

Valuation of Asset-Intensive Organizations

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Abstract

The value of asset-intensive organizations and their stakeholders have become prominent with the publication of the ISO 5500x series of standards on asset management. These standards are intended to guide asset-intensive organizations of different types towards realising value from their asset base. However, value can be defined and shaped in various ways, and a high-level conceptual construct to frame these differences is needed. Because such a construct has not yet been established, organizations have no standard guidance to systematically achieve and demonstrate that value is derived from their assets. This article presents an overview of theories on value and proposes an original high-level conceptual construct to be used by decision-makers in infrastructure organizations. This holistic proposal provides a structured understanding of the value concept and intends to assist infrastructure asset managers in establishing or developing their decision making processes at all levels of the organization.

Keywords: Value, Asset management, Critical infrastructures, Decision-making, Conceptual construct.

Introduction

Infrastructure assets are directly related to the economic growth of nations and the quality of life of citizens (Park et al., 2016; Lee et al., 2015; Too, 2009). Infrastructure organizations are a particular type of asset-intensive organizations that coordinate activities related to assets that are expensive, extensive, or complex (Mardiasmo et al., 2008). The discipline of asset management plays a vital role in this regard, and the relevance of its use has been recognized in asset-intensive organizations of different types, namely utilities.

Infrastructure organizations deal with the acquisition, operation and care of critical assets for service provision in the transportation, energy, water, and communications sectors. Some critical infrastructures are publicly owned and managed, and others have private stewardship, and such a context impacts how value is determined within the internal boundaries of an organization-centric perspective. In both types of asset-intensive organizations, public or private, the backbone of the business is a reliable and well-performing asset base (Rezvani et al., 2022). Nevertheless, in both cases, including in public-private partnerships, the external context of these infrastructure organizations is determined by the society in general, which relies on the organizations' asset

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management capabilities to provide public services, enhance the quality of life, generate profits and aid economic growth (Harchaoui et al., 2003).

On the other hand, internally, these organizations often face challenges associated with maintaining and operating with restricted budgets while satisfying demanding infrastructure performance requirements of the various stakeholders under risky and uncertain environments (Almeida et al., 2015). The international ISO 5500x series of standards on asset management is being implemented successfully by various organizations of different types (Alsyouf et al., 2018). These standards stress the relevance of a value-based approach in asset-intensive organizations (Maletič et al., 2022). One of the relevant recent outputs of the ISO/TC 251 (2018) responsible for developing these organization-centric standards has been an annex on the revised ISO 55002 distinguishing three major concepts of value used in the ISO 55000 family (Trindade et al., 2017): a) value generation: benefits from use, ownership or custodianship of assets; b) value determination: valuation of assets or the organization (e.g., the sale price of the asset or organization); c) values: principles that guide an organization's internal and external conduct. Nevertheless, there is still work to do towards a systematic approach to determine the overarching value derived from the asset base. Namely, such a systematic approach has not yet been widely discussed or tested in infrastructure organizations (Trindade et al., 2018).

The importance of overcoming this gap has been recognized by the international standardization committee ISO/TC 251 on asset management. This technical committee has recently established an Ad Hoc Group on guidance for investment and other asset management decision-making to optimize value when facing multiple criteria and competing goals. This group aims to prepare the discussion and address the gap in guidance for decision-making processes, criteria and governance requirements to resolve conflicting objectives and deliver maximum overall value to stakeholders. The public infrastructure consists of different asset categories that ultimately reflect the variety of public 'services' provided to the population (Harchaoui et al., 2003).

Despite the broad interest in public infrastructure, some authors argue the need to clarify which assets should be called infrastructure or why a portion of infrastructure should be called 'public' (Baldwin and Dixon, 2009). Infrastructures assets constitute interdependent systems that are characterized by complex deterioration patterns. Individual assets seldom provide value on their own, but they contribute to the value derived from the asset system or network as a whole. Each asset is highly dependent on other assets or systems. For example, events impacting one asset will inevitably influence the operation of other assets. This effect should be understood to develop effective infrastructure asset management solutions ((Kojenovic et al., 2016), Parlikad and Srinivasan, 2016; Amadi-Echendu et al., 2010; Alegre et al., 2014). These solutions should ideally be holistic, systemic and systematic and involve policies, strategies, processes, plans and activities aiming at deriving the best value from the asset base throughout the infrastructure lifecycle. Infrastructure assets involve multiple stakeholders, including asset owners, asset operators, asset managers, and asset users.

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Motivation and Research Method

According to the organization-centric view of the ISO 55000 series, which is shared by other well-known international management system standards (e.g., quality management), the point of departure of infrastructure asset management is the understanding of the external and internal context of the asset-intensive organization dealing with the infrastructure assets. This understanding sets the strategic objectives to be achieved. Asset management contributes to the alignment of these organizational strategic objectives with asset management activities and decision making at the various levels of the organization. The value derived from the infrastructure asset base is linked to the demonstration of objective achievement within the organization (value created for the organization) and the satisfaction of the needs and expectations of relevant stakeholders (value perceived by the stakeholders). ISO 55000 establishes that the key goal of asset management is to realize value from assets to the organization and its stakeholders.

In different terms, the standard also describes the goal to be achieved as the desired balance of cost, risk and performance. Meanwhile, there are multiple, and sometimes opposite, ways of conceptualizing and measuring the value derived from the asset base. Moreover, although decisions in asset management can to some degree be value-driven in a more or less explicit way, there are few contributions in the literature dealing specifically with the value concept for asset-intensive organizations or the means to systematically base asset management decisions upon it (Almeida et al., 2021).

One of the reasons for this is the underlying assumption that each organization must define its own understanding of value (Gonzalez-Prida et al., 2017). This approach does not necessarily encourage asset-intensive organizations to seek and materialize opportunities towards value realization from their asset base. Moreover, there is still no consensual definition for the term 'value', and thus the dimensions of 'value' that are to be managed remain unclear (Ang et al., 2015).

In the face of the different perceptions of objective achievement that often coexist within infrastructure organizations (e.g., short and long-term objectives) and the competing needs of different stakeholders (e. g., public and private interested parties), there is a need for an overarching construct that can both clarify the concept and enhance its practical application. Given developing a conceptual understanding of the value and establishing an overarching construct that can promote a value-based approach to infrastructure asset management, a conceptual research method is used to achieve the goal of this paper. According to Kothari (2004), in conceptual research, contrary to empirical research, the researcher starts from an abstract idea(s) or theory and uses it to develop and understand new concepts or reinterpret existing ones (Kothari, 2004).

Overview of the Value Concept

Conceptual construct

There are several conceptualizations of value deriving from the field of economics (Sheth et al., 1991; Ulaga and Chacour, 2001; Ojiako et al., 2014). Some examples of this are the value concepts related to

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exchange, utility and labour value theories, as well as marketing, accounting and finance (Payne and Holt, 2001; Ulaga and Chacour, 2001). Strategy and organizational behaviour literature on competitive advantage are also closely linked to value concepts and preferential choice (Payne and Holt, 2001). Value also has roots in psychology (Sheth et al., 1991; Ojiako et al., 2014).

Some authors claim that the concept of value management was introduced to compare alternative materials in order to determine the one providing the best function at the lowest possible overall cost (Oke and Aigbavboa, 2017). Apart from this product-oriented approach to the value concept, value management has also been defined from a service-oriented viewpoint. For example, Kelly et al. (2002) links value management to the maximization of the functional value of a project by managing its development from concept to use through the audit of all decisions against a value system determined by the client. The value concept has been explored in different contexts, and there are various and sometimes divergent definitions of it.

In the Australian standard AS 4183 on value management, the value is expressed as an attribute of an entity determined by the entity's perceived usefulness, benefits and importance (the terms 'benefits' refers to the advantages gained or enhanced well-being). The European standard EN 1325 on value management, value analysis and functional also defines value as the measure expressing how well an organization, project, or product satisfies stakeholders' needs in relation to the resources consumed (value = satisfaction of needs/consumption of resources). The international standard ISO 31000 on risk management recognizes that value can be financial and non-financial and apply to risk, performance, and cost. ISO 21500 on project management presents a framework for value creation. The ISO 55000 series of standards on asset management aims at helping organizations to realize value from their asset base.

According to this standard, assets exist to provide value to the organization and its stakeholders. Value is not defined in the ISO 55000 series of standards, but it is implicitly understood at the organizational level and not at the asset, system, or portfolio level. The revised version of ISO 55002 includes an Annex with considerations on the concept of value in asset management. According to these standards, the value is related to the organizational mission in delivering outcomes for its customers and stakeholders. The same understating is expressed in the international standard ISO 21504, where guidance for aligning cumulative portfolio risk with the value created from achieving strategic objectives is provided. Value can be approached from different angles and conceptualized from different perspectives (Ang et al., 2015; Parlikad and Jafari, 2016; Woodhouse, 2014). It is also context-dependent (Woodall, 2003).

Stakeholders Value Perception

Any organization must contemplate the needs and expectations of its interested parties (as used in this article, this term includes customers). Stakeholder satisfaction can be addressed as a strategic business development tool, positively affecting profitability. A difficulty both practitioners and researchers face when looking at the value concept is the wide variety of meanings for "value" held by different organizations and stakeholders. For example, Zeithaml (1988) defended that the researcher

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should understand which of many meanings are implicit in organizations and stakeholder expressions of value. The value perceived concept has been used by researchers in different ways, although often meaning the same thing (Woodruff, 1997). Perceived value is subjective; it differs for each stakeholder (Woodhouse, 2014; Morar, 2013) and depends on its satisfaction (Lai et al., 2011). It is a holistic concept composed of different and interrelated dimensions (Payne and Holt, 2001; Ramsay, 2005).

According to Zeithaml (1988), the value is whatever the client/user wants or benefits from a given product or service. The overall assessment of the utility of a product or service is based on perceptions of what is received and what is given; this is the value perceived. Several researchers view perceived value as a trade-off or ratio between perceived benefits and perceived sacrifices (Dodds et al., 1991; Lai, 1995; Ulaga and Chacour, 2001; Lai et al., 2011; Yang, 2015; Aarikka-Stenroos and Jaakkola, 2012). Woodruff (1997) defines customer-perceived value as their perceived preference for evaluating product attributes, attribute performances, and consequences arising from use that facilitate (or block) achieving the customer's goals and purposes in use situations.

Business Value Creation and Protection

Ang et al. (2015) argue that there are different approaches to the concept of value in organizations, including value engineering and value management, stakeholder theory, value chain model theory, and value as viewed from a systems and networks standpoint. In the context of asset-intensive organizations, it has been noted that each organization has to determine what constitutes value in relation to achieving its organizational objectives (IAM, 2015). These objectives will certainly take account of the needs and expectations of its stakeholders, such as investors, customers, regulators, employees and local communities, but may not be exactly coincident with the objectives of any of these groups. The organization often considers these external objectives as intangible elements of value in their decision-making, expressing them as reputation, customer satisfaction, or environmental responsibility (IAM, 2015). In an organizational context, value can thus be seen as a contingent notion (Ramsay, 2005) and subject to a range of social, cultural and environmental influences.

In asset-intensive organizations, value-based decisions are often interpreted as value for money. In this case, the value is conceptualized in economic terms as the ratio of costs and benefits (Ojiako et al., 2014).

Asset Management - Value derived from Assets

The ISO 5500× series of standards is organization-centric and implies that the value derived from assets is measured by achieving organizational and asset management objectives. However, the overarching construct of value and the need to demonstrate that asset management activities contribute to delivering value goes beyond an exclusive organizational logic. Organizations derive value from assets to achieve their organizational objectives, but what constitutes value will depend on these objectives, the nature and purpose of the organization and the needs and expectations of the

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stakeholders (GFMAM, 2016). According to Wijnia (2016), asset management as a field of interest on its own is relatively new. The term asset management does not appear in scientific records before the 1960s. The term physical asset management appeared in the 1970s, although often associated with scientific studies on terotechnology, defined as a combination of management, financial, engineering and other practices applied to physical assets in pursuit of economic lifecycle costs. From the 1980s and 1990s onwards, the field of asset management gained momentum with various scientific developments and the practical implementation and growing experience by various practitioners in the industry.

Value-based asset management is a structured way to ensure the pursuit of an organization's objectives with maximum exploitation of its assets over time, obtaining a sustained value by balancing cost and performance with risk mitigation (Raconteur, 2017). However, because an organization involves several stakeholders with different points of view, the value concept varies depending on the specific interests of each of those (Woodhouse, 2014). Thus, it is difficult to determine which actions and decisions to ensure maximum satisfaction for all stakeholders (Woodhouse, 2014; Martinsuo and Killen, 2014).

As the state deteriorates over the lifetime, the value creation ability of an asset portfolio will typically decrease over time. So, in this context, the value generation rate $v(t)$ can be written as

$$v(t) = v_0 - \Delta v (S_1(t), S_2(t), \dots, S_n(t))$$

where v_0 denotes the value creation at design functionality, and Δv the reduction due to the time-dependent state of the assets. The use of the initial value to establish the value at any point of the time (t) rather than looking into a one-time step before ($t-1$) is in line with asset management emphasis on life cycle thinking and its practical implications in terms of long-term planning (Vieira et al., 2020) and analysis of individual assets (Salvado et al., 2019).

It is relevant to note that asset management is above all related to the "value" that the use of the individual assets or they assembly can deliver and their contribution to achieving the organization's strategic goals in combination with the fulfilling the needs of relevant stakeholders needs and expectations. Asset management is also founded on principles of leadership and organizational transformation toward alignment and assurance (ISO 55000).

Conclusion

Public infrastructures are essential to a functioning society. These assets are of vital importance in the day-to-day life of communities and present a considerable social, environmental and economic impact, namely at the level of employment, quality of life, high material and energy consumption, capital investment and life-cycle costs. The principles of asset management are primordial to enhance the sustainability of public infrastructure in a context of limited resources and unprecedented ecological challenges (Trindade et al., 2018). Asset management offers the means to address the challenges of aging infrastructures with extended useful lives and the growing end-user demands for adequate service levels with lower costs and risks.

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The goal of asset management in general, and infrastructure asset management in particular, is to realize value from assets. However, value is a broad concept with different meanings, perspectives and dimensions, and there is an ongoing debate about an agreed definition for the value concept within the asset management community.

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