

Infrastructure Asset Management (IAM): Evolution and Evaluation

Eric Too

CRC for Integrated Engineering Asset Management, Queensland University of Technology
(email: e.too@qut.edu.au)

Linda Tay

Mirvac School of Sustainable Development, Bond University
(email: litay@bond.edu.au)

Abstract

Despite its rapid development in the last decade, infrastructure asset management today suffers from an identity crisis as the definition and scope of infrastructure asset management remains a contentious issue. The purpose of this paper is to trace the evolution of infrastructure asset management and evaluate the current practices. In the process, a framework defining the scope of infrastructure asset management is proposed. Notwithstanding the systematic approach that many organisations adopt to manage their infrastructure assets, this paper argues for the need to adopt a more integrated and strategic perspective in the light of the dynamic contemporary operating environment.

Keywords: Infrastructure, asset management, strategic, performance

1. Introduction

Infrastructure asset management (IAM) has emerged as a discipline to provide a more systematic approach to the management of infrastructure assets. The benefits of an improved asset management process envisaged by IPWEA [1] are enhanced customer satisfaction, governance and accountability, risk management, financial efficiency and sustainability. The purpose of this paper is to propose the need for an integrated and strategic approach to infrastructure asset management through examining the current practice of infrastructure asset management in the industry. The paper opens by discussing the development of IAM. The next section evaluates the current practices of IAM and puts forward a framework that encapsulates the scope of IAM. Finally, the paper reviews the current challenges to the management of infrastructure and concludes by arguing for the need of a more integrated and strategic approach to the effective management of infrastructure asset.

2. The development of Infrastructure Asset Management

The concept of IAM is not a new but an evolving idea that has been attracting the attention of many agencies operating and/or owning some kind of infrastructure assets. One of the first

comprehensive adoptions of the term “asset management” was during the privatisation of water utilities in Great Britain in the 1980s [2]. In Australia, “asset management” made its way into the public works in 1993 when the Australian Accounting Standard Board issued the Australian Accounting Standard 27 – AAS27. Standard AAS27 required government agencies to capitalise and depreciate assets rather than expense them against earnings. This development has indirectly forced organisation managing infrastructure assets to consider the useful life and cost effectiveness of asset investments. The Australian State Treasuries and the Australian National Audit Office was the first organisation to formalise the concepts and principles of Asset Management in Australia in which they defined asset management as “ a systematic, structured process covering the whole life of an asset” [3]. This initiative led other Government bodies and industry sectors to develop, refine and apply the concept of asset management in the management of their respective infrastructure assets. Hence, it can be argued that the concept of IAM has emerged as a separate and recognised field of management during the late 1990s.

However, IAM is more than a new management buzz word. There are still many questions about what asset management really means today. In comparison to the other disciplines such as construction, facilities, maintenance, economics, finance, to name a few, infrastructure asset management is a relatively new discipline and is clearly a contemporary topic. The primary contributors to the literature in IAM are largely government organisations and industry practitioners [1, 3-8]. These contributions take the form of guidelines and reports on the best practice of asset management. Hence, the literature tends to lack well-grounded theories. To-date, while receiving relatively more interest and attention from empirical researchers [2, 9, 10], the advancement of this field, particularly in terms of the volume of academic and theoretical development is at best moderate. A plausible reason for the lack of advancement is that many researchers and practitioners are still unaware of, or unimpressed by, the contribution of IAM towards the overall performance of the asset. A more compelling argument against the progression of the concept of asset management is the general lack of an integrated framework that defines what IAM. This is expected as the discipline of infrastructure asset management continues to evolve.

Infrastructure investment and maintenance decisions in the past were made in accordance to tradition, intuition, personal experience, resource availability, and political considerations. There was no systematic application of objective analytical techniques in such decisions. To address this deficiency, many asset management systems with inherent investment analysis capabilities have been developed, in practice, and have been used for years. These asset management systems focus on databases, asset inventories, technical models and other analytical tools. Most of these systems are used to monitor conditions through which the organisations then plan and program their projects on a ‘worst off’ basis. Success was often measured in terms of controlling backlogs in the short term, not in optimising system performance or minimising user impacts [10]. In addition, many such asset management approach ignore a systematic wide focus that involves bringing a variety of assets under one single entity [11] [2]. The focus is more on individual assets rather than the long-term asset management needs of an organisation.

Due to the relatively long life-cycle of infrastructure asset, the consideration of a whole life cycle approach is becoming increasingly important in infrastructure investment decisions. This shift has forced the design, procurement and decision-making on infrastructure asset to be based on whole life value [12]. Life cycle cost is the total costs throughout its life including planning, design, acquisition, installation, operation, maintenance, refurbishment, and disposal costs attributable to owning or using the asset [13]. Thus, life cycle approach is becoming central to asset management by taking account of the total cost of an asset throughout its life [6, 7]. This strategic view is important as it takes a long term view of infrastructure performance and cost. Furthermore, IAM is driven by policy goals and objectives based on performance and sustainability. These strategies are analysed in terms of objective assessment of costs, benefits and level of service provided to ensure that the present needs are met without compromising the ability of future generations to meet their needs [7].

3. Current Practice and Scope of Infrastructure Asset Management

The preceding discussion suggests that the management of infrastructure assets has traditionally been approached from a *functional* perspective i.e., to ensure the optimum performance of the asset. However, there is evidence to suggest a broadening of this perspective to include infrastructure asset as an important business *resource* that is capable of contributing to the organisation's goals. In this context, the main goals of infrastructure asset management are to achieve maximum return on assets, optimise total cost of ownership and fulfil safety and environmental requirements. In other words, asset management can and should contribute to the broader corporate goals. Clash & Delaney [14] found that the organisational and business foundations as well as disciplined decision making are far more crucial to achieving the capabilities of effective asset management than that of a full-blown asset management system alone; thus alluding to the extended role of IAM. For asset management to become a true value-adding pursuit within a corporate framework, it must be primarily concerned with filling a strategic role, i.e. asset manager must be proactive not reactive in their approach [15]. They must be able to forecast the needs of their organisations and make forward plans that will support the aims of the organisation in the future.

In the age of competition, especially with more involvement of the private sector in the provision of infrastructure, there is an increased emphasis on the management of valuable assets. In the private sector, a performance-based asset management strategy is needed at the heart of all asset management approaches. Practitioners in private IAM want and need a better understanding of its meaning, impact, and value to their organisations. The goals of IAM must reflect business goals i.e. infrastructure asset must generate revenue and ensure that business needs are met without compromising the competitiveness of the business in future. As a result, innovative ways of managing assets are being practiced. The scope of IAM activities extends from the establishment of an asset management policy and the identification of service level targets which match stakeholder expectations and legal requirements, to the daily operation of facilities required to meet the defined level of service [1].

In this regard, it can be said that infrastructure asset management responsibilities are today numerous and complex. Consequently, many individual asset management processes and practices have evolved, each with its own focus. Due to the diverse guides issued by different organisations, infrastructure asset management as it stands currently can mean different things to different organisations. As a result, different organisations have adopted different aspects and principles of asset management in accordance to what asset management means to them, in practice. To this end, a framework that synthesises the current practice of infrastructure asset management is useful for forging a common platform upon which future discussion on infrastructure asset management can be based.

The scope of infrastructure asset management can be depicted through four quadrants (see Fig.1). The north and south axes represent a strategic vs operational perspective. The operational aspect of asset management involves the practical business of keeping the infrastructure in working conditions. The strategic perspective of infrastructure asset management considers the integration of the user needs, the environment and the business functions of the organisation in the longer term. The east and west axes are anchored on each end by distinguishing asset as a function versus asset as a resource to business. Asset as a function concentrates on what can be done to improve the performance of the asset, i.e., asset optimisation. Asset as a resource on the other hand, considers how asset can best used to enhance business goals.

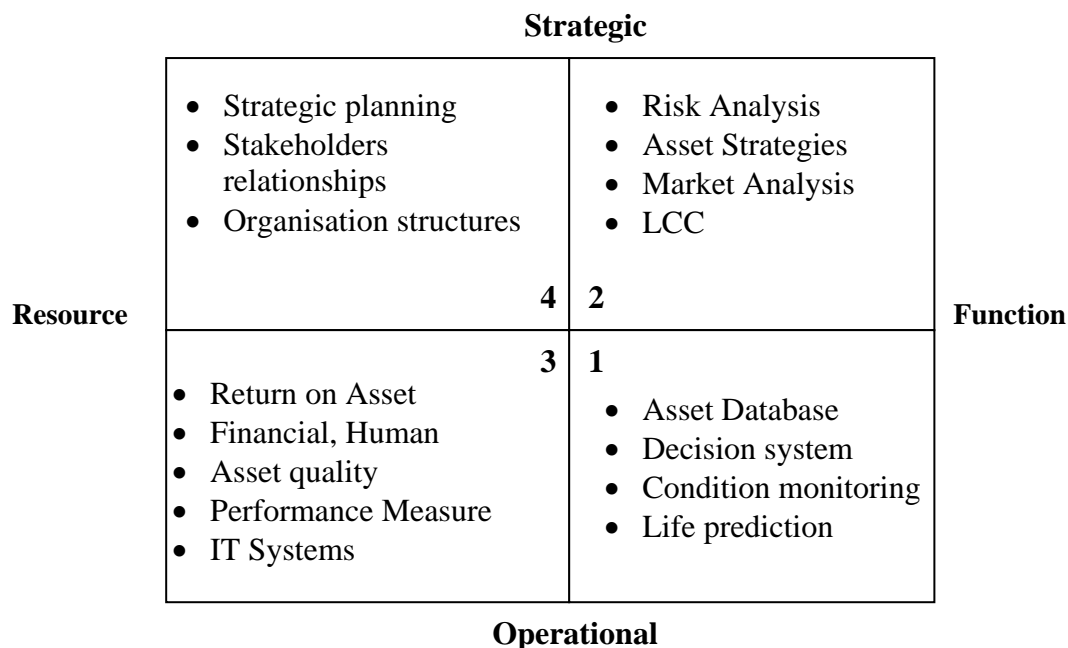


Figure 1- Infrastructure Asset Management (IAM) Framework

Quadrant 1: Asset as a Function (Operational)

This group of IAM practices concentrate on improving the maintenance of infrastructure asset to prevent failure. They are concerned with providing an asset that is reliable and in optimum condition. The activities include the development of infrastructure asset databases, decision systems, condition monitoring, and life prediction system within an asset management decision support framework.

Quadrant 2: Asset as a Function (Strategic)

The asset management activities in this quadrant aim at improving the performance of infrastructure assets over a longer term. They are concerned with not only the provision of infrastructure assets for operation, but also how the asset can perform and provide value for money over a longer period of time. This includes issues concerning the individual asset procurement and management, overall asset portfolio and the maintenance of an asset strategy. The typical activities include life cycle costing, demand analysis, risk analysis (financial, technical and environmental), etc.

Quadrant 3: Asset as a Business Resource (Operational)

This quadrant considers asset management processes related to achieving organisational productivity and quality enhancements. This includes cost minimisation initiatives, compliance with local environmental goals, asset profitability and quality, internal organisation efficiency (e.g. IT, operations, human resources, finance etc.).

Quadrant 4: Asset as a Business Resource (Strategic)

This quadrant focuses on asset management responsibilities that supports and creates value to all stakeholders. It typically involves the development of an IAM strategy by undertaking market trend analysis, asset demand analysis and stakeholder consultation. Various infrastructure asset options are then weighed and considered for their ability to contribute towards the organisation's business goals.

4. The future of Infrastructure Asset Management

The discussion thus far has illustrated the development of IAM from a narrow functional perspective to a broadening role in enhancing business goals. The expansive scope of IAM was summarised through a proposed IAM model. It is cogent and timely to end this paper by considering the future challenges to IAM.

In recent years, the challenges that most industrialised economies face relates to those of building and managing infrastructure assets. On the one hand, infrastructure is vital for supporting economic growth, meeting basic needs, facilitating mobility and social interaction, on the other, environmental pressures in the form of changing climatic conditions, congestion and so on are likely to increase, turning the spotlight firmly on the inherent tensions between the imperative for further infrastructure development and the quest for sustainability [16].

Accountability has emerged as a requirement for any organisational structure, public or private. Those in charge of economic resources, such as infrastructure must give account of their stewardship, irrespective of whether the transactions and resources in question are those of a government or a private sector entity [17]. Van der Mandele et al [18] suggests that there are four main groups of stakeholders involved in the provision of infrastructure: users, service providers, government, and the general public. Each of this group has conflicting demands from one another. Users are constantly looking for better service level in terms of speed, capacity, security and reliability. Their main objective remains one of identifying the most cost efficient way of securing a high quality service [19]. Service providers are constantly looking at how they can cater to the demand of these users efficiently so as to maximise the return to their shareholders. They will always look at how operation cost can be minimised, and how to increase capacity and reliability of the infrastructure assets. Government is concerned with how to regulate the infrastructure asset so that it can support the economic development and yet is accessible to all population. [20, 21]. Accountability on the use of public fund to build, maintain and regulate the infrastructure assets is also a top priority. The nexus between use of infrastructure assets and the physical environment is the area of concern for the general public. This relates to noise, air pollution and a host of other environmental issues. With so many stakeholders involved, infrastructure asset provision becomes a matter of prioritising these demands, and deciding how these demands can best be met with the least compromise on organisational goals.

The existing literature has also provided other challenges of infrastructure management currently faced in the industry. These challenges are: The need to accommodate continuing growth to support the economic and social developments of the nation [16, 20]; Significant parts of infrastructure are ageing and nearing the end of their economically useful lives [22]; Current funding commitments are either inadequate or yet to be identified, to support the substantial costs of renewal and replacement [22]; Current planning and political processes do not provide the necessary long term focus [22]; Only limited infrastructure information is available in some key areas [22]; The increasing sense of vulnerability of society and its economic structure because of perceived rise of terrorism [16]; The continuing integration of economies and systems, for example through the increase globalisation and trade in goods, services and information [16].

Moreover, globalisation is intensifying economic and other linkages among countries making it increasingly necessary to plan, develop and finance infrastructures across national borders. The key players too change over time, as the roles and responsibilities of the public and private sectors shift and evolve. In this challenging environment, infrastructure owners/providers need to focus on stewardship to meet the expectations for quality including safety characteristics, operational efficiency and durability and accountability as guardian of infrastructure assets. Asset manager must be responsible, accountable, open, consistent and ethical in the management of asset concerning the level of investments in assets, the benefits and costs that arise from the investment and how well the assets are maintained and managed. Asset management decisions need to be based on a proper evaluation of options which take into account all costs and benefits over the life of asset, and incorporate an explicit analysis and

determination of an acceptable level of risk [23]. This allows for more transparency in decision making and improves the process and accountability for capital and recurrent works. Hence asset managers must adopt a more holistic, integrated and structured process of maintaining, upgrading, and operating physical assets in a cost effective way [24, 25].

For this to happen, infrastructure asset management should be an interdisciplinary and comprehensive business strategy integrating finance, planning, engineering, construction, personnel, economics and information management. It should include all the dimensions proposed in this paper. In other words, IAM must not be approached only from a functional perspective but to also incorporate infrastructure asset as a important business resources from a more strategic perspective. It is a process for ensuring the requirements of organisations, users and other stakeholders are clearly understood and integrated into an asset management framework that optimises the outcomes achieved from policy and investment decisions [4].

5. Conclusion

The practice of infrastructure asset management has broadened in scope and complexity. Due to the lack of an integrated framework, it has led to an unsatisfactory state of confusion in practice and research. The contentious issue of defining IAM is a stumbling block to the advancement and accumulation of the IAM knowledge base. This paper has reviewed the development of IAM practices and formulated an IAM framework that categorised the practices into 4 quadrants. Most organisations have concentrated their IAM practice in one or two of these quadrants. However, with the increasingly challenging operating environment, such disparate practice of infrastructure asset management may not be sufficient to create maximum value and contribute to business success. Consequently, there is a need to adopt a more integrated approach to IAM through the incorporation of all the dimensions proposed in this paper. Only then, can infrastructure asset management be satisfactorily accountable to the different stakeholders.

References

1. IPWEA, *International Infrastructure Management Manual*. 2006, Institute of Public Works Engineering of Australia.
2. Stapelberg, R.F., *Infrastructure and Industry Assets Management Survey Research Report*. 2006, CRC for Integrated Engineering Asset Management: Brisbane, Australia.
3. ANAO, *Asset Management Handbook*, A.N.A. Office, Editor. 1996.
4. Austroads, *Integrated Asset Management Guidelines for Road Networks*. 2002, Austroads Incorporated: Sydney, Australia.
5. Government of South Australia. *Strategic Asset Management Framework*. 2006 [cited 2006 10 May 2006]; Available from: <http://www.buildingmanagement.sa.gov.au/Frames/systemframe1200.asp>.

6. LGV, *Asset Management Policy, Strategy and Plan*. 2004, Department of Victorian Communities, Local Government Victoria: Melbourne.
7. NSW Treasury, *Total Asset Management*, in *TAM 2004*. 2004: Sydney.
8. Queensland Government, *Strategic Asset Management Manual*. 1996, Queensland Department of Public Works: Brisbane.
9. Tao, Z., G. Zophy, and J. Weigmann, *Asset Management Model and Systems Integration Approach*, in *Transportation Research Record No. 1719*. 2000, Transportation Research Board: Washington.
10. Too, E., M. Betts, and A. Kumar, *A Strategic Approach to Infrastructure Asset Management*, in *BEE Postgraduate Research Conference, Infrastructure 2006: Sustainability & Innovation*. 2006: Queensland University of Technology, Brisbane.
11. Pal, S., et al., *Evaluation of Private Sector Asset Management Practices*, in *Transportation Research Record*. 2003, TRB, National Research Council: Washington D.C.
12. National Audit Office, *Improving Public Services through Better Construction*. 2005, National Audit Office: London.
13. AS/NZS 4536, *Life Cycle Costing: An application guide (AS/NZS 4536:1999)*. 1999, Standards Australia and Standards New Zealand.
14. Clash, T.W. and J.B. Delaney, *New York State's Approach to Asset Management*, in *Transportation Research Record*. 2000, TRB, National Research Council: Washington D.C.
15. Best, R., C. Langston, and G. De Valence, eds. *Workplace Strategies and Facilities Management*. 2003, Butterworth Heinemann: London.
16. Stevens, B., P. Schieb, and M. Andrieu, *A Cross-sectoral Perspective on the Development of Global Infrastructures to 2030*, in *Infrastructure to 2030: Telecom, Land Transport, Water & Electricity*. 2006, OECD Publishing: Paris.
17. Grimsey, D. and M.K. Lewis, *Accounting for Public Private Partnerships*. Accounting Forum, 2002. **26**(3): p. 245-70.
18. van der Mandele, M., W. Walker, and S. Bexelius, *Policy Development for Infrastructure Networks: Concepts and Ideas*. Journal of Infrastructure Systems, 2006. **12**(2): p. 69-76.
19. Commission on Public Private Partnership, *Building Better Partnerships*. 2001, Institute for Public Policy Research: London.
20. Kessides, I.N., *Reforming infrastructure: privatisation, regulation and competition*, in *A World Bank Policy Research Report*. 2004, The World Bank: Washington, D.C.
21. Amos, P., *Public and private sector roles in the supply of transport infrastructure and services*, in *Transport Papers*. 2004, The World Bank Group: Washington, D.C.
22. Hardwicke, L., *Australian Infrastructure Report Card*. 2005, Engineers Australia: Barton, ACT.

23. Government of South Australia, *Strategic Asset Management*. 1999, Government of South Australia: Adelaide.
24. FHWA, F.H.A., *Asset Management Primer*. 1999, Federal Highway Administration, US Department of Transportation.
25. Austroads, *Strategy for Improving Asset Management Practices*. 1997, Austroads Incorporated: Sydney, Australia.