Liyanage and Kumar 2003). Different organizational functions are involved in the AM process with their specific role in the organization's structure. In order to integrate AM in a company as a single process, two main requirements should be complied: (i) integration among different organizational functions that contribute in the AM value-chain; (ii) clear definition of AM related roles, authority and responsibilities.

The first thing to be considered is the interdisciplinary and collaborative nature of the AM system that can be gleaned from the definition of asset life cycle from a user viewpoint itself (El-Akruti and Dwight et al. 2013). At each life cycle stage of an asset, different disciplines and hence different organizational functions are needed. The success of a capital intensive organization often depends on its ability to coordinate activities efficiently and effectively among the various asset-related activities (El-Akruti and Dwight et al. 2013).

Secondly, as it is stated in the ISO55000 as well, leadership and workplace culture are determinants of realization of value and this includes clearly defined roles, responsibilities and authorities. It is advocated that the existing organization roles involved in asset management value chain are modified to include AM responsibilities and accountabilities. One ramification for this is that conventional process control rooms may need to be converted into ownership, management, and utilization centres (Amadi-Echendu 2004).

3.3.2. Capabilities

Capability is the measure of capacity and the ability of an entity (system, person or organization) to achieve its objectives. In order to implement value-based AM, certain capabilities are needed in an organization. AM capabilities include processes, competences and technologies to enable the effective and efficient development and delivery of AM plans and asset life activities, and their continual improvement (ISO55000). It is important for a company to put effort to foster them. Regarding required AM competencies, given by the ability to apply knowledge and skills to achieve intended results, details can be found in the IAM report (Competence Framework 2008). Concerning the required technologies, a reliable and flexible IT system should be integrated allowing the use of an asset common database and the implementation of the needed AM process activities (see (Koronios et

al. 2006). Proper DDSs need to be adopted as well.

3.3.3. Methodologies

Companies need to use specific methodologies to set the value-model and integrate it as a support in decision-making. Different methodologies will be required depending on the specific case. Some examples are: Root Cause Analysis (RCA), FMEA, etc., that help identifying criticalities and defining the reference system model. Moreover, methodologies such as data analytics methods, RAM analysis and risk evaluation approaches should be integral part of the AM approach.

3.4. Outputs

The envisioned output of the value-model is the quantification of value delivered by assets and it is the criterion guiding the decision-making.

4. Conclusions and Future Research

In the paper, a framework has been proposed highlighting and categorizing the key elements to be considered to enable the integration of a value-model with the AMS ensuring the effective implementation of value-based approach in AM in production companies. In fact, value-based AM is implemented when the value delivered by assets is taken as the decision criterion whenever a decision about assets must be taken (at operational or tactical level). The framework is addressed to the decision makers in the company to support them ensuring that they take informed decisions contributing to value generation.

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