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Value Optimisation of Public Infrastructure Assets – A Grounded Theory Study

*From theory to practice in the application of asset management
standards for New Zealand Public Infrastructure*

A thesis submitted in partial fulfilment of the requirements for the degree of
Doctor of Philosophy

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ABSTRACT

Many organisations accountable for public Infrastructure assets face significant challenges due to aging infrastructure, natural disasters caused by climate change, unexpected pandemic occurrences and population growth. Previous studies have shown current asset management capabilities are inadequate for these challenges. Asset management is not a new discipline and has a long history as a research topic mainly from a technical perspective promoted by financial, technical and engineering professional organisations. In contrast, the asset management philosophy within a socio-technical systems view of an organisation has rarely been studied. This thesis was undertaken to close the gap between theory and practice as it provided evidence-based insights of how complex asset management challenges are addressed to optimise value of public infrastructure assets.

The study adopted the Straussian Grounded Theory method that involved comprehensive literature reviews and semi-structured interviews of twenty-four senior leaders from twenty organisations responsible for complex asset management systems of large asset portfolios. The method chosen enabled discovery of the unwritten rules that govern asset management behaviour as it provides a broader understanding of social context that explains the interactions that influence actions of individuals and organisations that led to rich, empirical descriptions for development of a new conceptual framework of value optimisation.

The findings from the research revealed shortcomings of current asset management standards for the complex asset management challenges in New Zealand that are heavily impacted by social, environmental and political systems external to the organisations studied. In addition to the difficulty of defining what is organisation value, the multi-dimensional factors and interfaces between the asset management system, the wider organisation and the eco-system, asset management are further complicated by different layers of power and influence under a broader theme of political-social dimension. Asset management technologies and tools on their own cannot be used as proxies for effective decision-making. In fact, they may be sources of silos when not implemented properly.

The proposed Balanced Optimised Value framework that evolved from the research findings extends beyond the current asset management standards presumption that value is realised from the triangulated balance of cost, risk and performance of assets. The framework provides a new practicable approach of defining and optimising value by not only focusing on technical outputs internally (e.g. cost-funding matching) sometimes misconstrued as customer outcomes but instead, focus on outward looking outcomes for society. By adopting whole-of-systems thinking approach, the framework minimises the unfavourable trade-offs between economic, social/cultural and environmental outcomes by decision makers.

This research offers a more holistic asset management approach for optimising value of public infrastructure by establishing the appropriate authorising-enabling environment that enhances the capacity and capability through effective use of the enablers of new technologies, organisation culture and climate.

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I am particularly grateful to the study participants who willingly and voluntarily gave their time to provide honest views and supported the research with valuable information to make it so valuable for enhancing the asset management knowledge base in Aotearoa New Zealand. I am deeply humbled by the frankness afforded to me that made the three-year journey so memorable, having made many new friends and like-minded professionals along the way.

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ABBREVIATIONS

AM	Asset Management
AM Council	Asset Management Council
AMS	Asset Management System
ĀPŌPŌ	Infrastructure Asset Management Professionals
BOV	Balanced Optimised Value
BSI	British Standards Institution
CSR	Case Study Research
DIA	Department of Internal Affairs
DPMC	Department of Prime Minister and Cabinet
G-D	Goods Dominant Logic
GFMAM	Global Forum for Maintenance and Asset Management
GTM	Grounded Theory Method
IIMM	International Infrastructure Management Manual
INZ	Infrastructure New Zealand
IAM	Institute of Asset Management
IPWEA	Institute of Public Works Engineering Australasia
ISO	International Organization for Standardisation
ISO 55x	ISO 55001 suite of asset management Standards
MGI	McKinsey Global Institute
NPM	New Public Management
NZIC	New Zealand Infrastructure Commission
NZS	New Zealand Standard
NZTA	New Zealand Transport Agency
OAG	Office of the Auditor General
OECD	The Organisation for Economic Cooperation and Development
PDCA	Plan-Do-Check-Act

PSC	Public Service Commission
RICS	Royal Institute of Chartered Surveyors
S-D	Service-Dominant Logic
TEC	Tertiary Education Commission
TEFMA	Tertiary Educational Facilities Management Association
UNSDG	United Nations Sustainable Development Goals
UFA	Usable Floor Area
VfM	Value For Money
WPiAM	World Partners in Asset Management

LIST OF PUBLICATIONS

Tan, R., Rasheed, E., & Rotimi, J. O. B. (2022). Asset Management for the Built Environment: Creating Capability and Resilience. 7TH NEW ZEALAND BUILT ENVIRONMENT RESEARCH SYMPOSIUM,

Chapter 1

INTRODUCTION

1.1 OVERVIEW

This chapter provides the context of the overall study and sets the scene for the rest of the thesis. It starts with a background for the research, followed by the rationale and motivation for conducting this study. The aim and objectives of the research are then described. Specific terms and definitions are introduced to outline the scope of the investigation, and the research methodology used. The ethical consideration and researcher's disclosure are also included before the chapter concludes with an outline of the thesis structure.

1.2 BACKGROUND

For centuries, the built environment created worldwide has played a substantial role in for sustaining wealth, prosperity, and quality of life for billions of people. However, despite the vital importance of the built environment in terms of its socio-economic impact, investment is often insufficient. A McKinsey Global Institute (MGI) reported that \$57 trillion of global infrastructure investment was needed in 2013-2020 (Richard et al., 2013). The MGI research of over 400 case studies found that the weakness of the infrastructure planning, delivery, and management systems are significant factors in many countries. These challenges require a fundamental transformational shift in approach to capture and create value for their stakeholders. Capital-intensive organisations in both public and private sectors worldwide must continually design new strategies for their long-term survival in response to increasing competition, deregulation, external pressures, and technological advancement. The MGI

research showed 'up to 40 per cent savings could be translated from more effective project selection delivery, better management of existing assets, optimising project portfolios, or streamlining asset-service delivery.'¹ (p. 4-7). Some of the other causes of poor performance identified in the MGI report included failure to link asset investments to broader social and economic objectives, routine under-estimation of costs, over-statement of benefits, evaluation of projects conducted in isolation, and inability to adapt or failure to remain resilient to uncertainties caused by natural disasters and climate change (Richard et al., 2013)

Exacerbating the above challenges is a long-standing tendency for countries and asset-intensive organisations attempting to build their way out of problems of capacity constraints and poor asset management (Thurlby, 2013). There is a considerable amount of literature on how and why wrong infrastructure gets constructed in the first place after errors and biases were discovered in post-project delivery cost-benefit analyses (Flyvbjerg, 2009, Whitcombe, 2008). As noted by Hartley et al. (2008), "*Public service failure and turnaround are issues of pressing practical concern in most nations, yet theoretical and empirical research in this field is sparse*" (p. 249). By their very nature, infrastructure projects become embedded post-delivery into a wider complex physical asset and organisational system that requires continuous alignment to fit closely with organisational objectives of delivering value and outcomes (Blom, 2017).

¹ Six common traits of effective infrastructure governance systems were identified (Richard et al., 2013, p.7-8):

- Close coordination between infrastructure institutions
- Clear separation of political and technical responsibilities
- Effective engagement between the public and private sectors
- Trust-based stakeholder engagement
- Robust information upon which to base decision making
- Strong capabilities across the infrastructure value chain

Ageing infrastructure, inadequate funding, failure to adapt to climate change, short-term focus on political processes, and the increasing need to satisfy multiple stakeholders' demands are some challenges faced by those who build and manage assets (NZIC, 2022). Getting the most out of existing assets is becoming a focus in many countries as it is no longer viable to simply build more (Woetzel et al., 2017). Bielenberg et al. (2020) noted that productivity is a long-standing issue in the built environment sector globally. While there are positive instances of innovations occurring, governments and other stakeholders cannot solely rely on the industry's ability to make progress.' Flyvbjerg (2009) noted that few published studies explored the shortcomings of business-as-usual operations with the public infrastructure sector or addressed the issues at a system level or 'fitness', which the World Bank describes as 'big holes in the big picture' (Estache and Fay, 2007).

Similarly, the New Zealand Infrastructure Commission (NZIC) noted that New Zealand spends around 5.5% of gross domestic product (GDP) on public infrastructure² and cannot afford to "*build our way out of infrastructure challenge*" due to historical infrastructure deficit or under-investment in the past³ (NZIC, 2022). New Zealand faces challenges over the next 30 years in its civil and social infrastructure sectors with public housing shortages, failing healthcare services, deteriorating education facilities, and poor roading and water assets (INZ, 2021).

The Department of Prime Minister and Cabinet Office (DPMC) define infrastructure assets as fixed, long-lived structures that facilitate economic performance and wellbeing, including

² The inflation-adjusted value of New Zealand's infrastructure assets rose from \$32,900 per person in 1990 to \$55,800 per person in 2022. In 2022, our infrastructure assets, excluding land, were valued at \$287 billion. 45% of this infrastructure is owned by central government, 26% is owned by local government, and 29% is commercially or privately owned (NZIC, 2022).

³ It will cost 9.6% of GDP over a 30-year period, equivalent of \$31 billion per year to build our way out of current and future infrastructure challenges or poor quality and deficits, and to meet future population growth and support the associated housing growth (NZIC, 2022).

buildings and physical networks (i.e., transport, water, and social assets) and communications infrastructure such as mobile and broadband infrastructure, however funded. Similarly, the New Zealand Infrastructure Commission (NZIC) defined infrastructure as

“Fixed long-lived structures that facilitate economic performance and wellbeing. Infrastructure includes ‘horizontal’ physical networks (principally transport, water and energy and telecommunications); and ‘vertical’ infrastructure (buildings such as hospitals, schools and prisons). The latter are also known as social assets..” (NZIC, 2022)

Adopting a systems view, New Zealand infrastructure is made up of layers of connected systems and networks (p. 19) categorised into three broad areas of economic, social and natural environments to articulate the relationships between the enabling environmental assets and the sustainable use of resources or capital employed (social, financial, human, natural) in the development and management of assets to deliver the wellbeing benefits (p. 200):

- Economic infrastructure: energy, telecommunications, transport (including airports and seaports), water and waste systems
- Social infrastructure: hospitals, schools, correctional facilities, community facilities and parks
- Natural environment: ecological, biological, natural blue and green asset systems

Similarly based on the above environments, local governments in New Zealand often refer these infrastructure systems as the ‘built environment’ For example, the largest unitary local authority Auckland Council considers a holistic view that its built environment includes *‘the buildings people live, work and learn in, the infrastructure systems that enable the region to function, and the urban spaces that shape the city’*. Similarly, Wellington Regional Council describes the ‘built environment’ as *‘...all those structures and other physical resources built*

by people... includes urban and rural settlements, telecommunication and utility networks, transportation systems, sewerage and water systems, dams and flood control structures, and recreational facilities.

Despite the different definitions adopted by the local and central governments, and apart from providing essential services to society, these physical resources or assets tend to be natural monopolies, in most cases due to barriers to entry or fully controlled by New Zealand central and local governments. In most situations, there is no option of disposing or decommissioning these infrastructures for the market (supply and demand) to decide. Hence, noting there are many definitions for public assets, the terms '*built environment*', '*public infrastructure*', '*facilities*', '*infrastructure*' and '*physical assets*' are used interchangeably in this study as depicted in [Figure 1-1](#) (Shiem-Shin and Hee, 2004) for this thesis and as the foundation of terminologies and concepts applied in the study of asset management in the New Zealand public sector([Figure 1-2](#)),

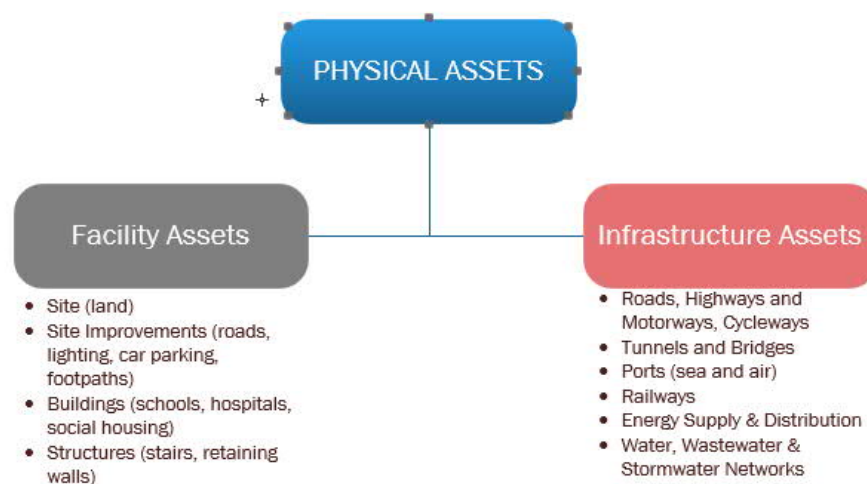


Figure 1-1 - Physical Assets in Scope (Then and Tan, 2013)

The Public Sector | Te Rāngai Tūmatanui

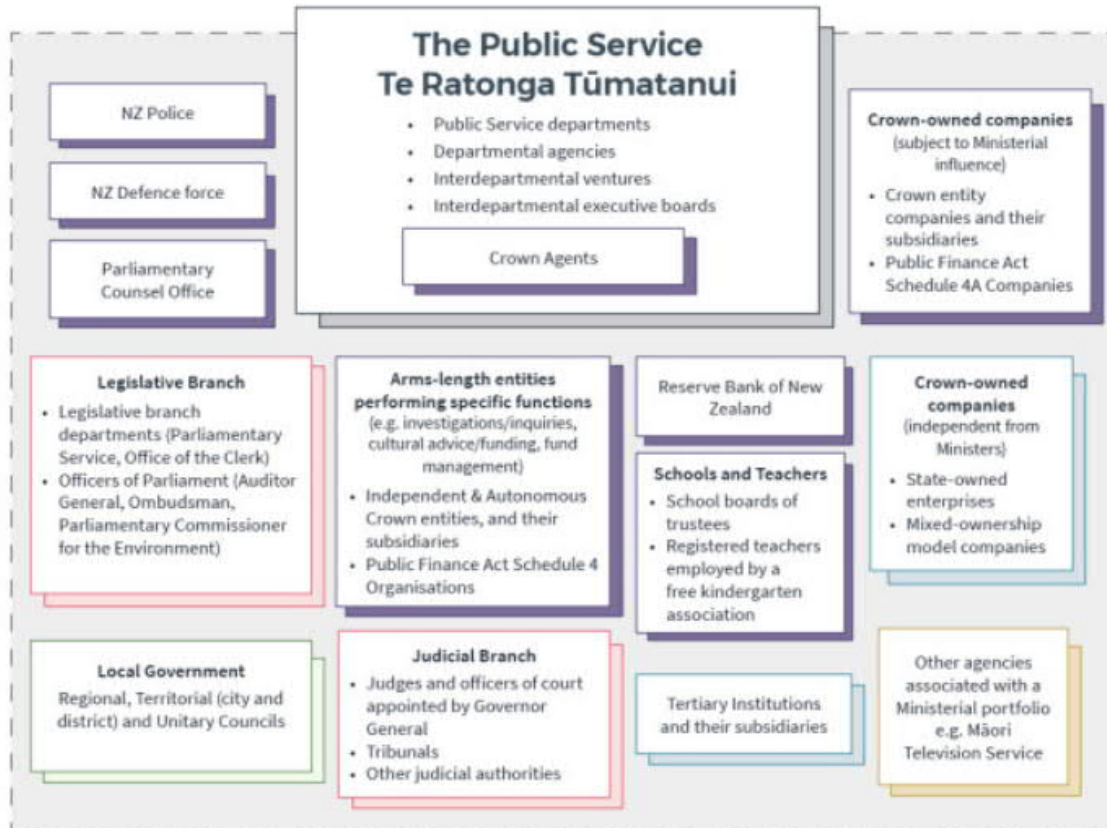


Figure 1-2 - Mapping the public sector (Source: [Central government organisations - Te Kawa Mataaho Public Service Commission](#))

The Office of the Auditor-General (OAG) and other government agencies have provided several reports on asset management performance over the last ten years and the challenges remain the same as noted in the New Zealand 2022-2052 Infrastructure Strategy-(NZIC, 2022).

The following are some of the findings since 2014.

The New Zealand Treasury noted a lack of asset management capability of New Zealand infrastructure entities, such as not understanding the condition of their assets and their adverse impact on society; or the ability to provide the required services the assets were designed for; or to ensure future needs to sustain their performance (Treasury, 2018, Treasury, 2021c). For example, Infrastructure New Zealand (INZ) noted 50 per cent of the

schooling estate and social housing are over 40 years old, critical roads and three water assets of local authorities urgently need renewals and upgrades (INZ, 2021). A study commissioned by INZ (2018) identified concerns that New Zealanders are *“getting short-changed regarding cost-of-asset delivery and opportunity cost concerning the quality of the asset in use, whether that be social, environmental, or economic”*(p.2). Some of the concerns identified include *“short-term reactive planning”* and *“high-level failure to understand the whole-of-life costs of an asset”*(p.4). The study noted that *“Public sector individuals are therefore often working in impossible contexts, with squeezed budgets and insufficient knowledge – often due to the lack of big picture planning - and on the express directives from those above”*(p.4). During the same period, OAG noted that local councils have more to do in terms of collecting better information about the condition and performance of critical assets, their exposure to natural hazards and the adverse effects of climate change on their infrastructure and community. The report also highlighted other asset management issues, such as a lack of effective decision-making, and poor selection of projects and execution (OAG, 2018). A government paper noted there were opportunities to *“overcoming silos”* and address the *“lack of alignment”* for investment proposals coming before cabinet (PSC, 2022). The above findings have led to several reforms in New Zealand under the Labour government (2017-2023) aiming to increase the value of public assets, in contrast with the earlier decades of focusing only on cost reduction (NZIC, 2022). This research will investigate some of the underlying causes of the above concerns.

Good asset management is vital to ensuring the value provided by the assets is optimised and replaced at the right time and in the right way. It involves the integration of engineering, financial and spatial planning disciplines (Treasury, 2023). This research intends to close the gaps and argues the need to move beyond the domain of engineering and construction

artefacts to include both potential asset and service-based typologies that highlight the interactions between actors, organisations, institutions and society in an asset management ecosystem.

Addressing the issues highlighted in this chapter and others discussed in subsequent chapters as the '*way forward*', the primary aim of this research is to:

Improve the effectiveness and efficiency of asset management practices of New Zealand public infrastructure assets through the development of a conceptual framework for value optimisation.

My research has adopted fundamental concepts of the Grounded Theory methodology, where the systematic data collection and analytical processes ensure that any preconceptions (or academic interests) of the researcher do not influence the data in an empirical setting regarded as an area of interest (Glaser, 1998, Glaser and Strauss, 2017). In this research, the discovery of the main concern (optimised value) is at the centre of the substantive area (asset management in the public sector), and conceptual theories (key considerations of research participants) and category properties (e.g., leadership) all emerged from the empirical setting of the research (e.g. case selection, archival records, published documents and interviews), and not by preconceived notions of the researcher or from existing theoretical constructs or findings of other similar research previously undertaken (if any) (Glaser, 1978, Glaser, 2005, Strauss and Corbin, 2015).

1.3 RATIONALE AND MOTIVATION

The rationale and motivation for establishing the research aim are further strengthened by the discourse in this section.

To address some of the global concerns in the MGI reports mentioned earlier, the International Organization for Standardisation (ISO)⁴ published the ISO 55000 suite of asset management standards (ISO 55x) in 2014, which provided guidance on the requirements of a management system for asset management. ISO 55000:2014 defines 'Asset⁵' as: *"...an item, thing or entity that has potential or actual value⁶ to an organization"*. 'Asset Management' is defined as: *"...the coordinated activity of an organization to realize value from assets"* (ISO, 2014a).

Processes (transformation of inputs into outputs) and risk-based thinking are the backbones of modern asset management standards (Kohl, 2020). Recognising the longevity of a physical asset where value can be created, sustained or destroyed over time, the value concept is a central tenet within the ISO 55x standards. The realisation of value according to the standards requires the optimal balance of costs, risks and opportunities (environmental, social, economic) against the expected or desired performance of assets to achieve organisational objectives/outcomes throughout the lifecycle stages of the asset, the asset portfolio or an asset system. This optimal balance might include selecting the right asset or project, streamlining project delivery through the proper structure, or simply making the most of an existing asset (ISO, 2014a)

The concepts of strategic asset management and organisation value creation and optimisation have been extensively studied and developed in different contexts over the last few decades

⁴ ISO was founded in 1946 after the 2nd World War by representatives from 25 countries with the aim of coordinating the development and unification of industrial standards focused on quality, safety, environment, etc. (Kohl, 2020).

⁵ In financial terms, an asset is generally regarded as a tangible or intangible economic resource owned by a business entity or an individual, the cost of which at the time of acquisition could be measured in monetary terms and can be presented on a company's balance sheet.

⁶ Value can be financial and non-financial, tangible or intangible including the consideration of risks and liabilities (ISO, 2014a).

(e.g. Almeida et al., 2022, Srinivasan and Parlikad, 2020, Gavrikova et al., 2020). Despite the relatively increased attention from empirical researchers and practitioners and acknowledgement of the critical role of asset management activities in the development of business strategies, research on the strategic aspect of managing assets is rare and, at best, moderate (e.g. El-Akruti et al., 2013, Too, 2009). It is well established from various studies that asset management is considered a framework to facilitate effective decision-making by integrating engineering and business principles⁷ (e.g. Valencia et al., 2011, El-Akruti et al., 2018, Ali, 2021, Kelly, 2018, Alsyouf et al., 2021). While there has been a convergence of a widely accepted definition through the development of the ISO standards, many researchers had doubts about what asset management means in practice (e.g. Lloyd, 2019, da Silva and de Souza, 2021, Hodkiewicz, 2015). Other researchers have called for the need to provide empirical evidence concerning the holistic strategic perspectives (e.g. Mediavilla et al., 2015, Simões et al., 2016, Cigolini et al., 2008, Léger and Morel, 2001, Elizaveta et al., 2020) These shortcomings of the discipline led to the first research objective of this thesis (RO1):

To identify critical properties e.g., a pattern of cause-effect relations that link value creation/capture activities with asset management decision-making in the built environment.

⁷ A growing body of published work provides evidence of both internal and external benefits of adopting ISO 55x such as (e.g. Ali, 2021; Alsyouf et al., 2021)

- Financial – reduction in operating costs, improved ROI, increase revenue, decrease insurance premiums
- Customer – Increase customer satisfaction, improved corporate image
- Efficiency – Process and organisation effectiveness, improved productivity, improved performance in working conditions, health and safety, product/service quality and reliability, decrease non-value-added activities, continuous improvement, and innovation
- Learning and growth – improved asset intelligence, increased employee motivation and commitment, increased employee development, increase innovation

Currently, there is no shortage of asset management models promoted by different professional organisations for specific industry groups or asset classes (e.g., IAM, AM Council, IPWEA, GFMAM), as provided by an example in *Figure 1-3*.

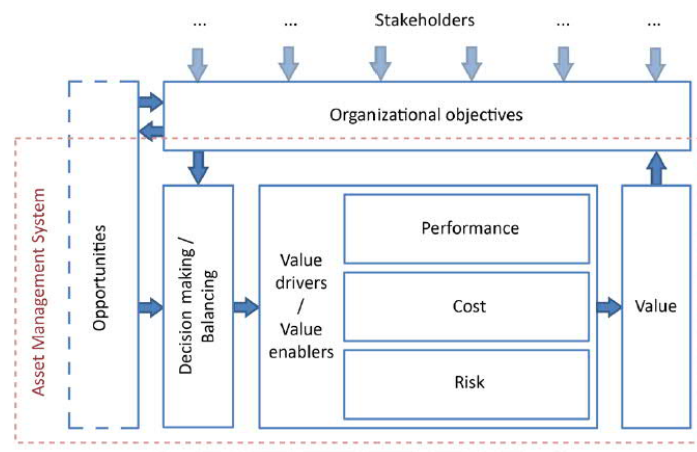


Figure 1-3 - The Value Model (GFMAM, 2016)

The GFMAM (2016) model describes the organisational objectives derived from stakeholders' expectations interdependent with the asset management system and varies with the levels of importance of the assets in achieving the objectives. Value is created by drivers and enablers such as strategy, system, process and other elements that can affect asset performance, cost and/or risk of the asset/s that is constantly subjected to internal and external factors in the organisational context. It is suggested in this model that the distinction between asset drivers and asset enablers helps organisations understand 'how' asset management creates value. In this instance, value represents the balance of performance, cost and risk as in the ISO 55000 standards (GFMAM, 2014).

Most organisations can easily define the frameworks that help to manage value, but determining value itself is difficult at best as it depends on one's past, present, and future lived experiences and perceptions. Furthermore, these asset management models were often

developed in isolation from the business models of creating and capturing organisational value which led to the need to establish the relationship between asset management and business performance (Lima et al., 2020). The models were often mainly focused on value from the asset perspective rather than the organisation. In addition to these shortcomings, several researchers (e.g. González-Prida et al., 2019, Carnero and Gonzalez-Prida, 2017, Wijnia and de Croon, 2019, Wijnia, 2016, Wijnia et al., 2014a) after extrapolating value definitions and concepts from the ISO 55x standards and asset management literature, noted there was a lack of any references of quantifying value for an organisation, or provided an agreed definition of what 'value' is delivered by assets or by asset management to the organisation. To address this, the research question (RQ1) was formulated:

What are the key considerations for defining value from the perspectives of internal and external stakeholders of (i) the asset, (ii) the asset management system and (iii) the organisation?

Gavrikova et al. (2020) noted in their analysis of 700 articles devoted to the strategic aspects of asset management that the articles were often case-specific, drawing on various theoretical grounds and approaches leading to the concept of strategic asset management and "*lacked a clear focus as different interpretations are promoted by various communities of practice*" (p. 2). This view is also shared by earlier researchers (e.g. Konstantakos et al., 2019, El-Akruti et al., 2018) that there is a lack of reference to the holistic strategic perspectives of asset management. A plausible reason may be the lack of appreciation by researchers and practitioners of what strategic asset management can offer to the performance or value of the organisation. There was also a call for more '*practice-oriented*' research that will benefit the industry (e.g. Fraser et al., 2015, Velmurugan and Dhingra, 2015). Hence, this thesis

intends to enhance the cross-fertilization of *'theory-oriented'* research with *'problem-solving'* research to support a business model that integrates asset management strategy with the overall business strategy, leading to the second research objective (RO2):

To identify relevant theoretical frameworks that support the conceptual business model for optimising organisation value through the successful development and implementation of an effective asset management system.

Winter et al. (2006), in UK government-funded public sector project management research, observed that all many published models are based on the fact that the *'organisation value'* realised by the assets within *'the context'* of the organisation is already pre-determined by establishing all the appropriate stakeholders in the value chain for any decision-making. Their research also identified the frustration of not addressing system-level issues such as poorly structured situations with unclear objectives, and different constituencies having conflicting aims, where the way forward requires a vision (often lacking), leadership, and hard systems analysis and design. To address this, the research question (RQ2) was formulated:

What are the key considerations for prioritising asset management strategies/asset decisions?

Blom and Guthrie (2018) assert that infrastructure asset management needs to transition away from how the community interacts with the asset to the actual outcomes achieved that reflect the needs, beliefs and choices available to society as well as its ability to respond or adapt to the change of behaviour. Some researchers call for incorporating asset whole-of-life value considerations (Frolov et al., 2010, Schuman and Brent, 2005, Tsutsui and Takata, 2012). This research intends to explore the notion further with the third research objective (RO3):

To establish the linkages of both tangible and intangible benefits embedded within asset lifecycle management decisions.

ISO 55X clearly states that not all aspects, such as leadership, culture, motivation, and behaviour, can be achieved within the system (Abe and Mizutani, 2016, ISO, 2018, ISO, 2014b, ISO, 2014a). Reason (1990) similarly asserted that many systems' safety and failures could no longer be solved by more engineering fixes nor resolved by conventional remedies of human resource specialists. Similarly, Edkins and Zerjav (2014) identified the limitations of traditional engineering research methods that cannot address the complexities of social and cultural factors and the relationships between human actors and organisations in a given situation involving complex infrastructure asset systems, a better understanding of the breakdown of complex socio-technical systems, and the development of new techniques of asset risk assessment is needed. This research explores what other aspects or factors are critical to the effectiveness of an asset management system, and how these factors affect the outcomes and the way the infrastructure asset systems are managed with the research question (RQ3):

What are the critical cultural/social factors for the successful development and implementation of an asset management system?

In addition to industry and government reports highlighted above, a preliminary literature study of academic journal articles on the asset management discipline highlighted no major contributors from New Zealand to the topic despite its importance, which is well recognised by both the private and public sectors in other countries. It also confirmed there has not been any significant research on what organisations identify as crucial success factors of an effective asset management system in New Zealand (Le, 2021, Kamarazaly, 2014, Blom, 2017). Thus, this thesis presents pioneering research on the topic in New Zealand which lags in both asset

management research and adoption of an international standard compared to other OECD countries and developing countries in Asia with the fourth research objective (RO4):

To evaluate the key attributes of a business model that enables all stakeholders in the sector to improve their capability and capacity for value optimisation when managing public assets.

In 2020, over 300 private and public organisations from 20 industry sectors in 45 countries attained the ISO 55001 certification⁸ (ISO, 2020). In that period, there were four organisations in New Zealand compared to over sixty in Australia⁹. Hodkiewicz (2015) noted some parallels between adopting ISO 55x and ISO 9000 quality management system standards (first published in 1987). Unless mandated by regulation or legislation, adoption takes time, as there is a need for organisations and industries to re-model themselves to ensure the asset management philosophy ‘fits’ with the organisational strategy and external business environment.

There is also a call for the need for a more comprehensive ‘*business-focused*’ approach to engineering asset management as most large organisations are governed by non-engineers (e.g. Haffejee and Brent, 2008, Stapelberg, 2006b, Amadi-Echendu, 2004, Mohseni, 2003, Dornan, 2002). Hence, it is an opportune moment for this research to fill that need for organisations and sectors to understand better the enablers for an asset management system

⁸ Given the more generic language employed in ISO 55001, certifying bodies needed subject-specific knowledge in order to perform their assessments effectively to complying with a new set of requirements: ISO 17021-5: Competence requirements for the certification of asset management systems (Woodhouse, 2014)

⁹ After the Australian Productivity Commission (2014) inquiry into public infrastructure performance. Federal, State and Local authorities (e.g. Governments of Queensland, New South Wales, South Australia, Victoria, Western Australia) have now established Strategic Asset Management Frameworks to enable agencies to enhance their asset management capability. These frameworks adhere to the ISO 55x requirements found in other quality management systems such as ISO 9001 - Quality Management Systems and ISO 14001 – Environmental Management Systems that are focused on the need of stakeholders, and organisational objectives.

that conforms (or close) to the ISO 55x requirements with answers to the research question (RQ4):

What are the enabling structures and processes for an effective and efficient asset management system?

As asset management is often regarded as an emerging concept, there are many opportunities for this research to contribute to the knowledge base and call for the need for new research designs to address some of the gaps identified above (e.g. El-Akruti et al., 2018, Schraven et al., 2015). Compared to prior work, the key difference of the current study is the closer alignment of asset management theory with real life practices to inform the development of practicable solutions (models) for enabling all stakeholders in the sector (whole-of-system) to improve capability and capacity.

This research attempted to achieve the last research objective (RO5):

To validate recommendations for future research and development of an asset management knowledge base for managing NZ public physical assets.

1.4 SCOPE AND LIMITATIONS

This study does not investigate issues specific to the participants' organisations, legal jurisdictions, sector-specific studies, or asset lifecycle strategies, as it is not a comparative study between organisations, -sectors or governments. Instead, this research seeks to draw out common themes (categories) provided by qualified respondents concerning their current or past involvement with asset management systems of public infrastructure assets. The research considerations will exclude any attributes of the participants in relation to age,

gender, education or professional backgrounds. No effort is made to critics, qualify or correlate asset management strategies to organisations' performance reports available in the public domain or could be made available on request through the Official Information Act 1982. While some participants mentioned performance challenges and barriers, the research is not designed to support claims concerning particular behaviours, processes or capabilities that would identify participants or their associated organisations. The investigation is limited to identifying asset management best practices and opportunities relevant to the participant's experiences of establishing and managing asset management systems of their particular infrastructure asset classes. Theoretical saturation occurred after 24 participants from 20 organisations completed the semi-structured interviews that generated nearly 30 hours of recorded interviews and produced over 100,000 words of transcription that were analysed and coded.

It was concluded earlier that asset management is multidisciplinary and cross-functional within an organisation, and an asset management system can be viewed as either a closed or open system. This thesis focused on endogenous challenges as opposed to exogenous pressures, exploring the potential for improved asset management practices and decision-making within the organisation. In other words, the research considerations are made in the context of increasing exogenous pressures such as inflation leading to cost-of-living pressures, global supply change disruptions due to war, negative impacts of climate change, natural disasters and the recent Covid19 pandemic.

1.5 APPROACH

Typically, there are multiple ways to frame any given problem, and considering what has been discussed thus far, it may only be the symptoms, and symptoms do not always equal problems. As Bosch et al. (2013) noted for complex issues, treating symptoms with band-aid solutions via linear thinking has not always been useful as there is no one solution to complex problems. The Oxford Advanced Learners Dictionary defines research as “... a careful study of a subject, especially to discover new facts or information about it.” (Turnbull et al., 2010). Weingand (1993) notes that ‘careful study’ in the definition implies the thoroughness of the process, rather than the type of methodology used. ‘Discover new facts or information’ also indicates a methodology-neutral position to ‘discover’ or ‘obtain sight or knowledge’ without bias to either quantitative (e.g., empiricism, statistical quantification) or qualitative (e.g., action research, grounded theory, case study) methods. Meredith (1998) noted that the case (field) focus in the Case Study Research strategy is preferable to new theory development because the explanation of any quantitative findings will ultimately have to be based on qualitative understanding to construct theory. As building a controlled environment for asset management research is not feasible due to the lack of researcher control over the different contexts, this research has applied a Case Study Research (CSR) strategy (Yin, 2003, Eisenhardt, 1989)

Yin (2003) describes CSR as “to investigate a contemporary phenomenon within its real-life context.” The approach is appropriate for this study, where boundaries between phenomenon and context are not always clear or when multiple sources of evidence are needed. As noted by Eisenhardt (1989), a Case Study Research approach can be used to develop theory, explain causal links in real-life situations that are too complex for survey or experiment-based

approaches to record, and to describe a social or organisational intervention and the real-life context in which it has occurred.

In conjunction with the qualitative theory-building approach, this research has adopted the interpretivist¹⁰ Grounded Theory (GT) methodology (Strauss and Corbin, 2015). The GT method focuses on the emergence of a phenomenon after an area of study has been selected, where an overall theoretical structure progressively takes shape as the research process unfolds (Glaser et al., 1968). Glaser (1998) asserts that GT allows a researcher to use any data from any relevant, available source to explain the pattern that is not only valuable to theorists but also for practitioners to understand better and explain “*high impact main concerns*” that can be applied or “*actionable*” to gain improvements (Schön, 2017).

Using both approaches aligns with the views of (Starkey and Madan, 2001) and (Limoges et al., 1994) that emphasised it is less of a concern with the discipline agenda and more with knowledge relative to the nature of the issues in the management research. Their views that all participants will define the problems in a practical context and the researcher can make comparisons or references to existing theories and developed new ones throughout the research process.

Considering these notions and preventing being overwhelmed by data, *a priori* specification construct based on the ISO 55x standards was applied to develop the four core research questions corresponding to the research objectives, as shown in [Figure 1-4](#) that are of significant relevance to those that are responsible for developing and managing asset

¹⁰ The interpretive approach assumes people create and associate their own subjective meanings as they interpret their interactions with the environment (Strauss & Corbin (2015).

management systems in any organisation conforming or complying to the current ISO standards.



Figure 1-4 – Relations between the A Priori and Research Questions

The research used semi-structured open-ended interviews to identify known and unknown variables and relevant themes for establishing an explanatory theory of events and processes in the asset management discipline of public assets. The four questions align with Eisenhardt’s (1989) views on the appropriateness of using an *a priori* construct specification that provides strong triangulation measures to ground emergent theory during the subsequent analytical process of collected data. [Figure 1-5](#) provides an overview of how the four research questions fit with the overall objective of the thesis.

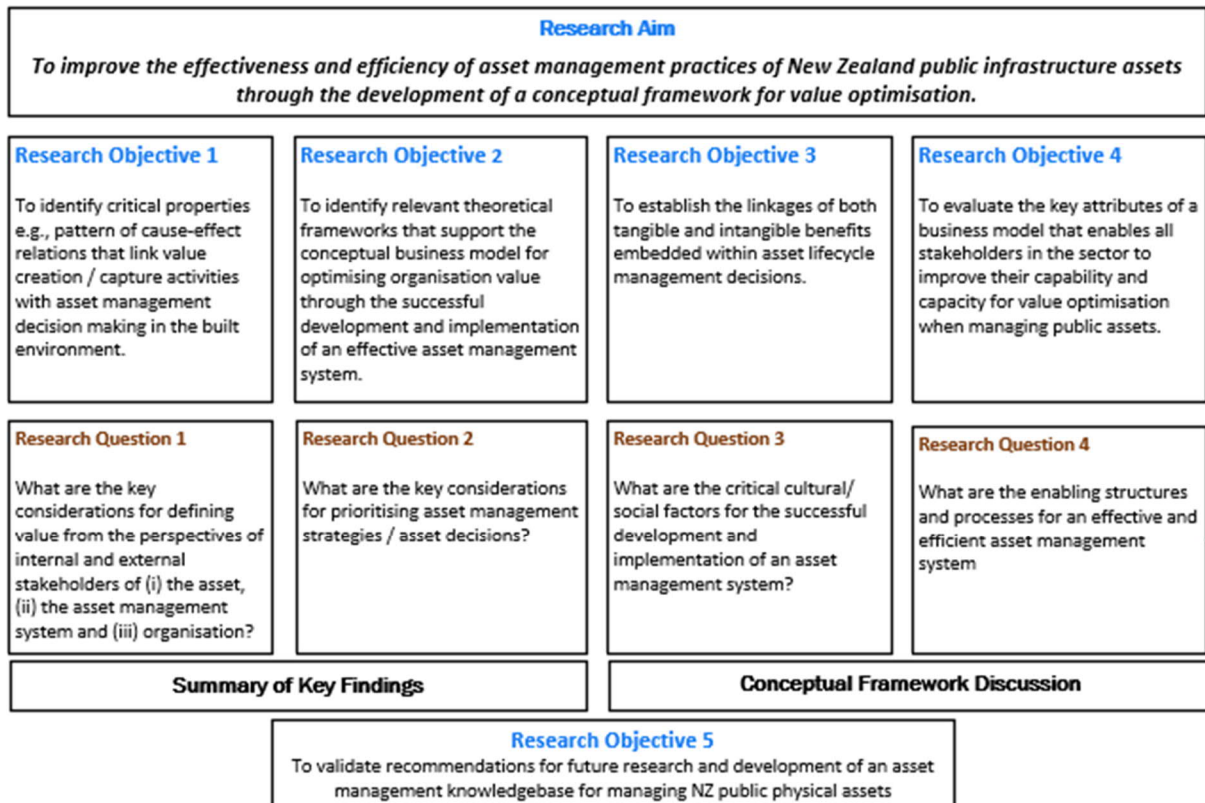


Figure 1-5 - Research Overview

The research strategy has applied various tools to capture and synthesise meso- and meta-data via a staged process that captures holistic and practical methodology. Based on the 'interpretivism' and 'constructivist' perspectives (Liu et al., 2015, Schraven et al., 2015, El-Akruti et al., 2018, El-Akruti and Dwight, 2010, Mir and Watson, 2001), a multi-phase mixed methods approach was adopted as follows:

- Initial and Continuous Literature Reviews:** Critical reviews of academic and professional literature were conducted using an intellectual structure approach to provide a thorough understanding of recent developments in asset management philosophies and practices that distinguish emerging topics, existing gaps, their influences and linkages with the asset management standards and associated theoretical frameworks.

- **Open-ended Interviews:** Inductive and deductive methods ¹¹were used to analyse primary data collected through semi-structured open-ended interviews based on the core research questions. The intention was to develop theoretical propositions on value optimisation by examining the dynamics in the organisations and individuals studied. These dynamics from the responses obtained reflected real-life experiences and the participants' perspectives that are beyond the control of the researcher, where reality created by individuals is composed of how they see their purpose and, in specific settings, come to understand and manage the day-to-day expectations of the stakeholders. This approach aligns with this study's exploratory and interpretative research paradigm.
- **Model Development:** Findings from the ground theory method informed the proposed models or conceptual frameworks offering system-oriented and sense-making perspectives at both detailed and systemic levels.
- **Validation:** The proposed business model was validated through direct correspondence with interviewees and other asset management specialists from the relevant sectors. The intention was to test the appropriateness and relevance of the model to be used in any context for managing public assets. ([Appendix D](#))

1.6 ETHICAL CONSIDERATION

This research involved human participants and needed to be evaluated by the Massey University Human Ethics Committee to ensure that the research activities were conducted in accordance with the Code of Ethical Conduct for Research, Teaching & Evaluations. A 'Low Risk Notification 4000024756' was issued on 16th November 2021 valid for three years ([Appendix A](#)). The researcher adhered to the required ethical standard throughout the data collection, data analysis, literature review and validation processes. The ethics peer review was further conducted with the primary and co-supervisors to ensure the completion of

¹¹ Straussian approach is an inductive-deductive one; deductive as the researcher has some preconceived theories and hypothesis, and inductive as it enables new concepts to emerge (Hekkala, 2007)

participants' consent, the confidentiality of information collected, the anonymity of the participants/organisations, and the disclosure of any conflicts of interest.

1.7 RESEARCHER DISCLOSURE

Holton and Walsh (2016) argue that although Grounded Theory methodology is philosophically unbiased, no study can be epistemologically and ontologically neutral. The researcher has adopted the '*critical realist*' stance that assumes ontologically reality is multifaceted and perceived differently by individuals in different contexts; and epistemologically, '*relativism of knowledge as socially and historically conditioned.*' (Mingers, 2004).

The researcher in this study is a certified asset management professional with over twenty years' of senior management experience in the public sector, he is also an accredited ISO 55001 assessor involved with international standards development as an observer member of the ISO Technical Committee for asset management (TC 251). The researcher's interest has only influenced the angle of the investigation with better understanding of other professional-discipline practices of establishing and managing asset management systems in various public sector organisations having worked, designed and implemented such systems locally and abroad.

According to Chavez (2008), research can benefit or be advantaged by the '*closeness afforded by subject-object positionality*' by the ease of access to research participants and the potential to gain greater insight, including the possible observation of emotions and behaviours that might otherwise not be possible. Berger (2015) noted that it is not uncommon for the disclosure of the researcher's background for qualitative research with the broader process of

generating valuable insights while employing reflexivity as a significant strategy for quality control of the different positions of the researcher during the course of study such as (1) when the experience of study participants are shared (2) when the researcher moves from the position of an outsider to the position of an insider in similar situations and (3) when the researcher has no personal familiarity or knowledge of the data collected.

However, it is noted by other researchers (e.g. Fontana and Frey, 2005, Hill, 2006, Davies and Davies, 2007, O'leary, 2004) there are also constraints or disadvantages placed by the position of the researcher within the study that can affect the focus of the investigation, a bias of findings considered most relevant and the framing of conclusions. Hence there is a need for data collection and subsequent analysis to constantly examine researcher-participants' relationships, reposition studies, re-examine what the data can mean and continuously ask critical questions about the research process, products, and the researcher's perceptions throughout the study. These processes resonate well with the philosophical underpinnings and practical guidelines of theory building using CSR and GT methodologies, as discussed in [Chapter 3](#).

1.8 THESIS STRUCTURE

The thesis structure illustrated in [Figure 1-6](#) below shows the high-level topic coverage of the research.

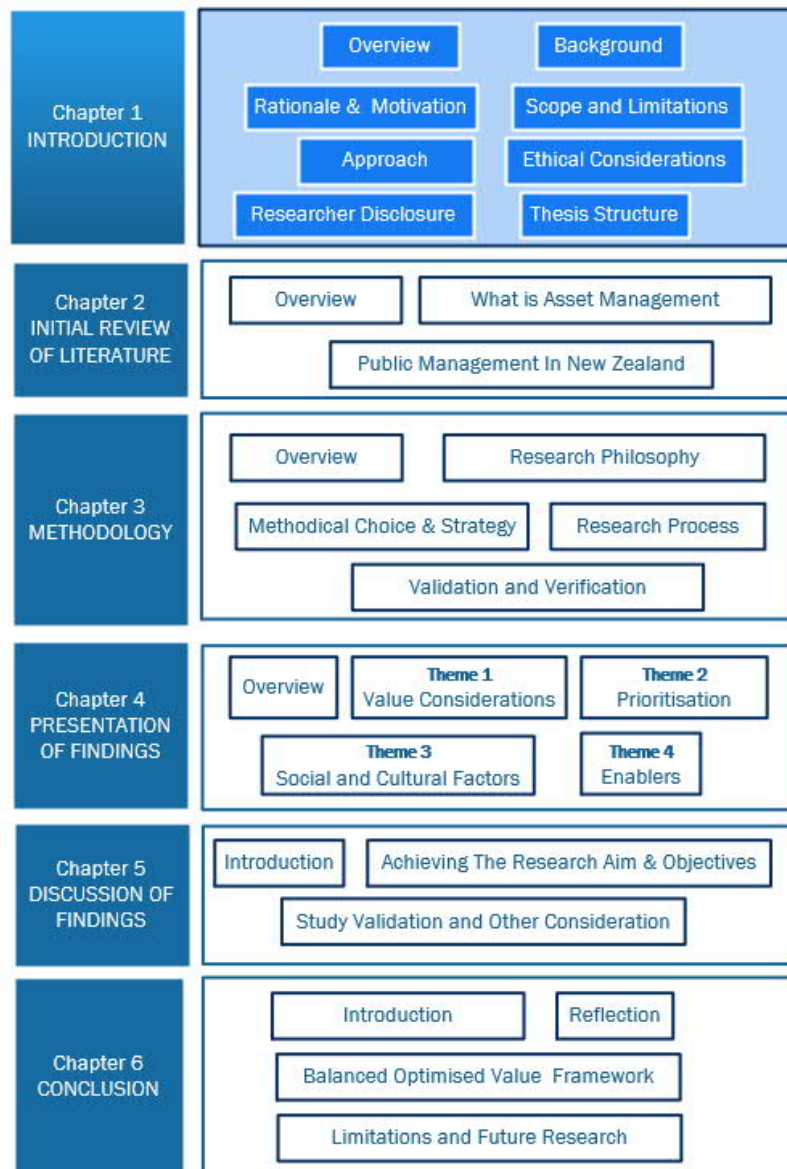


Figure 1-6 - Thesis Structure

Summaries of the six chapters are as follows:

- Chapter 1 provides the context of the overall study and sets the scene for the rest of the report. It starts with the research background and the rationale for conducting this study. This is followed by the research's aim and objectives that define the scope and structure.

- Chapter 2 presents a critical review of the extant literature on the asset management practice and the underlying theories that support the asset management discipline that provide an insight into the issues and challenges of implementing an effective and efficient asset management system. It also looks at the context of public management in New Zealand and abroad to identify opportunities and gaps by adopting the asset management standards for managing New Zealand public assets.
- Chapter 3 describes the overall research strategy that is based on the ontological position taken from the literature reviews. It describes the research philosophies, parameters and methods used for data collection, analysis, and how findings are used to develop the business model and achieve the research aim and objectives.
- Chapter 4 presents the qualitative data of the interviews, the findings of the content, and thematic analyses of the collected data. Recurring themes and critical factors are identified to form the basis for the proposed business model. References to relevant theoretical frameworks are included to identify both consistency and discrepancy with current practices and thinking of asset management practitioners in New Zealand.
- Chapter 5 discusses the development of the model and validation. The chapter describes the key elements of the model and its application for managing public assets. Additional findings from the validation are also included
- Chapter 6 presents the study's conclusion and recommendations that contribute to the knowledge base of the asset management philosophy and discipline with particular relevance to managing public assets in New Zealand. It highlights the limitations of this

research and suggests further research. Reflections on the research journey are included.

- Appendices contain relevant documentation and further details of data collected to achieve the aim and objectives of the research.

Chapter 2

INITIAL REVIEW OF LITERATURE

2.1 OVERVIEW

The discussion in this chapter is based on an iterative process of reviewing extant literature that was performed throughout applying the different stages of the Grounded Theory research method, from initiation, identification of the rationale and establishment of its purpose, collection and analysis of the investigation's data and during the gathering of evidence for the final stage of developing the conceptual framework/model. While some theory scholars have noted the benefits of conducting a broad preliminary literature review before conducting grounded theory research (e.g. Suddaby, 2006, Giles et al., 2013, Elliott and Higgins, 2012), other researchers (e.g. Glaser, 1992, Strauss and Corbin, 2015) have maintained that conducting a comprehensive literature review before conducting the research may force theory. According to Holton and Walsh (2016), incorporating existing literature into a Grounded Theory study should be put on hold until a core category emerges from the empirical data collected. This research supports that view, and hence, only a high-level perspective of asset management standards and value concepts was initially used to craft the *a priori* interview questions as opposed to a broader extensive literature review on the topic. Subsequent literature reviews and references to a wider domain outside asset management were carried out after the primary data collection. These are briefly referenced in this chapter, with further discussions in Chapters [4](#) and [5](#). In light of the arguments above, the research has adopted

the Grounded Theory approach of constant literature reviews throughout the research process as the data emerge as illustrated in *Figure 2-1*.

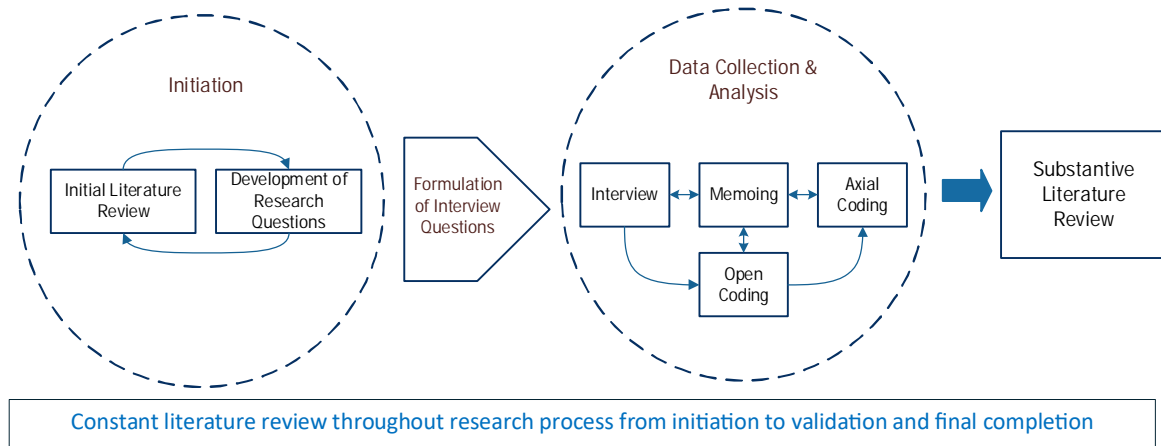


Figure 2-1 Initial and Substantive Literature Review

Time frame and time period are important considerations in a literature review, as it defines the level of granularity and degree of specificity of key variables identified during primary data collection. The purpose of the literature review is threefold. Firstly, to reaffirm the place of this study in the context of existing work and asset management body of knowledge (and standards) and to substantiate the presence of the current challenges under investigation. Secondly, the following sections identify the appropriate breadth and depth, rigour, and consistency of the research strategy to achieve the research aim and objectives and to ensure that the research contributes to something new in the asset management philosophy. Thirdly, to enhance the understanding of the phenomenon under study and highlight how theory and practice are intertwined with the perspectives of academia and asset management practitioners.

The emphasis of ISO 55x that asset management is *“the coordinated activity of an organisation to realise value from assets”* (ISO, 2014a, p.14) implies it is about managing organisational value provided by the assets (Márquez et al., 2020), as well as the strategic

management of any assets (Gavrikova et al., 2020) that have value or potential value for the organisation.

An Asset Management System, according to ISO 55001, is used to *“direct, coordinate and control asset management activities in a consistent manner that effectively manage risk and assures that objectives will be achieved”* (ISO, 2014a). These fundamental premises of asset management entail that it is holistic and strategic, and it adopts a systems approach to generate organisational value. However, the ISO (2014a) states that not all asset management activities, such as leadership, cultural motivation, and behaviour, can be formalised through an asset management system that can significantly impact achieving objectives. In addition to these informal asset management activities, this research intends to identify what other attributes are required and how they can be applied in practice.

Apart from continuously evolving, asset management is not considered a new discipline but rather an emerging one (Konstantakos et al., 2019, Wijnia and de Croon, 2019). References to a holistic and systems approach to managing assets appeared in the 1960s under the term *“Terotechnology”* (White, 1975). Whilst there is a lack of consensus regarding the origins or theoretical basis upon which asset management discipline is founded, there is agreement among researchers (e.g. Konstantakos et al., 2019, Crespo Marquez et al., 2020) that the concept evolved from other disciplines such as finance, engineering, maintenance, information technology, construction, project management, etc. A considerable body of knowledge has since been developed for managing assets, with the focus changing gradually from a functional approach towards strategic, holistic and systems approaches centred on continuous improvement (Hart and Hunt, 2019).

The rest of this chapter is divided into two parts following the overview section of the literature review approach and the study's importance.

The first part comprises five sections, describing past and contemporary asset management thinking and practices. [Section 2.2.1](#) describes the evolution of asset management as a discipline based on underlying philosophies of various multi-disciplinary schools of thought. [Section 2.2.2](#) extends the previous section and discusses the ISO 55x standards and strategic aspects of contemporary asset management, what it means in practice, and its relevance to managing assets, particularly the realisation of organisational value. The discourse in this section was used to frame the discussions in [section 2.2.3](#) on the various theoretical value concepts and value-based approaches for asset management. [Section 2.2.4](#) highlights the different theoretical concepts of the strategic aspects of the asset management discipline. [Section 2.2.5](#) explores the process-based systems thinking concepts underpinning the asset management system requirements of the ISO 55x standards. It will also discuss the limitations due to the socio-technical aspects of an organisation and the complexity, including the service-dominant logic of creating value as compared to the traditional asset- or product-dominant logic of value creation.

The second part ([section 2.3](#)) describes the public management landscape in New Zealand and its effect on asset management practices to provide context to the findings ([Chapter 4](#)) as well as to provide the foundation and validity for the proposed model ([Chapter 5](#)). [Section 2.3.1](#) provides some background relevant for subsequent discussions including the Investment Management System administered by NZ Treasury, the roles and responsibilities of different government agencies, the NZ Living Standards as a basis for

public value considerations, and mandated asset management requirements for certain organisations in the sector. The section concludes with a summary of recent initiatives to improve asset management practices in the sector.

The structure for the initial literature review is presented in *Figure 2-2*

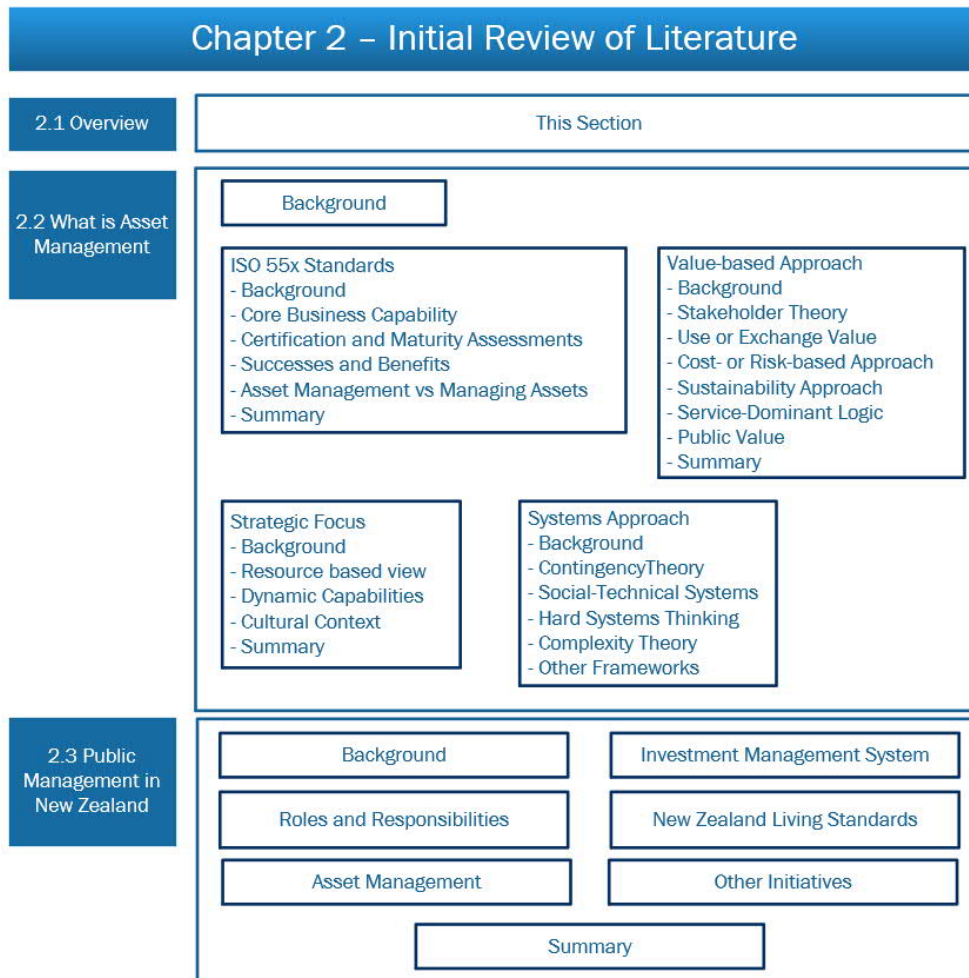


Figure 2-2 - Chapter 2 Structure

2.2 WHAT IS ASSET MANAGEMENT

2.2.1 BACKGROUND

Scientific records showed that the term asset management did not appear before the 1960s. During the 1960s and 70s, the term was often associated with business economics

where assets in the financial domain relate to accounting entries on the balance sheet and investment portfolios (Cohen and Hammer, 1967). The first indirect reference to asset management was the "*management of physical assets*", often attributed to the concept of terotechnology introduced in the UK during the late sixties (White, 1975, Thackara, 1975, Wijnia, 2016) described as:

[..] a combination of management, financial, engineering and other practices applied to physical assets in pursuit of economic life-cycle costs: it is concerned with the specification and design for reliability and maintainability of plant, machinery, equipment, buildings and structures, with their installation, commissioning, maintenance, modification and replacement, and with feedback of information on design, performance and cost.

There was initial confusion about whether terotechnology was indeed an '*inter-disciplinary*' subject (involving the interplay between different engineering disciplines) or a '*multi-disciplinary*' subject (involving engineering and non-engineering disciplines) where both terms were used ambiguously by the United Kingdom Department of Trade and Industry (DTI) . Answering criticism in the literature that terotechnology was just another word for '*maintenance engineering*', it was suggested later by DTI that the phrase terotechnology in relation to '*resource management*', '*cost of ownership*', '*life-cycle management*', '*physical assets management*' and '*life-long care*' (Harvey, 1978, Darnell and Smith, 1975) should be:

Terotechnology [...] concerns the application of the business objectives of an enterprise to the management of its permanent physical resources. [...] As such Terotechnology can be considered to be one of a number of sub-systems [...] which taken together comprise the business.

This thinking suggested that managing assets should always involve other functions besides engineering by considering risk, financial (costs) and performance throughout the asset lifecycle. It also deviated from the common understanding that it is more than just maintenance as it challenges the thinking devoted to the maintenance field¹² for asset management that was well documented in historical archives before modern civilisations (Rodgers and Oleson, 2005).

Another perspective centred was around quality management systems and the adoption of Deming's *'Plan-Do-Check-Act'* (PDCA) cycle of continual improvement for all ISO management standards. This view was rooted in works that recognise similarities with other models such as *'Define-Measure-Analyse-Improve-Control'* (DMAIC) of Six Sigma® and the criteria of *'Leadership-Planning-Support-Operation-Performance-Improvement'* that is now common in all ISO management standards (Kohl, 2020, Pilling, 2010). PDCA introduces the need for several essential *'enablers and controls'* to ensure alignment, integration and sustainability of efficient and effective asset management activities (Hassan et al., 2017). The approach stems from the evolution of the industrial age, as illustrated in [Figure 2-3](#), where over time, there was a transition of looking at the entire asset portfolio and the entire organisation through the introduction of total quality management, balanced scorecard, value engineering and systems integration approach

¹² It is important to note that maintenance is only one of the several stages of an asset lifecycle typically made up of the following stages and activities (Standards New Zealand, 1999):

- Acquisition/ Creation - Asset Design, Procurement, Construction, Project Management, Digital Management
- Operation - Facility Management, Contract Management, Performance Management, Enterprise Asset Information Management, Sustainability & Energy Management
- Maintenance - Repair, Rehabilitation, Renewal, Replacement
- Disposal - Decommission, Removal, Make Good

(Pilling, 2010) where asset management is not just about managing asset costs and risks but value creation and realisation.

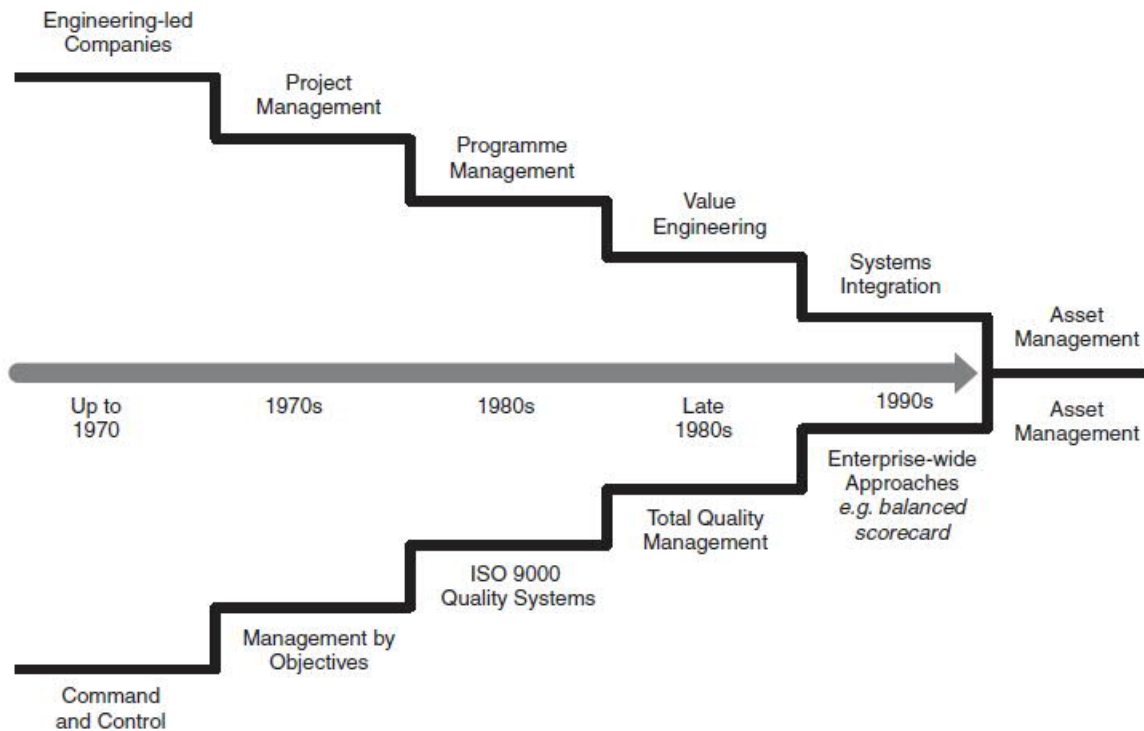


Figure 2-3 Evolution of the Asset Management Discipline (source: Pilling, 2010)

While there appears to be a convergence of thinking of what asset management is or is not, Frolov et al. (2010) noted the term asset management and its differing interpretations of usage were widely promoted by technical societies, academic and relative sector groups from their own perspectives. There were many definitions of asset management before the simplified version of ISO 55x in 2014. Some examples of are provided in Table 2-1

Table 2-1 - Asset Management Definitions 1995 -2012 (pre-ISO 2014)

Country	Authority	Definition
New Zealand	New Zealand National Asset Management Steering Group (1995)	...the combination of management, financial, economic, engineering and other practices applied to physical assets with the objective of providing the required level of service in the most cost-effective manner for present and future customers)
Australia	Australian National Audit Office (1995)	...aims to provide an approach to the management of assets, encompassing the principles of integrated planning, asset planning, asset accountability, asset disposal and the internal control structure
	The National Public Works Council (1996)	...provides a flexible service delivery approach, driven by present and future needs, and using both asset and non-asset solutions
	Asset Management Council (2007)	...lifecycle management of physical assets to achieve the stated outputs of the enterprise.
	Australian Asset Management Collaborative Group (2012)	... the process of organising, planning, designing and controlling the acquisition, care, refurbishment, and disposal of infrastructure and engineering assets to support the delivery of services. It is a systematic, structured process covering the whole life of physical assets
	Austroroads (1997)	...a comprehensive and structured approach to the long-term management of assets as tools for the efficient and effective delivery of community benefits
	Cooperative Research Centre for Integrated Engineering Asset Management (2008)	...the process of organising, planning and controlling, the acquisition, use, care, refurbishment, and/or disposal of an organisation's physical assets to optimise their service delivery potential and to minimise the related risks and costs over their entire life
	New South Wales Government (2004)	...provides a structured and systematic resource allocation approach to infrastructure and physical asset management so that resources are aligned with the service objectives of agencies
	Victorian Government (1995)	...the process of guiding the acquisition, use and disposal of assets to make the most of their service delivery potential ad manage the related risks and cost over their entire life (Victorian Government, 1995)

Country	Authority	Definition
United Kingdom	Royal Institute of Chartered Surveyors (2008)	...a structured process that seeks to ensure best value for money from property assets in serving the strategic needs of public sector organisations
	Institute of Asset Management (2008)	...the set of disciplines, methods, procedures and tools to optimise the whole life business impact of cost, performance and risk exposures (associated with the availability, efficiency, quality, longevity and regulatory / safety / environmental compliance) of the company's physical assets
	British Standard / Publicly Available Specification - PAS 55 (2004)	...the systematic and coordinated activities and procedures through which an organisation optimally manages its physical assets and their associated performance, risks and expenditures over their lifecycles for the purpose of achieving its organisational strategic plan
USA	New York Department of Transport (1998)	...a systematic process of maintaining, operating and upgrading physical assets cost-effectively. It combines engineering and mathematical analyses with sound business practice and economic theory. The total asset management concept expands the scope of conventional infrastructure management systems by addressing the human element and other support assets as well as the physical plant
	American Association of State Highway and Transportation Official (2002)	...a strategic approach to managing transportation infrastructure. It focuses on...business processes for resource allocation and utilization with the objective of better decision-making based upon quality information and well-defined objective
Canada	Federation of Canadian Municipalities (2005)	...the combination of management, financial, economic, engineering, and operational and other practices applied to physical assets with the objective of providing the required level of service in the most cost-effective manner

These definitions reflected the thinking of that period of what asset management was, principally focused on the asset itself, optimising its value, and minimising the costs (resources) and risks of owning and using the asset. Asset management was also considered as just a process, a tool (method), an asset information system or a combination depending on the function and complexity of the asset types that could be horizontal (buildings/facilities), vertical (road network) or buried/underground (pipes). In the opinion of many practitioners, data quality was the most significant barrier to good practice (Woodall et al., 2012). In contrast, Woodhouse (2001) argues that the human element is more significant than the technical aspects. He argued that data collection, analysis, and decision-making processes involve the human element.

It is interesting to note that the word 'value' did not appear in most of the definitions apart from the definition of the Royal Institution of Chartered Surveyors (Jones and White, 2008):

...a structured process that seeks to ensure best value for money from property assets in serving the strategic needs of public sector organisations

Although it was commonly assumed that physical assets have both a financial and a utility value, what is being managed is not always clear. For the public sector, this implied that assets must be managed efficiently to minimise cost and preserve value while being utilised to their full capacity effectively with minimal risks exposed to stakeholders. For private assets, it was simply a financial return on investment.

Around the same period, many new professional organisations focused on asset management were established, such as the Institute of Asset Management (UK) in 1994, the National Asset Management Steering Group (NZ) in 1995, the Cooperative Research Centre for Integrated Engineering Asset Management (Aus) in 2003, the Global Forum in Maintenance and Asset Management (GFMAM)¹³ in 2010, and many other societies that stemmed from the engineering and built environment disciplines. These organisations were tasked with promoting their respective disciplines to incorporate '*asset management*' in their vocabulary and by collaborating on knowledge, standards and practices via forums, conferences and journal publications which led to the inevitable battery of consultants and institutions promoting the discipline. The consultants and institutions claimed to be addressing the asset systems and societal challenges while simultaneously delivering own commercial benefits from their viewpoints (Too, 2009).

Other researchers noted introducing a holistic and whole-of-life approach for managing assets led to a rapid increase in publications on asset management in the Web of Science databases (da Silva and de Souza, 2021). Bibliometric analysis indicated that before the 1980s, asset management research mainly belonged to the domain of business economics (90%). In the last ten years, engineering and asset-focus discussions comprised more than 75% of the literature for specific industries in different countries (da Silva and de Souza, 2021). Using the keyword co-concurrence network approach, da Silva and de Souza (2021) noted the four most appeared clusters of keywords related to asset

¹³ GFMAM current member associations were established much earlier from Canada (PEMAC), UK (IAM), USA (SMRP), Brazil (ABRAMAN), South Africa (SAAMA), France (IFRAMI), Belgium (BEMAS), Europe (EFNMS), Japan (JIPM, JAAM), Malaysia (MAPM), Australia (AM Council), Arabian Gulf Region (GSMR), Malaysia (MAPMA).

management were *“infrastructure”*, *“maintenance”*, *“optimisation”* and *“management”*, summarised in [Table 2-2](#).

Table 2-2 - Most appeared keywords and research focus (adapted from da Silva and de Souza, 2021)

Main Cluster	Other Integrated Keywords	Research Focus
Infrastructure	Inspection, Prediction, Bridge, Rehabilitation	Research applied to the condition of infrastructure assets mainly in civil, transport and water areas.
Maintenance	Reliability, replacement, condition-monitoring	Research addressed topics on maintenance management, condition-based reliability maintenance and asset renewals
Optimisation	Model, Policy, Cost Algorithm	Research concentrated on maintenance policies, optimisation and asset life cycle cost
Management	Management, building information management, facility management, construction, framework, systems approach	Research discussed framework for implementation of information management in projects, buildings and facilities

The first three keywords, *“infrastructure”*, *“maintenance”* and *“optimisation”*, relate directly to the asset and could be further grouped as *“maintenance”*. Hence, despite the growth of publications, asset management was often regarded as the professionalisation of maintenance management (Wijnia, 2009). The keyword *“management”*, unfortunately, usually refers to the technology and tools used to support maintenance. Furthermore, a preliminary review in our study of university textbooks by leading academia of the discipline (e.g. Campbell et al., 2016, Uddin et al., 2013) and earlier publications of International professional organisations (e.g., ASCE, IPWEA) appears to have also used the terms *“asset management”* and *“maintenance management”* interchangeably.

Frolov et al. (2010) noted that every technical society and related academic and sector groups have published their own perspectives and interpretations of the application of asset management in specific functions such as asset information management, risk modelling or maintenance strategies. Because these concepts are often focused on the type of assets and the specific business operational models popularised in the industries or sectors they are part of, there is little theoretical and methodological consistency in understanding how to effectively integrate organisational value creation into the strategic management of assets. Almost a decade later, literature reviews on asset management for the built environment continue to focus on the technical aspects limited to specific activities associated with the asset lifecycle, such as design, construction, operation, maintenance, or disposal of assets. This phenomenon has led to significant challenges in the scholarly study of the Asset Management philosophy and lacks any well-grounded theory. Views expressed in most publications focused on the *'how'*, *'what'* and *'when'* as opposed to answering the *'why'* or understanding the broader application of asset management and its implications on overall performance (e.g., El-Akruti et al., 2018, Konstantakos et al., 2019, da Silva and de Souza, 2021).

Blom (2017) noted in her research that asset management performance is based mainly on the perspectives of project delivery or investment decisions or the speed of recovery from disruptive events such as natural disasters and climate change impacts. In contrast, the delivery of services, outputs and outcomes across the asset systems are rarely examined even as in addition to technical factors, the performance of the asset management systems is also dependent on societal and organisational factors.

This research has also observed in the initial literature reviews, that another explanation may have been a more significant driver related to the advent of the New Public Management (NPM) approach in the 1980s. The NPM approach began in New Zealand and was later replicated in many OECD-AngloSaxon countries like the UK, USA, Sweden, Netherlands and Australia. Government reforms resulted in significant deregulation and privatisation of public assets. Instead of being the asset owners and service providers, many agencies became enablers (funders) and coordinators and held others accountable (Stoker, 1998). There was a marked change in thinking and practice from the “*tax or ratepayer-funded*” to “*user pays*” for public services such as health, transport and utilities (Grimsey and Lewis, 2007). During this era, asset management was considered a valuable framework for ensuring that public funds efficiently delivered the desired outcomes by adopting business-like thinking (Stapelberg, 2006a). For instance, New Zealand had a significant recession from 1987 to 1993, with minimal infrastructure investments by local and central government organisations. A report by the New Zealand Office of the Auditor-General to the government in 1995 (OAG, 1994) led to legislative changes in 1997, where reporting by local authorities and roading authorities on asset performance and 10-year financial forecast became mandatory. In specific sectors of other countries, legislative and regulatory requirements for adopting the ISO 55x standards are required, as discussed in the later chapters of this thesis.

2.2.2 ISO 55x ASSET MANAGEMENT STANDARDS

2.2.2.1 Background

All commercial and public sector organisations apply some form of management systems to achieve their business objectives of creating value and ensuring continuity of services

or profitability. The overall philosophy behind a generic management system standard is to offer organisations a framework for establishing, implementing and continually improving their management capabilities (Kohl, 2020). Operating models of organisations vary according to the level of complexity where the scope of the management systems may apply to a subset of an organisation or the whole organisation. These management systems can be very informal in small organizations or highly structured and formalized in large and complex organizations. Each system element can be considered a process dependent on the interrelationship of other processes and parts of the organisation. The foundational principle of a management system is an understanding of the context in which an organisation operates by examining the external and internal issues that influence its success and sustainability. Based on these issues, organisations plan their resources, develop processes and sub-systems, implement them, monitor their efficiency and effectiveness based on relevant data/information and ensure continual improvement activities such as enhancing competencies, knowledge capture and shared use (ISO, 2008). The asset management system is characterised by a structured approach to direct, coordinate, and control asset management activities such as risk management and assurance to ensure objectives are achieved consistently through an integrated systems approach. There are currently more than forty ISO management systems (asset and non-asset related). In many organisations, multiple ISO systems (e.g., quality, risk management, environment, health & safety, asset management) may be developed and used in an integrated manner with other management systems for asset- or process-specific, organisation-specific, industry or regulatory/government-specific standards.

2.2.2.2 Core Business Capability

The current understanding of asset management as a core business capability and not just as a support function is well-emphasised by the asset management standards published by the International Organisation for Standardisation (Konstantakos et al., 2019). Based on the Deming cycle, Plan-Do-Check-Act (PDCA), a quality control philosophy introduced in Japan in the 1950s (Koiesar, 1994), representatives from 31 countries in 2014 agreed to a global asset management standard consisting of the following parts (current and under development) listed below:

Under Revision

ISO 55000: - Overview, principles and terminology (ISO, 2014a)

ISO 55001 - Management systems–Requirements (ISO, 2014b)

ISO 55002 - Management systems–Guidelines for the application of ISO 55001 (ISO, 2018)

ISO 55010 - Guidance on the alignment of financial and non-financial functions in asset management (ISO, 2019)

Under Development / Consultation

ISO 55011 - Guidance for development and application of public policy to enable asset management (ISO, 2022a) - *under development*

ISO 55012 - Guidance for people involvement and competence (ISO, 2022b) – *under development*

ISO 55013 - Asset Management – Guidance on the management of data assets (ISO, 2022c) - *under development*

ISO 55001 specifies the requirements for a management system for asset management rather than a '*management system for assets*' or a '*management system for managing assets*' (ISO, 2014a) and more than an asset information system. According to ISO 55x,

there are two types of physical assets within the portfolio: those that fulfil the organisation's primary function or purpose, such as a hospital or a stadium, and those that could be considered '*enabler assets*' that perform supporting functions, such as a computerised booking system for spaces or a computerised maintenance management system for the facilities or asset systems. The standard states that different physical assets deliver different values (ISO, 2014a); for example, it is difficult to replace a train station in case of failure, whereas an online ticketing system could be outsourced or replaced entirely with a lesser loss of value to the whole transport system.

Wijnia et al. (2014b) suggest there are essentially three groups of asset management system requirements; the first group consists of three mandatory documents (policy, strategic plan and asset management plan) supported by documented evidence of implementation (e.g., quality management, competencies, communication) with specific content decided by the organisation. The second group emphasises processes including information management, operational planning and control, and risk and opportunity management. The third group centres around behaviour and values and uses terms such as: '*to demonstrate, ensure, consider, determine, take into account*'. However, it is unclear how these behaviours could be measured or observed as evidence for certification. Nevertheless, this requirement implies that the coordination of multi-disciplinary activities across the entire organisation is needed. Asset management translates the organization's objectives into asset-related decisions, plans and activities, using a risk-based approach that addresses both technical and financial risks together in the organisation's decision-making processes to achieve a '*desired balance of cost, risk and performance*' (IEC, 2016). Having a solid asset management culture significantly

influences success where everyone has some understanding and alignments with the organisation's aims and value it seeks within the organisation and its supply chain where appropriate (Johnson and Lloyd, 2012).

ISO 55000 states that both asset management and the asset management system should form part of an organization's overall management system. The distinction between the two is 'asset management' must apply the four fundamentals or pillars to realise organisational value with assets summarised as follows (ISO 2014a):

- **Value:** It is not about the asset itself but the value it provides, determined by the organisation and stakeholders. For example, a fully functioning asset is useless if it is no longer fit-for-purpose or unused. Value is realised through balancing risk, cost (financial, environmental, social), quality of service and performance related to assets.
- **Alignment:** Organisational objectives are translated into asset management decisions (technical, financial and operational) that represent value and reflect stakeholders' needs and expectations. This is achieved by implementing risk-based, information-driven planning and decision-making processes and integrated activities (e.g., finance, operations, human resources) that deliver value.
- **Leadership:** Leadership and workplace culture are intertwined to ensure commitment, awareness, empowerment, and competencies are clearly identified in roles, responsibilities, and authorities of actors within the organisational system, including outsourced suppliers and service providers.
- **Assurance:** Ensure the necessary assurance resources are available, such as implementing processes for monitoring and continual improvement by competent personnel to undertake asset management activities and asset management system operation

Complementing these “*fundamentals*”, an asset management system defines the policies, plans, criteria and requirements for management controls that support asset management decision-making processes (ISO, 2022a); there are 67 ‘*shall*’ statements contained in clauses (and sub-clauses) divided into seven system elements and associated sub-elements as illustrated in *Figure 2-4* below (ISO, 2014b).

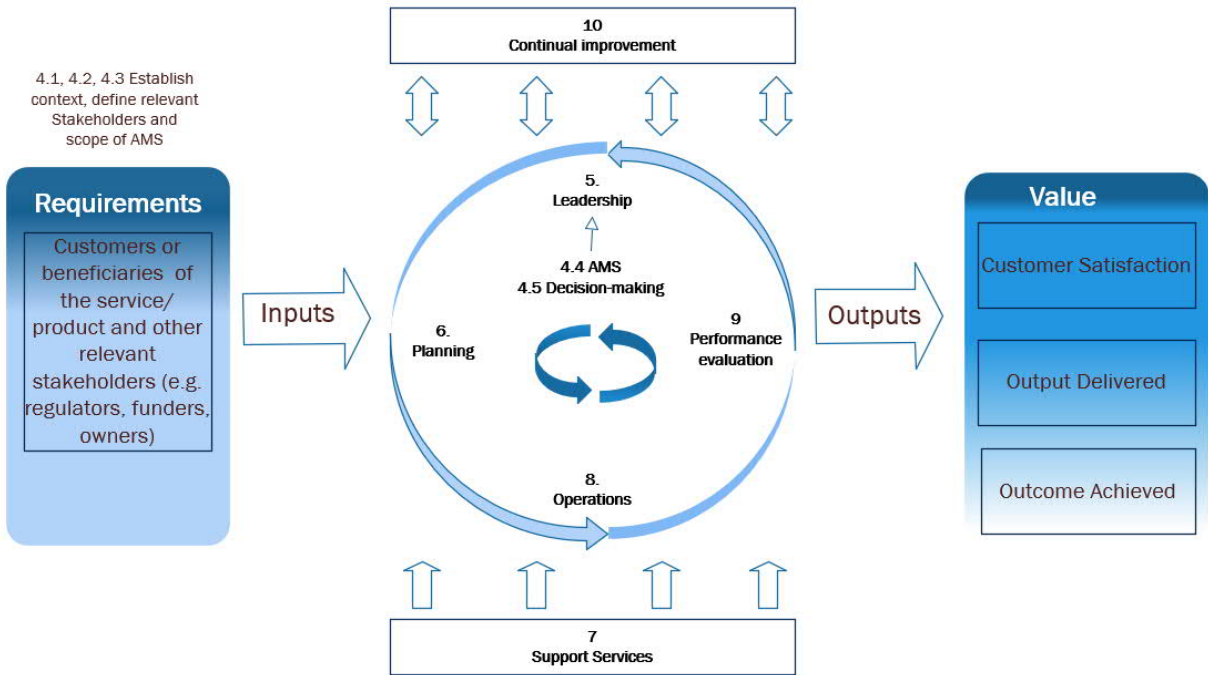


Figure 2-4 Asset Management System Elements, Clauses and Sub-clauses in the Standards (adapted from ISO 2014, 2018, 2019)

ISO (2018) states four key pathways for the execution of asset management and the design of the asset management system:

- Line of sight (alignment) from the organisational context to the system's artefacts (e.g., asset management policy, strategic asset management plan, operational plan).
- A **hierarchy of objectives**, derived from organisation to strategic asset management to (operational) asset management objectives translated into a hierarchy of key performance indicators.
- Decision-making criteria and processes that facilitate adherence to the asset management fundamentals, dynamic and responsive to potential changes in the internal and external context, applied in a coordinated and consistent manner, and tailored to the complexity, urgency, risk/criticality and/or the importance of the decision (i.e. its impact on the fulfilment of objectives (ISO, 2018)).
- Risk management developed at all levels aligned to ISO 31000 Risk Management.

2.2.2.3 Certification and Maturity Assessments

The Asset Management Landscape document (GFMAM, 2014) describes the required competencies of an ISO 55001 Auditor/Assessor as made up of six knowledge and practice groups (Body of Knowledge) consisting of thirty-six subjects: (1) strategy & planning, (2) asset management decision-making, (3) lifecycle delivery, (4) asset information, (5) organisation and people, (6) risk and review. These subjects are contained within various clauses of the ISO standards and guidance documents. The purpose of these competencies is also to provide the structure and criteria for assessing the organisation's maturity in asset management, and the requirements of individuals or groups involved in different asset management functions, as summarised in *Figure 2-5* below.

<p>Strategy & Planning</p> <ul style="list-style-type: none"> ▪ AM Policy ▪ AM Strategy & Objectives ▪ Demand Analysis ▪ Strategic Planning ▪ AM Planning 	<p>AM Decision-Making</p> <ul style="list-style-type: none"> ▪ Capital Investment Decision-making ▪ Lifecycle Value Realisation ▪ Resourcing Strategy ▪ Shutdowns & Outage Strategy 	<p>Lifecycle Delivery</p> <ul style="list-style-type: none"> ▪ Technical Standards & Legislation ▪ Asset Creation & Acquisition ▪ Systems Engineering ▪ Configuration Management ▪ Maintenance Delivery ▪ Reliability Engineering ▪ Asset Operations ▪ Resource Management ▪ Fault & Incident Response ▪ Asset Decommissioning and Disposal
<p>Asset Information</p> <ul style="list-style-type: none"> ▪ Asset Information Strategy ▪ Asset Information Standards ▪ Asset Information Systems ▪ Data & Information Management 	<p>Organisation & People</p> <ul style="list-style-type: none"> ▪ Procurement & Supply Chain Management ▪ AM Leadership ▪ Organisational Culture ▪ Competence Management 	<p>Risk & Review</p> <ul style="list-style-type: none"> ▪ Risk Assessment and Management ▪ Contingency Planning and Resilience Analysis ▪ Sustainable Development ▪ Management of Change ▪ Assets Performance and Health Monitoring ▪ Management Review, Audit & Assurance ▪ Asset Costing & Valuation ▪ Stakeholder Engagement

Figure 2-5 Asset Management Competencies (GFMAM, 2014)

2.2.2.4 Success and Benefits

There are many publications on the successes of organisations that have attained the ISO 55001 certification by implementing a more holistic approach to business planning, better cooperation between different functions, and applying systematic and analytical methods with a deeper understanding of the effects of uncertainties on the activities of the organisations. The benefits of asset management are mainly centred around organisations realising value from assets that could be internal or external, direct or indirect to stakeholders, may or may not be measurable or quantifiable (e.g., reputation,

asset resilience, social outcomes). These benefits or valued realised are sometimes only evident after a long period as claimed by ISO 55001 certified private and public organisations, often well publicised by ISO, professional and academic journals, presented at conferences and forums, that include but are not limited to the following in [Table 2-3](#) (e.g. Alsyouf et al., 2021, Kelly and Hardy 2018, Ali, 2021):

Table 2-3 - Internal (Direct) and External (Indirect) Benefits/ Successes of Asset Management (source: Authors)

Asset Management Benefit	Stakeholders	
	Internal / Direct	External / Indirect
Improved Financial Performance	<ul style="list-style-type: none"> ▪ Improve return on investment ▪ Reduce Cost ▪ Economically more efficient, effective and profitable use of capital: 'turnover of and return on assets' 	<ul style="list-style-type: none"> ▪ Value for money for customers
Informed Asset Investment Decisions	<ul style="list-style-type: none"> ▪ Improve decision-making ▪ Optimal combination of costs, risks, opportunities, performance and sustainability ▪ More accurate long-term life cycle decisions ▪ Establish external and internal influencing factors and their effect on physical asset and maintenance management 	<ul style="list-style-type: none"> ▪ Optimal risk exposure to asset or service risks
Managed Risk	<ul style="list-style-type: none"> ▪ Reducing financial losses, ▪ Improving health and safety, good will and reputation ▪ Resulting in reduced liabilities such as insurance premiums, fines and penalties 	<ul style="list-style-type: none"> ▪ Minimizing environmental and social impact
Improved Services and Outputs	<ul style="list-style-type: none"> ▪ Assuring the performance of assets can lead to improved services or products ▪ Integrated approach for production function (assets, operation and maintenance) 	<ul style="list-style-type: none"> ▪ Consistently meet or exceed the expectations of customers and other stakeholders
Demonstrated Social Responsibility	<ul style="list-style-type: none"> ▪ Conserve resources ▪ Adapt to climate change 	<ul style="list-style-type: none"> ▪ Enables it to demonstrate: <ul style="list-style-type: none"> - socially responsible - ethical business practices

Asset Management Benefit	Stakeholders	
	Internal / Direct	External / Indirect
		- moral stewardship
Demonstrated Compliance	<ul style="list-style-type: none"> ▪ Transparently conforming with legal, statutory and regulatory requirements 	<ul style="list-style-type: none"> ▪ Enhance confidence and trust ▪ Improved credibility in the eyes of regulators
Enhanced Reputation	<ul style="list-style-type: none"> ▪ Staff reputation 	<ul style="list-style-type: none"> ▪ Improved customer satisfaction ▪ Improved stakeholder awareness and confidence
Improved Organizational Sustainability	<ul style="list-style-type: none"> ▪ Effectively managing short and long-term effects, expenditures and performance ▪ Improve the sustainability of operations and the organization ▪ Create and systematize the link between business, physical asset management and maintenance activities of organisations. ▪ Promote transparency in organisational decision making ▪ Promote uncertainty management to improve the quality of decision making 	<ul style="list-style-type: none"> ▪ Reliable service delivery
Improved Efficiency and Effectiveness	<ul style="list-style-type: none"> ▪ Systematic review and improving processes enhance efficiency and effectiveness of assets to deliver outcomes ▪ Greater engagement and motivation of the workforce, and in more sustainable, continual improvement business processes ▪ Prevent silo behaviour and promote cooperation between different organizational functions 	<ul style="list-style-type: none"> ▪ Improved levels of service to customers enhanced capability to operate within extended enterprise ecosystems (including customers/suppliers)

2.2.2.5 Asset Management vs Managing Assets

Despite the publication of the standards, there was evidence that other activities were being deliberately rebranded as asset management by various organisations to the extent of preventing more ambiguity and confusion for the discipline; the ISO Technical Committee for Asset Management Systems (TC251) published an article titled *'Managing Assets in the context of Asset Management'* to address concerns by clearly stating that *'asset management'* and *'managing assets'* are not interchangeable (Dempsey, 2017). The article was intended to ensure that the value from a broader organisational or strategic aspect of the asset management discipline was not lost through misinterpretation of the standards and their practice, as summarised in [Table 2-4](#).

Table 2-4 Different focus of Managing Assets vs Asset Management (Dempsey, 2017)

Managing Assets Focus on:	Asset Management Focus on:
<ul style="list-style-type: none"> ▪ Lifecycle activities and asset care (availability, reliability, dependability, and safety) ▪ Asset location, condition, life extension and/or interventions ▪ Asset databases, systems (and IT) and performance ▪ People, skills, and work management ▪ Budgets and key performance indicators (KPIs) / cost of maintenance and current performance 	<ul style="list-style-type: none"> ▪ The purpose of your organization and what assets does it need – and why ▪ Value, purpose, and long-term outcomes Risk and context e.g., markets / climate / regulation ▪ Holistic approach to different funding streams e.g., CAPEX and OPEX? ▪ Collaborative behaviours - breaking down silos both internal and supply chain? ▪ How assets contribute to organizational value

According to Dempsey (2017), it is important to understand the different focus of actors in an asset management system for conversations on managing assets and asset management, although they are closely interrelated, as shown in [Table 2-5](#).

Table 2-5 Focus of Interested Parties for Managing Assets vs Asset Management (Dempsey, 2017)

Interested Parties	Managing Asset	Asset Management
Colleagues	<ul style="list-style-type: none"> ▪ Asset data, location and condition assessment ▪ Current KPIs ▪ Department budget 	<ul style="list-style-type: none"> ▪ Information-supported decisions (strategic context and related to customer needs) ▪ Strategies to select and exploit assets over their lifecycles to support business aims ▪ Collaboration across departments to optimise resources allocated and activities
Stakeholders	<ul style="list-style-type: none"> ▪ Costs ▪ Current performance ▪ Response to failures / maintaining function 	<ul style="list-style-type: none"> ▪ Triple bottom line and value ▪ Clarity of purpose of the organization ▪ Focus on the impact of activities on the organisation's objectives
Top Management	<ul style="list-style-type: none"> ▪ Short-term gain/loss ▪ Departmental/individual performance ▪ Savings, especially OPEX 	<ul style="list-style-type: none"> ▪ Long-term value for the organization ▪ Developing competence and capability across the workforce ▪ Business risks understood and mitigated
Suppliers	<ul style="list-style-type: none"> ▪ Short-term contracts and performance ▪ Service-level agreements are focused on contract specifications 	<ul style="list-style-type: none"> ▪ Long-term contracts and/or partnering relationships in support of client value and objectives ▪ Understanding client strategy and needs in 5-10 years

2.2.2.6 Summary

'Asset management' is focused on a holistic, risk-based, long-term approach and adapting to the external environment to optimise organisational value while 'managing assets' is short-term focused, centred around capacity and capability to support the asset management system while ensuring value by the asset is delivered., value realisation requires a strategic approach through balancing cost (e.g., financial, environmental, social), risk, quality of service and performance related to asset (ISO 2014a). Anecdotal evidence of the successes and benefits published can be internal (direct) or external (indirect) include improved financial performance, informed asset investment decisions,

managed risk, improved services and outputs, demonstrated compliance, enhanced reputation, improved organisational sustainability, improved efficiency and effectiveness

2.2.3 VALUE-BASED APPROACH

2.2.3.1 Background

Applying the meaning and use of the term value in ISO55x would include the need to understand the construct of how the identified realisable value is vertically cascaded in the organisational objectives and asset management objectives, purpose and use of the asset management system, asset management activities and assets. The definition of value for each company/organisation must accurately determine and describe each organisation's asset portfolio, answering the questions of what those assets are and how they contribute to precisely achieving or conserving this value (ISO 2014). Aligned with this thinking, the European standard EN 1325:2014 - Value Management defines value as *“a measure which expresses how well an organisation, project or product satisfies stakeholders’ needs in relation to resources consumed”* and *“...different stakeholders gain different types of value from the way an organization manages its assets.”*

ISO 55x uses the following value concepts for its various documents:

- **Value generation** – derived from the use, ownership or custodian of assets
- **Value determination** – the financial value of an asset that can generate an economic profit or loss
- Values that influence an organisation’s internal and external conduct or behaviour

However, notwithstanding the increasing body of academic literature and industrial interest in asset management systems and their strategic role, there is no single agreed

definition of value delivered by assets or asset management (El-Akruti et al., 2013). Physical assets seldom provide value on their own but contribute to the value generated at the system or network level. They are often highly dependent on other assets within the *system* or between *systems* (Srinivasan and Parlikad, 2020). However, many asset-intensive organisations in the literature often focus on the assets themselves and their performance rather than on long-term stakeholder needs (Adams et al., 2016, Crespo Marquez et al., 2020). These observations are in contrast according to ISO 55x, an asset provides the means for the realisation of value¹⁴ for the organisation where value can be tangible or intangible, financial or non-financial, and should be determined by the organisation based on stakeholders' concerns and expectations.

2.2.3.2 Stakeholder Theory

Noting that the value of an asset to an organization can change over its lifecycle, ISO (2018) states that an organisation's or its stakeholders' asset value specification can vary even within the organization and among external stakeholders. The standards do not prescribe to which stakeholder concept is applicable that has evolved significantly since 1963, when the Stanford Research Institute originally defined it as *"those groups without whose support the organization would cease to exist."* Subsequently, Freeman (2016) broader definition of a stakeholder as *'a group or individual who can affect or is affected by the organisation's objectives'* leaves the notion of *'stake'* and the field of possible stakeholders ambiguously open to virtually everyone. The broad view of

¹⁴ Applying the meaning and use of the term "value" in ISO55x would include "the need to understand the construct of how the identified realisable value is vertically cascaded in the organisational objectives and asset management objectives, purpose and use of the asset management system, asset management activities and assets. The definition of value for each company / organization, must serve to determine and describe, accurately, the asset portfolio of each organization, answering the questions of what those assets are and how they contribute to precisely achieve or conserve this value".

stakeholders is based on the empirical reality that companies can indeed be vitally affected by, or can literally affect, almost anyone. This implies that the ultimate aim of stakeholder management based on this view could be either organisation-focused or systems-focused, which extends beyond just economic foundations of value and may also include societal, environmental, and other non-economical outcomes.

In contrast, Clarkson (1995) offers a narrower definition of stakeholders as '*voluntary or involuntary risk-bearers*' based on the notion that some form of capital, human or financial, or something of value has been vested in an organisation. A '*stake*' in this sense can only be lost; this distinguishes those with legitimate claims regardless of their power to influence the organisation or legitimacy of their relationship with the firm. Other narrow views of defining stakeholders include those that have direct relevance to the organisation's core economic interests (Bowie, 1991, Freeman and Reed, 1983, Näsi, 2002) or are directly involved in exchange relationships (Freeman and Evan, 1990, Hill and Jones, 1992, Cornell and Shapiro, 1987). Those favouring a narrow definition of stakeholders aim for a "*normative core*" of legitimacy so that managers can be advised to focus on the claims of a few legitimate stakeholders and fulfil their affirmative duty to stakeholders in terms of distributing the harms and benefits of the firm's actions fairly (Donaldson and Preston, 1995, Langtry, 1994). However, Siriwardhane and Taylor (2014) argue there is a risk of bias or prejudice if the manager or decision-maker perceives the stakeholder to be more salient than others, having more significant concern for the needs and claims that may not be the case.

From an academic / theoretical perspective, most empirical studies based on stakeholder theory have used a measure of stakeholder performance as the independent variable,

with some measure of economic performance as the dependent variable (Berman et al., 1999, Choi and Wang, 2009, Hillman and Keim, 2001). Harrison and Wicks (2013) believe if a broad-based measure of stakeholder performance instead becomes the dependent variable together with an organizational action or phenomenon as the independent variable, then there is much greater potential to understand how that phenomenon influences the overall value the firm creates. Further, this perspective suggests the organisation can sustain performance over time if its efforts extend beyond just economic performance and do not erode support from other stakeholders from a social, environmental, or other performance perspective.

2.2.3.3 *Use or Exchange Value*

The concept of value has been studied and developed in different contexts for decades, including industrial economics, manufacturing, consumer economics, marketing, psychology, sociology, asset and facility management, leading to numerous definitions. Bowman and Ambrosini (2000) differentiate two types of value at the organizational level of analysis: *use value* and *exchange value*. Use value refers to the specific quality of a new job, task, product, or service as perceived by users concerning their needs, such as the speed or quality of performance on a new task or the aesthetics or performance features of a new product or service. Exchange value is defined as either the monetary amount realized at a certain point in time, when the exchange of the new task, good, service, or product takes place, or the amount paid by the user to the seller for the use value of the focal task, job, product, or service.

Based on lean thinking, Womack and Jones (1997) note that value can only be determined by the ultimate customer and only meaningful when expressed in terms of a specific

product (a good or service, and often both at once) which meets the customer's need at a specific price at a specific time. For example, the value of building assets must be derived from both the perspectives of users and owners that can relate to financial and non-financial value, functional value, emotional value or strategic performance, delivering a long-term objective and effect (Haddadi et al., 2016b).

Viewed together, these definitions suggest that value creation is both subjective and individual-specific and depends on the relative amount of value that is subjectively realised by a target user (or buyer), which should ideally be the focus of value creation by an individual, organization, or society. This subjective value realisation effort must translate into the user's willingness to exchange a monetary amount for the value received.

2.2.3.4 Cost- or Risk-Based Approach

Current asset management decisions are predominantly based on managing the costs and risks of the asset life cycle for asset owners. These cost-based or risk-based approaches lack consideration of various stakeholders associated with the asset, and the organisation often excludes other value expectations, such as those related to social, environmental, or ecological issues etc. Despite its importance, there is no consistent view on the concept of risk in either the asset management or risk management literature (Aven, 2012, Wijnia, 2016). The definition of risk in ISO 55x as the *"effect of uncertainty on objectives"* in accordance with *ISO 31000:2018 – Risk Management* does not clarify what can be managed to achieve the *"balance"*. To address these conflicts, ISO 55x stipulates that value generation requires a balance of cost, risk and performance. In other words, value is generated from the systematic consideration of benefits provided by the

asset by minimising costs and risks in asset decisions throughout the asset life cycle. It is important to note that in practice, decision-making based on an asset's cost, risk and performance often involves a combination of quantitative and qualitative assessments. Risk is defined as the occurrence of a negative unplanned outcome or result that is characterised with reference to potential events and consequences (ISO, 2019). ISO 55x refers explicitly to ISO 31000 for managing risks in asset management, which defines risk management as *“the coordinated activities to direct and control an organization with regard to risk”* (ISO, 2019).

The distinction between owner and user for public assets, according to Wijnia et al. (2014b), poses a different challenge with regards to balancing costs, performance and risks, as additional asset investment would add to the cost to the owner but benefit the user, and vice-versa where a reduction in spending would be a direct benefit to the owner in the short term but may pose a cost to the user when the asset fails in the long run. Another challenge is the nature of passive assets in the public domain, such as buried or underground assets, retaining walls, and pavements, where performance is often taken for granted and measured in terms of availability and reliability. Performance is expressed in terms of risk and is only visible or gets attention when the asset fails and is unavailable. Planning for these assets is complex, with uncertainty over time typical for assets with long life spans. Other types of infrastructure assets, like hospitals, universities, airports, and seaports, can be considered monopolistic and often non-competitive. Creating value for increased profits or customer satisfaction is not at the top of the agenda and is heavily regulated, including price controls that prevent seeking opportunities that correspond with more risks. As a result, asset management performance is often about lowering costs

without increasing risks instead of value creation, as in the private sector or in for-profit organisations. Srinivasan and Parlikad (2020) provide a comparison of cost-based and value-based asset management approaches in [Table 2-6](#).

Table 2-6 - Comparison of cost-based vs value-based asset management (adapted from Srinivasan and Parlikad, 2020)

Focus	Cost based ¹⁵	Value-based
Core	Cost	Cost, Risk, and Performance
Management Philosophy	Minimize expenditure while maintaining satisfying performance requirements	Maximize performance while satisfying budgetary constraints
Stakeholder	Asset owners or Asset Stewards (Decision makers)	All stakeholders of the asset (internal/external)
Service Impact	Maintain minimum levels of service	Explore innovative approaches to improve service levels
Body of Knowledge	Well established	Evolutionary, not well understood
Decision making	Asset-specific issues related to the life cycle stage	System-level dependencies and business value

2.2.3.5 Sustainability Approach

Finding the best trade-off between cost, risk and performance is further complicated by the short-term vs long-term considerations, as well as conflicts of interests and objectives of different stakeholders (Srinivasan and Parlikad, 2020). The long-lasting life cycle of assets and inevitable changes in users' needs over time also suggest that the concept of value and value management should be focused on users' as well as owners' needs to maximize the value creation and capture (EN1325, 2014, Haddadi et al., 2016a). The complexity and challenges of sustainable asset management can also be framed under

¹⁵ For life cycle costs (LCC) consideration, quantitative assessment requires the systematic breakdown of an asset into its constituent cost elements that can be distinctly defined and estimated over time. Cost elements relate to applicable resources such as materials, labour and other overheads required at different lifecycle stages of an asset (NZS, 1999, p. 25).

the pursuit of the whole life-value concept (Bourke et al., 2005). The *'whole life'*, in general, refers to the design life of the asset as defined by the designer or manufacturer (and assumes regular maintenance or renewal requirements). Traditionally, reliability and engineering excellence were expected, and many strategies and models were designed to deliver these. However, in recent years, due to privatisation, funding constraints and economic pressures, many organisations have resorted to *'sweating the assets'*, being focused on increasing performance with less money to improve returns or reducing cost, making assets operational for longer than initially intended, and even longer for assets of heritage value (e.g. Mujica Mota et al., 2017, Yuan et al., 2019). Thurlby (2013) noted that organisations realised that striving for operational efficiency is often a one-off exercise as it often becomes difficult to achieve over time to determine the remaining useful life or rate of performance degradation for an asset. Uncertainty increases and it is not captured by traditional planning and modelling tools as they are not tailored for an ageing asset base.

According to (OAG, 2010), optimised decision-making also needs to consider non-asset solutions and priorities across different service areas. For example, asset solutions for a road could include repairs or strengthening, while non-asset solutions might include weight and speed restrictions or even closures. This requirement poses distinct challenges for owners or stewards of public assets with longer service life and ever-changing multiple stakeholders demands (Srinivasan and Parlikad, 2020). Hence, the value is highly dependent on the environment at a point in time; value can be related to either a monetary measure (price) or, a non-monetary measure (benefit), or a combination that defines the performance of an asset, an asset system or a portfolio of

assets (ISO, 2014b). The inclusion of both intangible and tangible assets also meant that the total value of physical assets such as land, buildings and infrastructure could include the non-physical elements such as asset information, reputation, branding or public perception. These elements would have been separately considered prior to the ISO 55x standards, but in the current environment, it is expected that further integration of the cyber (e.g. social media, augmented or virtual reality tour of a facility) and physical domains of asset management in the built environment will be even more pronounced from technological advances.

2.2.3.6 Service-Dominant Logic

Adding to the complexity of asset management is the service-dominant (S-D) logic that challenges the foundation of economics or goods-dominant (G-D) logic, which focuses on the asset users, processes and resources that interact to create value in 'service systems' (Vargo et al., 2008, Vargo and Lusch, 2008b, Vargo and Lusch, 2008a). The S-D logic tied to 'value-of-use' posits that the roles of producers and consumers are not distinct, and value is always co-created jointly and reciprocally in interactions among providers and beneficiaries through the integration of resources and application of competencies. This phenomenon of 'service system thinking' emphasises collaboration and adaptation in value co-creation and establishes a balanced and interdependent framework for systems of reciprocal service provision. These systems can involve individuals, groups, businesses, nations, etc., that survive, adapt, and evolve through the application of shared resources. For example, governments provide public infrastructure (roads, schools, hospitals, social housing) that are part of an integrated system to support businesses or maintain societal well-being; the individuals and businesses are themselves integrators of public and

private resources. The *'service systems thinking'* differ from the *'asset systems thinking'*, where the former posits a mutual service exchange relationship while the latter focuses on what is produced in terms of functionality and purpose (Vargo and Lusch, 2008a). Most of today's social problems are complex, as Kania and Kramer (2011) noted, and require a multidimensional, multi-sectoral, multi-organizational approach.

There is very little literature regarding the design of the whole asset management system (or value chain) encompassing all interested parties and expanding the current scope and boundary of an asset management system beyond the organisation. One of the reasons is that the notion of S-D logic challenges some of the ISO 55x principles. In its current form, the standards imply that an asset management system is monolithic and lies within the four walls of an organisation, and the systems approach is mainly centred around integration with other supporting systems for balancing an asset's cost, risk and performance. In practice, most asset-intensive organisations have heavily outsourced their asset management functions, often with conflicting objectives with external providers (e.g., whether activities are for profit or social outcomes). ISO 55x standards emphasise the need to manage outsourced resources effectively through increased interfaces with the organisation's asset management system and knowledge-sharing between the organisation and its external providers. However, as Keast and Mandell (2014) pointed out, there is still a reluctance to shift from *"cooperation"* to *"collaboration"* between stakeholders and the organisation, where *"cooperation"* is associated with hierarchical power structures that are defined by low trust and low commitment relationships as opposed to *"collaboration"* that is dependent on the willingness of participants to develop high trust, stable and interdependent relationships.

2.2.3.7 *Public Value*

The concept of “*public value*” is very relevant to the organisations explored in this research as value is deemed to be created by the governments through policies, legislation, regulation, the services it provides and the investment (current and future) in public assets. In a democratic society, value is ultimately defined by the public themselves, determined by citizens’ preferences in addition to the benefits derived from the assets (and services), which can include perceptions of fairness, outcomes desired, trust, legitimacy and confidence (Kelly et al., 2002). Seen through the lens of public value, any public organisation and associated service providers will be judged by their ethos and values that underpin the value creation of better outcomes, services and trust (Moore and Khagram, 2004). The following paragraphs will provide an overview of the public management environment in New Zealand based on some of the conceptual frameworks identified above.

According to Kelly et al. (2002), public or social value is determined by the public’s preferences expressed through a variety of means, including election outcomes, choosing alternate service providers (e.g., private vs public health insurance), and is very dependent on behaviours that allow shared aspirations to be formed, expressed and given legitimacy (e.g., social equity). In other words, for something to be of value, it is not enough for citizens or ratepayers to say it is desirable; it must be something, individually or collectively, that they can forgo willingly (e.g., money, convenience) for something in return (e.g. less taxes or rates to pay). In some ways, citizens are often involved in producing public services as they vote on or approve what public assets are required to deliver desired services.

Moore and Khagram (2004) describe the above in their Strategic Triangle (*Figure 2-6*) for managing government agencies and they argue that managers have to provide answers to three critical questions in decision-making: 'What public value is being created?', 'Where is the legitimacy and support from?' and 'Do we have the operational capabilities to deliver?'

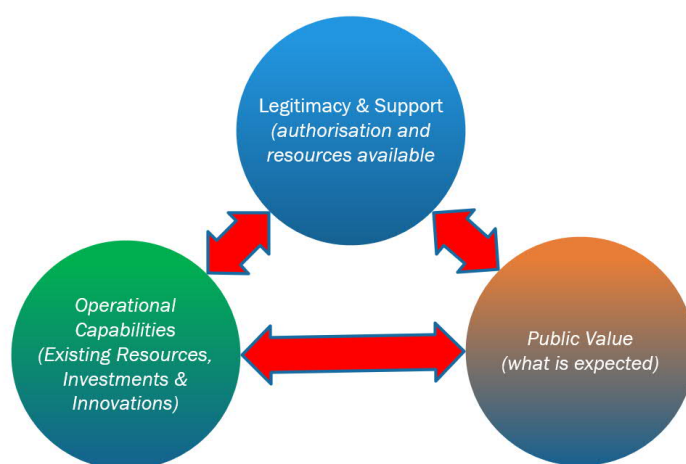


Figure 2-6 Strategic Triangle (adapted from Moore, 1995)

To a lesser degree, based on the systems view of ISO 55x, the relationship of asset management, the asset management system and the operating environment of an organisation are constantly immersed in the context of external elements (e.g., environmental, political-legal, economic, financial, sociocultural, technological and external stakeholders) and internal elements (organisational structures, people, assets and procedures/processes as shown in *Figure 2-7*. ISO (2022c) describes an enabling environment for public sector organisations made up of formal rules and other interrelated conditions that positively affect the conduct and outcomes of activities and achievement of objectives, typically featuring across five categories - economic, political, administrative, socio-cultural and resources.

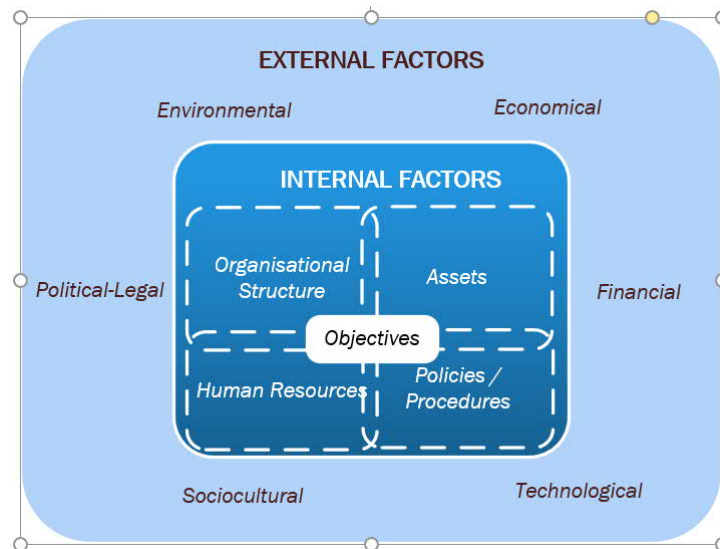


Figure 2-7 Enabling Environment (adapted from ISO 2022c)

These conditions provide the context for incentives¹⁶ (Brinkerhoff, 2004) and opportunities for achieving government objectives through effective asset management (Minogue et al., 1998). Other categories can include, but are not limited to, financial, technological, competitive and natural environmental factors, whether international, national, regional or local (ISO, 2018). It is essential to understand the key drivers and trends in these that are identified as potentially having an impact on the objectives of the organization, including the relationships with, and perceptions and values of, external stakeholders.

The internal context can include but is not limited to

¹⁶ For example, economic factors include the funding of physical infrastructure or administrative actions may include creating incentives for performance. Brinkerhoff, D. W. (2004)]

- organisation culture, (defined as the belief and behaviour that determines how people and management interact and handle transactions inside and outside an organisation)
- the governance, management and operating/outsourcing structures (such as the asset standards, maintenance guidelines and operating models adopted,
- the organisation capability (e.g. people, systems, technologies)
- information flows (both formal and informal)
- the complexity and criticality of the assets.

2.2.3.8 Summary

Both academia and practitioners agree that asset management is a multi-functional discipline that is still evolving. As a discipline, it lacks grounded theory. Theoretical discussions are often drawn from specific concepts in engineering, economics, social sciences, etc. As highlighted in the last chapter, discussions for the built environment are often limited to specific technical aspects of asset lifecycle management, such as design, construction, operation, maintenance, or disposal (e.g. Gavrikova et al., 2020, Wijnia and de Croon, 2019, Ruitenburt et al., 2017). While there is a consensus (according to ISO 55001) that the realisation of value for managing assets involves the balancing of costs, risks, opportunities or benefits arising from how assets' performance is specified (e.g. network, portfolio), nature of the asset (tangible, intangible), strategic objectives and stakeholder expectations; value-based asset management is still a concept more quoted in theory (El-Akruti et al., 2013). It is not described in practical terms and does not deal specifically

with the concept of creating organisation value (González-Prida et al., 2019, Räikkönen et al., 2016).

2.2.4 STRATEGIC FOCUS

2.2.4.1 Background

Three common perspectives emerged from the literature focused on the strategic aspects of asset management: (i) the resource-based view (e.g., Amit and Schoemaker, 1993, Steven and Richard, 2003, Wright et al., 1994), (ii) the dynamic capabilities paradigm (Gavrikova et al., 2020, Tranfield et al., 2004) and (iii) the cultural context (Frolov et al., 2010, Roda et al., 2016, Lima et al., 2020). Tan et al. (2022) noted a degree of conceptual similarity due to their *“epistemological similarities grounded within the theoretical assumptions of systems thinking, complex systems, environmental dynamism and uncertainties”* (p.3).

The Strategic Asset Management Plan (SAMP) is a vital artefact of the ISO 55x certification requirements and is sometimes referred to as the *“Asset Management Strategy”*. The SAMP details the relationships between organisational and asset management objectives and must be developed through an iterative process. It provides direction and approach through documented policies, principles, assumptions, parameters, and the criteria used in the consistent and methodical decision-making framework¹⁷ for the development of time-bound and resource-constrained asset management plans for a specific asset or

¹⁷ The purpose of the decision framework (ISO, 2018) is to:

- Incorporate a risk-based approach
- Alignment of asset management objectives and organisation objectives
- Ensuring resources are targeted at achieving objectives
- Taking into account cost effectiveness of decisions

portfolio of assets (ISO, 2018). The organisation determines the level of detail in a SAMP, which typically consists of the following areas as listed in *Figure 2-8*.

Figure 2-8 Typical topics covered in the SAMP / AM Strategy (ISO, 2018)

<ul style="list-style-type: none"> • Executive Summary • Internal and External Issues • Role of the AMS • Composition of the asset/portfolio • Strategic asset management objectives derived from the organisational objectives • Asset Management Policy Implementation 	<ul style="list-style-type: none"> • Decision-making criteria • AMS Scope • Assumptions and parameters • Asset portfolio plan and financial plan with whole-of-life considerations • Critical capabilities and resources requirement for asset management • Creating and improving the asset management system 	<ul style="list-style-type: none"> • Progress monitoring of AMS implementation • Risks, opportunities, issues and dependencies in implementing the SAMP or executing the AM Strategy • Roles and responsibilities for the SAMP • Provisions for review, update and improvement
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According to ISO (2018), an organisation is typically expected to start with a basic SAMP that provides the framework and alignment for planning, prioritisation and decision-making on asset management activities, as shown in *Figure 2-9*. It progressively addresses specific areas of concern as it matures. The SAMP usually has a longer time frame to manage the lifecycle of long-lived assets that is beyond an organisation's business planning timeframe or, in New Zealand, the political timeframe of three years for both local and central governments appointments where elections are held one-year apart¹⁸.

¹⁸ More information is available from the Electoral Commission – Te Kaitiaki Take Kōwhiri website: (<https://www.elections.nz/democracy-in-nz/what-is-new-zealands-system-of-government/>). New Zealand has a representative democracy where every three years during general elections, voters elect Ministers of Parliament to pass laws and govern the country on their behalf. In the following year after general elections, voters elect councillors and local/community board members to run essential services and respond to the needs of their towns, cities, districts and regions during local elections.

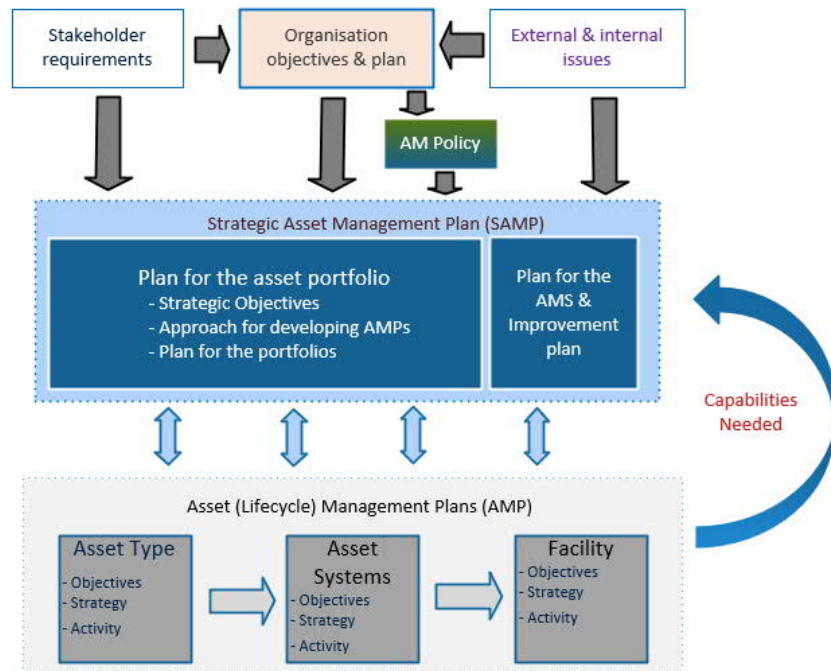


Figure 2-9 Strategic Asset Management Plan (adapted from ISO 55002:2018)

The discourse on the evolution of asset management as a strategic tool implies that a more comprehensive view of its use is required beyond just some influential definitions. Amadi-Echendu et al. (2010) conceptualise three strategic dimensions for asset management: temporal, organisational and spatial, which was expanded upon by Laue et al. (2014) to include statistical and measurement as follows:

- Time generality – intergenerational where both short-term (e.g., utilisation) and long-term (e.g., whole-of-life) aspects of assets are covered
- **Spatial generality** – all tangible and intangible assets are included
- **Organisational generality** – strategic implications at all levels, from direct contact with the asset to the strategic decisions at the governance level
- Measurement generality – both financial (e.g., economic value) and non-financial (e.g., social value) attributes of assets are considered

- **Statistical generality** – both essential, first-moment return measure (utilisation) and higher moment return measure (risk) of asset performance are considered

These elements imply that asset management is multi-disciplinary and multi-dimensional, occurs from operational to tactical and strategic levels and requires the use of both traditional quantitative (technical) mode of analyses and qualitative (social/cultural) methods for a holistic approach.

Despite the evolving views of strategy, strategic management scholars have long emphasized the importance of goal orientation, aligning all company processes to a company's objectives (Drucker, 2018, Chandler Jr, 1993). In other words, an organisation must create value to meet two fundamental demands: the excellent execution of activities and the development of the capabilities to be sustainable for the long term, such as responding effectively to environmental changes (Beinhocker, 2006). Capabilities development might include designing organisational structures that incorporate efficient systems and decision-making processes to build the appropriate culture and values by recruiting and developing the right people (FitzRoy et al., 2012).

2.2.4.2 Resource-based View

Strategic management, with its roots in military strategy, was popularised in the 1960s by Alfred Chandler for application in a business context (Johnson et al., 2020). Analogous to strategic management, the resource-based view (Peteraf, 1993, Wernerfelt, 1984) argues that an organization can be regarded as a bundle of resources (Amit and Schoemaker, 1993, Rumelt, 2005). Considering both tangible and intangible assets, virtually all organisations have some form of formal or informal asset management

system in place. A resource may be conveniently classified under a few headings, for example, physical assets, human (including capabilities and knowledge), and capital (tangible and intangible).

The traditional view, common in professional journals and textbooks in the 1960s and 1970s, was that strategy should be managed through planning processes, in the form of a neat sequence of steps building on objective setting and analysis, through the evaluation of different options, and ending with the careful planning of the strategy implementation (e.g. Argenti, 1976, Ansoff, 1965, Rhyne, 1986). However, according to Aldrich et al. (2020), the heart of business management and strategy concerns the creation, evaluation, manipulation, administration, and deployment of unpriced specialized resource combinations. Based on this view, organisations will aim to find the optimal resource boundary that ensures the value of their resources is optimised compared to other possible combinations. Mintzberg (1994) shared a similar view that strategic management is seen not so much as a formal planning process but rather as a process where strategies developed in organisations are based on internal capability, sensitivity to changes in their environments and past learnings. This view appears to align with Porter (1980) when he drew attention to the subject of strategic positioning based on the argument that organisations must react effectively in a dynamic environment to seize new opportunities and mitigate significant threats or risks constantly. FitzRoy et al. (2012) describe strategic management as the managerial process of creating and building an organisation that generates value that requires leadership, creativity, passion, and analysis as the organisation must develop and adapt to change or possess dynamic capabilities.

2.2.4.3 *Dynamic Capabilities*

Dynamic capabilities arose from the perceived shortcomings of the resource-based view that assumes resources exist and adopts a process approach that acts as a buffer between resources and the changing business environment (Eisenhardt and Martin, 2000, Makadok, 2001, Teece, 2018). Teece et al. (1997) defined dynamic capabilities as the organisation's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments. This ability is described as three clusters of applications: '*sensing*', '*seizing*' and '*transforming*'; and three sets of organisational processes: coordination/integration, learning and reconfiguration (Teece, 2007).

- *Sensing* – identification, development, and co-development of opportunities concerning stakeholder needs through learning as an outcome of experimentation, practice and knowledge management.
- *Seizing* – mobilising of resources to address needs and opportunities in a coordinated and integrated manner
- *Transforming* – continual renewal involves reallocation, recombining or modifying existing resources.

According to Teece (2017), dynamic capabilities must be developed or built through a process of knowledge generation, learning and investment analogous to Nonaka (1994) theory of knowledge creation – the Knowledge Spiral where individual tacit knowledge is shared (socialisation), then made explicit (externalisation) and synthesised with other new knowledge (combination) to create new tacit knowledge (internalisation). Along similar veins, the empirical phenomenon described in the dynamic capabilities framework

is considered fluid and hence '*deductive logic*' or '*appreciative theorising*' (e.g., qualitative, observation-based) is a more useful approach to characterise the methodology of choice for value creation and realisation (Nelson and Winter, 1982). Acknowledging that much-accepted theories cannot be empirically verified (Von Hayek, 1989) or falsified (Rosen, 1997) suggests that deductive and inductive reasoning need to be replaced by abduction and other sources of expert knowledge or '*super forecasters*' (Tetlock and Gardner, 2016) or the distributed '*practical wisdom*' within the organisation (Nonaka and Takeuchi, 2007, Nonaka and Toyama, 2007).

It is important to note the difference between ordinary capabilities or technical efficiency as '*doing things right*' and dynamic capabilities or evolutionary fitness as '*doing the right things*' (Teece, 2007, Teece, 2018, Teece et al., 1997). Winter (2003) describes ordinary capabilities as generally falling between three categories: administration, operation, and governance, which include skilled personnel (including contractors/suppliers), facilities and equipment (including technology), processes and routines, and effective administrative coordination. These capabilities can often be measured against requirements of specific tasks, such as several defects, unplanned shutdowns, and efficiencies that can be benchmarked against industry best practices internally or externally. On the other hand, dynamic capabilities are based on new product (or process) development, unique managerial orchestration, change-oriented culture, innovation and continual adaptability to the changing environment led by top management and leaders. Teece (2010) argues that the strengths and weaknesses of an organisation's dynamic capabilities are dependent on the organisation's values, culture and collective ability to

effectively and efficiently implement a new business model or other changes that cannot be bought, unlike ordinary capabilities.

Unlike the traditional analytical approach of breaking down problems into manageable parts to resolve sequentially, Tan et al. (2022) noted the ISO 55x standards reflect the systems dynamics approach (Duggan, 2008) that emphasises an '*overall endogenous point of view*' encompassing (i) stocks and flows dimensions, (ii) strategic decision making and (iii) feedback loops in complex systems. This approach stems from the classical models of '*industrial dynamics*' (Forrester, 1958) and '*urban dynamics*' (Forrester, 1970) that describe four key generic characteristics of (i) theory of information feedback systems, (ii) knowledge of decision-making processes (iii) an experimental model approach to complex systems and continuous improvement, and (iv) realistic mathematical model simulations or predictive analytics. The considerations of an evidence-based and continuous improvement (Forrester, 2007) resonates with the PDCA cycle and the fundamentals philosophy of the ISO 55x standards (Tan et al., 2022) in particular:

- The feedback loops are the primary structural elements of a closed boundary management system (ISO 2014a, 2018)
- Level (state) variables representing accumulations within the feedback loops (ISO, 2011)
- Rate (flow) variables represent activity within the feedback loop such as goal/purpose, observed condition, discrepancy detection, and corrective actions (ISO, 2015).

From a systems thinking perspective, Haines (2000) argues that every living system interacts openly with its environment and describes a system as a process characterised

by a series of inputs to throughputs (or actions) before transforming resources to outputs that is continuously monitored and evaluated through a feedback loop as show in [Figure 2-7](#) comprising of five phases or elements of Systems Thinking.

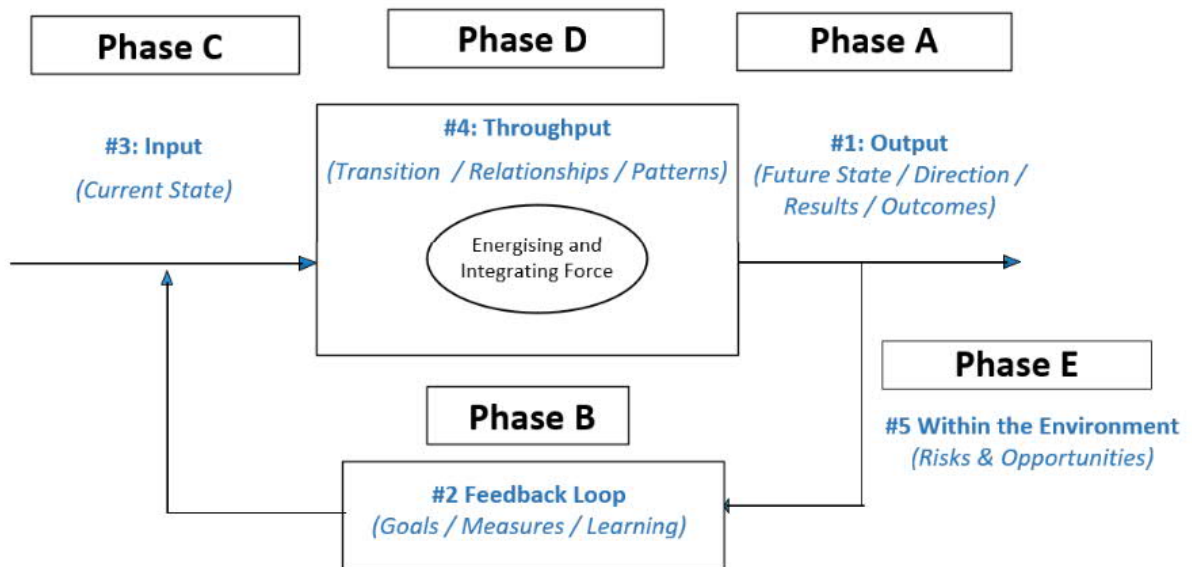


Figure 2-7 Five Elements (ABCDE) of Systems Thinking - from theory to practice (Haines, 2000)

In contrast to ISO 55x standards of ‘where we are now’ or organisational contexts, Haines (2000) asserts that true systems thinking starts with the following questions for each phase (p. 38):

- Where do we want to be? (Phase A)
- How do we know we get there? (Phase B)
- Where are we now? (Phase C)
- How do we get there? (Phase D)
- What will/may change in our environment in the future? (Phase E)

These questions set up a holistic approach to strategic management and should be applied as part of the strategic asset management planning process of defining the agreed

value for stakeholders and what needs to be done to ensure there is sufficient capability and capacity to deliver the value expected.

Marsden and Dawson (2017) noted that to cope with uncertainty caused by internal and external influences, organisations need to possess resilience characteristics of flexibility and adaptability. In their studies of organisational resilience and from a dynamic capabilities perspective, Pavlou and El Sawy (2013) regarded resilience as a positive response to challenging conditions evidenced by technological innovations, new operating models, and new methods of problem-solving. Tan et al. (2022) argue that it is not for asset managers to find a solution to every problem but instead, there should be a clearly defined process of resilience management embedded within its strategic management framework as well as being truthful or accountable for their vulnerabilities to be better prepared (Dalziell and McManus, 2004)

2.2.4.4 Cultural Context

Johnson et al. (2020) consider strategic management a framework with three key elements: '*strategic position*', '*strategic choices*', and '*strategy in action*' that emphasises the non-linear nature of strategy implementation. A common feature of this differing view of strategic management is that the cultural context of strategy plays a vital part in strategic positioning as managers seek a better understanding of the critical factors that influence the expectations of internal and external stakeholders and how far these factors help or hinder strategic choices and implementation (Johnson et al., 2020). The recognition that strategy formulation contains both rational-deductive and political processes (Freeman, 2016) could be attributed to the view of MacMillan (1974) that "*... organisations are dependent upon the environment for the provision of certain inputs,*

which the organization then transforms into outputs; which it, in turn, uses to get more inputs.” Viewing organisations as systems similar to stakeholder theory, he argued that analysis of ‘*symbionts*’ (shareholders, unions, suppliers, competitors) is just as important in addition to customers, markets and products. This notion is certainly the case for public sector organisations in their quests of defining their purpose and what value to optimise.

Culture can be considered as an enabler for strategic management, an invisible platform of value, principles, behaviours and commitment that runs the organisation, influencing the mindsets and attitudes of staff (Carataş Maria et al., 2018), similar to asset management culture described in the ISO 55x standards. As with many business concepts, organisational culture is defined in many ways through models that describe the relationships between phenomena and dimensions or variables. Deal and Kennedy (1982) defined culture simply as *‘the way things are done around here’* which they identified six interlocking cultural elements:

- History – A shared narrative of the past that keeps people anchored to the core values that the organisation was built on.
- Values and Beliefs – Cultural identity built around shared beliefs of what is really important for the organisation
- Rituals and ceremonies – Things that employees do regularly that create a natural bond
- Stories – Messages that exemplify company values, enable employees to understand better what is expected of them and share their achievements as values turn into actions.
- Heroic Figures – Managers and staff who serve as role models or champions that inspire others

- Cultural Network – Informal network within an organisation that transfers information and knowledge (formal and informal) with different degrees of influence (i.e., storytellers, gossipers, whisperers, spies, priests and priestesses)

Schein (2010) established that organisational culture can be conceptualised as comprising a superficial level of culture capturing the vision or value statement and a deeper level of culture (formal and informal), encompassing the shared language and criteria for status, authority and power through rewards and control. He argues that organisational culture will evolve as a result of the following:

“A pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems.”(p.18)

For describing asset management culture in the UK/European context, Johnson (2010) suggested four primary dimensions (participative-authoritative, risk-taking-cautious, short term–long term, individualistic-collective) and four secondary dimensions (outcome-process, certainty-uncertainty, accepting-questioning and information restricting-information sharing).

2.2.4.5 Summary

Strategic management has attained a certain level of maturity, leading to ever greater academic and researcher interest in its critical themes through empirical studies and literature reviews (Ramos-Rodríguez and Ruíz-Navarro, 2004). However, strategic management as an academic field of study remains relatively recent ((Nerur et al., 2016). Similarly, ISO 55x standards do not prescribe the strategic management processes that

are used to develop the SAMP based on the assumption that they should be aligned or integrated with the organisation's wider strategy formulation efforts, that is, the key considerations for strategic planning and strategic management. Woodhouse (2003) suggests major issues with contemporary asset management practices are not caused by technical capabilities but rather centred around human factors that require a paradigm shift in the sophisticated requirements of skills and abilities of employees. However, asset management research is predominantly focused on technology, methods and systems for managing assets (Hipkin, 2001, Hodkiewicz and Pascual, 2006, Trevelyan and Tilli, 2007, Albert, 2002) and has the tendency to overlook the importance of internal and external stakeholders or people play as a critical element in implementing an effective asset management system which this research intends to address. This research intends to identify the key social/cultural considerations when managers developed the strategic asset management plans and asset strategies.

2.2.5 SYSTEMS APPROACH

2.2.5.1 Background

Under '*General Systems Theory*', a system according to Kielhofner (2002), refers to "*any complex group of elements which interact and together constitute a logical whole with a purpose of function*". [Figure 2-8](#) illustrates the relationship between the elements of an asset management system within an organisation.

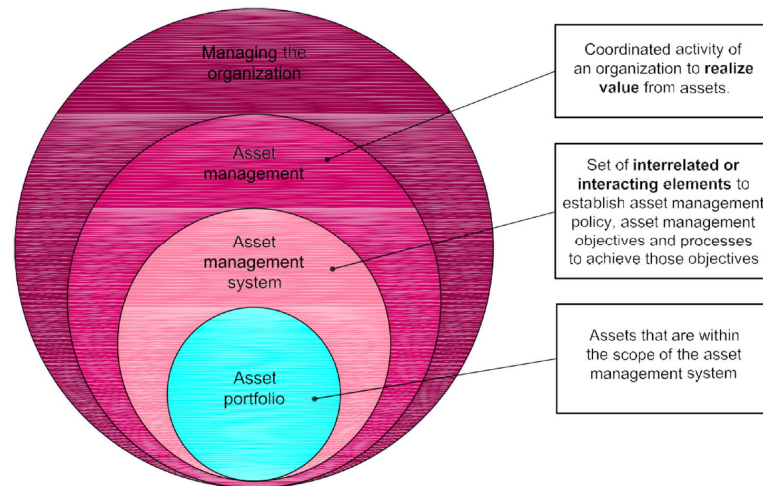


Figure 2-8 Relationship between key asset management terms (source: ISO 55000:2014)

Public value, previously discussed in [section 2.2.3.7](#), requires a good understanding of an organisation's external and internal context¹⁹. This view is based on ‘*Organizations-as-systems*’ thinking with its theoretical roots and developed within the disciplines of sociology and management and organization theory that led to two distinct strands: the ‘*mechanical analogy*’²⁰ (Barnard, 1968) and ‘*organismic analogy*’ employed in sociology by Durkheim (2023) and Spencer (1985) who saw society as an interconnected whole capable of adaptation and evolution, and with the parts fulfilling the needs of the whole. Selznick (1948), Katz and Kahn (1978) transferred the organismic analogy to the level of the organization and, more importantly, provided the theoretical basis for the two most important research programs²¹ of ‘*contingency theory*’ and ‘*sociotechnical systems*’ theory developed within the “*organizations as systems*” tradition. The four essential

¹⁹ Common techniques for identifying and analysing internal and external issues include force field analysis, environmental scanning and benchmarking, Strengths - Weaknesses - Opportunities - Threats (SWOT), and Political-Economic-Societal-Technological- Legal-Environment (PESTLE) (e.g., see ISO/TS 9002:2016).

²⁰ For the mechanical analogy, Barnard reasoned that organizations were “co-operative systems” as long as they are effective and efficient.

²¹ The empirical evidence challenged the traditional approach that organisations were like machines (based on Taylor’s scientific management theory, Fayol’s administrative management theory and Weber’s bureaucracy theory) and some weaknesses of the human relations theory of group behaviour, individual motivation and leadership (based on Mayo, Maslow, Herzberg, and McGregor) that neglected other important factors such the market, technology, competition and structure (Perrow, 1972)

characteristics of an organisation to be considered as a system are: (i) contain at least two purposeful elements with a common goal, (ii) a functional division of labour in pursuit of the common goal/s, (iii) the functionality distinct parts (by function, space, or time) can respond to each other through observation and communication, and (iv) at least one subset of the system has a system control function (Ackoff, 1971, Ackoff, 1994).

2.2.5.2 Contingency Theory

Contingency theorists view organizations as consisting of a series of interdependent subsystems, each of which has a function to perform within the context of the organization as a whole. Jackson (2007) identifies four primary sub-systems of goal, human, technical and managerial that define the size and nature of its structure, and transformational system as represented by *Figure 2-9* and summarised below.

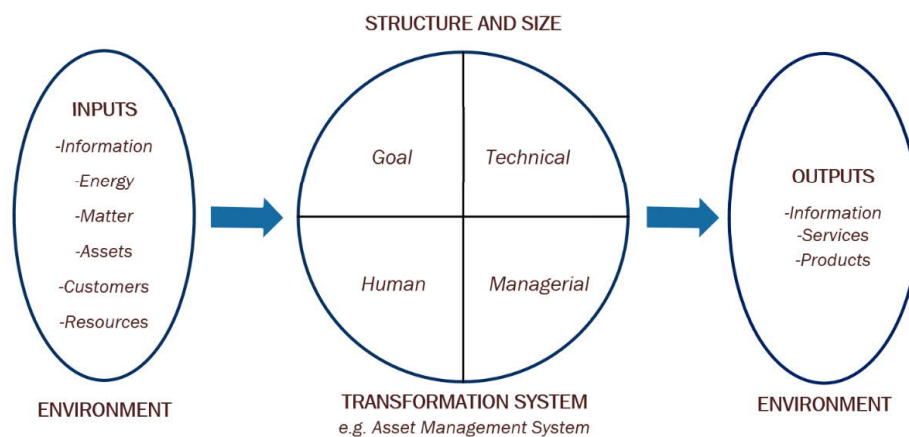


Figure 2-9 The Primary subsystems of an organisation as an open system (Jackson, 2007)

- The goal subsystem has an effect on the other subsystems and its structure. Goals must be chosen to ensure the organisation's legitimacy and viability within the context of its wider environment, which could be static under a stable environment or flexible to address constraints in a turbulent environment. Organisations do not exist in isolation, nor is the environment (context) static

and able to be controlled (Snowden, 2002, Snowden, 2005, Larsen-Freeman, 2013).

- The human subsystem and its needs are seen from a functional perspective, and attention should also be given to informal groups, proper job design, and participation in decision-making (Schein, 1965, Schein, 2010, Schein, 1990).
- The technical subsystem relates to the technology employed that determines the transformation process and the best performance (Woodward, 2013).
- The management subsystem is a functional imperative of efficient and effective organisations that provides the balance of the other subsystems and ensures strategic fit with the environment. (Child, 1984) argued that managers possess “strategic choices” where they can choose to influence some of the environmental factors that affect their organisations (e.g., employees, customers, location, suppliers) and not simply at the mercy of environmental determinations.

Based on the above understanding, which is prevalent in the ISO 55x standards, there are essentially three functions management must undertake (Jackson, 2007):

- Organizational communication must be maintained by creating a proper structure for the enterprise, selecting suitable people for the executive role, and securing an informal organization that backs up and supports the formal.
- Essential services must be secured from appropriate individuals by making them aware of the organization, bringing them into a cooperative relationship with it, and making sure they are motivated to work for or with the organization by offering them sufficient inducements in return for their contributions.
- An organization’s objectives should be formulated, and the idea of a common purpose should be taught at all levels of the enterprise.

2.2.5.3 Socio-technical Systems

Socio-technical systems thinking was prevalent from the sixties to the eighties associated with the Tavistock Institute of Human Relations, where theorists including Trist and

Emery (1960) attempted to transfer behavioural science and systems ideas to industry through the consultancy mechanism that led to the Coal Mining Studies and Shell's New Philosophy of Management in the 1960s. Socio-technical systems theorists regard organisations as pursuing primary tasks that can best be realized if their social, technological, and economic dimensions are jointly optimized and treated as open systems that fit into their environment. The primary task is the task that must be accomplished to survive and can be achieved through semi-autonomous work groups. The emergence of procedures for operationalising socio-technical theory has had a major impact on the industry and, apparently, brings satisfactory results (Pasmore et al., 1982). One of the most widely known is the ten-principles checklist for socio-technical design (Cherns, 1987):

- **Compatibility** - the process of design must be compatible with its objectives
- **Minimal critical specification** - of the way in which the work is actually carried out and who should carry it out
- Socio-technical criterion - variances from specifications are to be controlled as near to the point where they arise as possible
- **Multifunction principle** - to provide for flexibility and equifinality, each individual should be able to perform more than one function
- **Boundary location** - control of activities in a department should become the responsibility of the members, with the supervisor concentrating on boundary activities
- **Information flow** - information systems should be designed to provide information, in the first place, to the work teams who need it for task performance.
- Support congruence - systems of social support should reinforce the organizational structure.
- Design and human values - high-quality jobs based on the six design characteristics

- **Incompletion** - design as an iterative process (once at the end, one must go back to the beginning again)
- Power and authority - states that those who need resources to carry out their tasks should have the authority to command them and must accept responsibility for their proper use.

The concept of the socio-technical system was established to stress the reciprocal interrelationship between humans and machines and to foster the program of shaping both the technical and the social conditions of work in such a way that efficiency and humanity would not contradict each other any longer (Ropohl, 1999). Some also see '*quality circles*' as having been derived originally from socio-technical thinking, and indeed, many of the same principles are involved in quality circles, although in a less well-developed form (Jackson, 2007). It is also widely acknowledged that adopting a socio-technical approach to system development leads to systems that are more acceptable to end users and deliver better value to stakeholders. Baxter and Sommerville (2011) proposed using '*socio-technical systems engineering*' for organisational change and technology system development primarily focused on two activity types: sensitisation and awareness and constructive engagement. Their approach is based on the largely independent research of groups investigating work design, information systems, computer-supported cooperative work, and cognitive systems engineering.

2.2.5.4 *Hard Systems Thinking*

Around the same time as the '*Organisations-As-Systems theory*' was evolving with the works of Parsons (1960), Von Bertalanffy (1950) and others, another strand of thought, '*hard systems thinking*' was taking place (Checkland, 1978). The thinking included systems engineering and systems analysis based on the assumption that to tackle a problem

effectively is to select an efficient means of achieving a known and defined end. However, Jackson (2007) argued that operational research, decision science, and organisation cybernetics could also be considered as they have similar orientations.

Jenkins (1972) defined Systems Engineering as:

...the science of designing complex systems in their totality to ensure that the component subsystems making up the system are designed, fitted together, checked and operated in the most efficient way. (in Beishon and Peters, 1972)

The approach was based on the engineering discipline previously used to engineer asset systems that could also be used (or extended) to address any systems made up of the interaction of various system components. The term was first coined at the Bell Telephone Laboratories during the 1950s, where Hall (1963) account of the methodology used included:

- Systems existing in hierarchies and general objectives must similarly be arranged in a hierarchy
- Internal consistency and integration of plans
- Optimisation of the system requires establishing processes for problem definition, choosing objectives; system synthesis, analysis, selection and development, and current engineering (operation).

While the original concept was concerned with a physical entity, its popularity was later extended to parts of firms, whole organisations, and even local government sectors to ensure the optimal use of resources through four phases (Jenkins, 1972):

- System Analysis – The problem defined and analysed by the importance of subsystems using a whole-of-system approach

- Systems Design – The schema of the future environment is developed and represented in a quantitative model that stimulates performance under different operational conditions
- **System implementation/Operation** - Pursuits of its objectives is carried out within a control system, operated and tested in the real world through a feedback mechanism

2.2.5.5 Complexity Theory

Opposite to the conventional principles of scientific management that emphasise order, control, predictability and the deterministic world of cause and effect, Keene (2000) argues that according to complexity theory, *'our world is not only subjective, but it is the result of our interactions with each other and the environment'*. Marion and Bacon (1999) describes complex systems as *'robust, involving multiple, often redundant chains of interaction and causation...'* where the whole is more than some of its parts implying predicting of outputs may not necessary simply be achieved through studying of inputs; and complex organisations create behaviour that is neither predictable nor unpredictable as labelled as the *'edge of chaos'* (Peters, 1992).

Application of complexity theory helps to explain how change evolves that is not linear like the intentions that drive it and enables a better understanding of processes that accelerate or amplify change. (Salem, 2002, Tetenbaum, 1998). Smith and Humphries (2004) suggest three key principles for the application of the theory. Firstly, organisations that are comprised of people cannot be controlled like machines with inanimate components. It might be more effective for leaders to define business parameters and not be involved in operational matters. Secondly, macro structures can evolve emergently into unconventional networks which encourage innovation and further creativity. In

other words, stability akin to inflexibility can signify organisational unresponsiveness and failure. Thirdly, complexity thinking encourages comfort with uncertainty and room for experimentation if the right philosophy is in place. Tetenbaum (1998) advocates these principles to build readiness to engage in the *'new order'* of: (i) complexity and chaos awareness through knowledge and information sharing, (ii) collaboration and teamwork, (iii) innovation and creativity, (iv) diversity and inclusivity. As a result, this implies a manager's role becomes managing the transition, building resilience, destabilising and stabilising the system, manage order and disorder to create and maintain a learning organisation that optimises value (organisation) through instilling strong core values (individuals).

2.2.5.6 Other Frameworks

Outside the AM research realm, other theorists suggest the use of *'network systems thinking'* (e.g. Cardillo et al., 2013, Sidorova and Kappelman, 2012, Steen, 2010) could prove to be a useful framework for executives to immerse in a vast range of management theories and tools to choose from that provided a clear and systemic overview of the complex interrelations in a company. Applying this thinking enables a distinction between structure, activities, and behaviour between three management levels: *'normative'*, *'strategic'* and *'operative'* (Gao, 2005). Burns and Stalker (1961) argue that different environmental conditions require other management systems. De Geus (2011) observed many organisations try to predict the future instead of asking how they might respond and adapt, and as Owens (1995) noted, there is a particular challenge in the built environment where there is the tendency to *'predict and provide'* as in traditional asset

management instead of *'predict and prevent'* focused on continually adaptation and evolution²².

This research will explore these notions as it attempts to develop a conceptual model for asset management that could enable current infrastructure problems to be constructed in a form that can be logically extracted and defined under specific dimensions. This would then enable problems to be resolved through a conceptual framework/business model using the systems approach.

2.3 PUBLIC MANAGEMENT IN NEW ZEALAND

2.3.1 BACKGROUND

New Zealand's current public management model resulted from a succession of government reforms in the 1980s that conformed to broad objectives, ideas, principles and practices of *'managerialism'* (Mulgan, 1996). Some key objectives include improving allocative and productive efficiency, improving public sector institutions' accountability, and enhancing governmental programmes' effectiveness (p. 4). Among the key policies related to public infrastructure include:

- the removal, whenever possible, of dual or multiple accountability relationships within the public sector,
- the avoidance of joint central and local democratic control of public services,
- the separation of commercial and non-commercial functions and the development of sophisticated strategic planning and performance management systems throughout the public sector.

²² Gunderson (2000) asserts that most scientific ideas are based on the static view of the world and the place of humans in it where in contrast, the evolutionary basis of our biological insight or natural tendencies stresses adaptation and responsiveness to changing conditions (or threats).

While New Zealand's public sector previous reforms were due to the economic pressures and political opportunities (Schwartz, 1994), they were also shaped by various administrative and economic theories popular at that time, often translated to specific policies by Treasury New Zealand (Hood, 1995). Several theories such '*Public Choice Theory*' (see Boyne, 1998), '*Agency Theory*' (see Bendickson et al., 2016), '*Transactional-Cost Economics*' and '*Managerialism*' (see Williamson, 2007, Williamson, 1989), or '*New Public Management*' (see Hood, 1995) were particularly influential in this regard. Many successive governments have been addressing continuing dilemmas concerned with the management of the public sector (Boston, 1996), such as:

- Where is the boundary for appropriate public and private sector ownership of assets and services?
- What are the limits of discretion for providing public services regarding diversity vs uniformity, control versus flexibility, and strategic coherence vs fragmentation?
- What is the appropriate balance between centralisation and decentralisation, single vs multiple (overlapping) accountabilities, and elected vs appointed governance?
- At what point should formally autonomous and independent organisations continue to depend on public funding and government coordination?
- How should performance be measured without discrete outputs or clear outcomes for social well-being or quality of living?

The research will not address these questions directly, although they may provide context to the responses of participants who face these perennial issues as part of their roles and responsibilities of managing public infrastructure and recorded as such where appropriate.

2.3.2 INVESTMENT MANAGEMENT SYSTEM

The New Zealand Government's expectations for managing investments and physical assets by its agencies were set out in an October 2019 in a Cabinet circular CO (19) 6 - *'Investment Management and Asset Performance in the State Services'* that must be complied with by all departments and other entities as an expression of government policy (TEC, 2019). Among the key principles related to asset management in the policy include the involvement of government in only activities that cannot be more efficiently and effectively carried out by non-governmental organizations, and any commercial enterprises retained within the public sector should be structured similarly to private sector companies and on the interest of administrative efficiency and consumer responsiveness, decision-making powers should be allocated as close as possible to the place of implementation. The two main focuses of the policy are: (i) capital expenditure, asset disposals, lease arrangements, and (ii) *"as a service"* investments, as well as asset performance.

Implementation of the policy was through *an 'Investment Management System (IMS)'*²³, framed by four investment life cycle phases: *'intentions'*, *'planning'*, delivery and benefits realisation, the primary objective of the system was to optimise value from new and

²³ Investment means the commitment of financial and physical resources to the delivery of government services with the expectation of receiving future benefits from investment activities irrespective of funding sources or appropriation type or form of government financial support such as:

- changes (additions or disposals) to asset portfolios or infrastructure managed by or through agencies such as crown agents, autonomous crown entities, independent crown entities and crown entity companies;
- new lease arrangements, or renewals of lease arrangements (for example, property rentals)

existing assets for current and future generations of New Zealand (p.3)²⁴. Value optimisation in this context refers to the net fiscal, economic and wellbeing benefits of an asset over its life cycle taking into account the following dimensions (CO-19-6, p. 19):

- **Effectiveness** – the extent to which the asset delivers the required level of service in support of the Government’s wellbeing priorities.
- **Efficiency** – the extent to which the asset makes best use of resources to deliver the service, while minimising any negative impact
- **Sustainability** – the extent to which the asset is able to deliver service to present and future New Zealanders
- **Resilience** – the extent to which the asset can participate in, absorb, accommodate, or recover from the effects of an event in a timely and efficient manner
- **Adaptability** – the extent to which an asset can respond to long term trends, new technologies or changes in the way services need to be delivered.

Cabinet identified twenty-five investment-intensive departments and Crown entities that collectively manage assets worth over \$100 billion, which makes up 75 percent of the Crown’s balance sheet (Treasury, 2021a) that are subjected to Investor Confidence Rating (ICR) assessments on a three yearly cycle. The ICR uses nine elements weighted according to the Treasury’s view of the relative importance of each element to the system as illustrated in *Figure 2-10*. The focus of the assessment is on performance against agreed targets levels that differ for each element. Agencies set the targets for ‘lag indicators’ to

²⁴ The objectives of the system are (p. 3):

- enable Cabinet and agencies to prioritise and coordinate significant investments according to government and State services long term priorities.
- establish, disclose and then deliver the agreed value from particular investments.
- promote good stewardship of Crown resources.
- enable all parties to exercise their required roles in a flexible and efficient manner.
- make systematic use of performance information in government and agency investment management and decision-making processes.

reflect agreed investment objectives, while 'lead indicator' targets are set either by the Treasury (as system lead) or by agreement between the agency, the Treasury and external assessors (Treasury, 2021a, p.3).

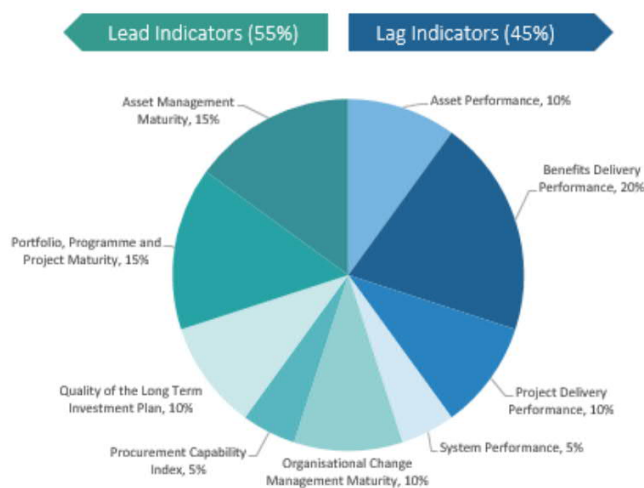


Figure 2-10 - Nine ICR Factors or Elements used to assess performance (Treasury, 2021a)

The five key investment management capabilities considered in the level of ICR maturity are (p.12):

- Asset Management – Physical and Intangible assets are optimised in the long-term interests of the organisation and its customers
- **Portfolio, Programme and Project Management** – Investments are successfully delivered
- **Organisational Change Management** – Incremental or transformational change are delivered
- Long-term Investment Plan Quality
- Strategic Procurement of goods and services and adequate management of providers, suppliers and markets

The expectation of the cabinet was that investment-intensive agencies to achieve a minimum of a 'B rating'. *Figure 2-11* shows the results presented to parliament after Round 2 of assessments (Treasury 2021a)

ICR Scoring system

Total Score	Rating
81	A
66	B
51	C
26	D
0	E

Agency		Round 1		Round 2	
		Score	Rating	Score	Rating
ACC	Accident Compensation Corporation	77	B	74	B
ADHB	Auckland DHB	71	B	73	B
CCDHB	Capital & Coast DHB	51	C	62	C
CDHB	Canterbury DHB	69	B	75	B
CMDHB	Counties-Manukau DHB	82	A	66	B
Corrections	Department of Corrections	61	C	77	B
Customs	New Zealand Customs Service	77	B	78	B
Defence	Defence Sector (NZDF & MoD)	73	B	79	B
DIA*	Department of Internal Affairs	58	C	56	C
DOC	Department of Conservation	61	C	72	B
HNZC	Housing New Zealand Corporation	87	A	87	A
IRD	Inland Revenue Department	83	A	86	A
MBIE*	Ministry of Business, Innovation, and Employment	70	B	79	B
MFAT	Ministry of Foreign Affairs and Trade	81	A	77	B
MoE	Ministry of Education	63	C	68	B
MoH	Ministry of Health	62	C	40	D
MoJ	Ministry of Justice	68	B	68	B
MSD	Ministry of Social Development			63	C
NDHB	Northland DHB	61	C		
NZTA	New Zealand Transport Agency	72	B	60	C
Otakaro	Otakaro Limited	88	A		
Police	New Zealand Police	56	C	69	B
SDHB	Southern DHB			36	D
WKDHB	Waikato DHB	57	C	52	C
WDHB	Waitematā DHB	72	B	70	B

* Excludes the Government Chief Digital Officer (GCDO) and New Zealand Government Procurement (NZGP) functional leads

Figure 2-11 Investor Confidence Rating Agency Results (Treasury, 2021a)

Interesting, as shown in *Figure 2-12*, the results also indicated a strong positive correlation ($r = 0.7$) between capability in 'asset management plans' (a core capability within the Asset Management Maturity element) and an agency's overall ICR score in Round 2. This correlation reinforces the importance of asset management planning and how well an agency performs in their investment intentions, asset service performance, and managing sustained asset services (p. 14).

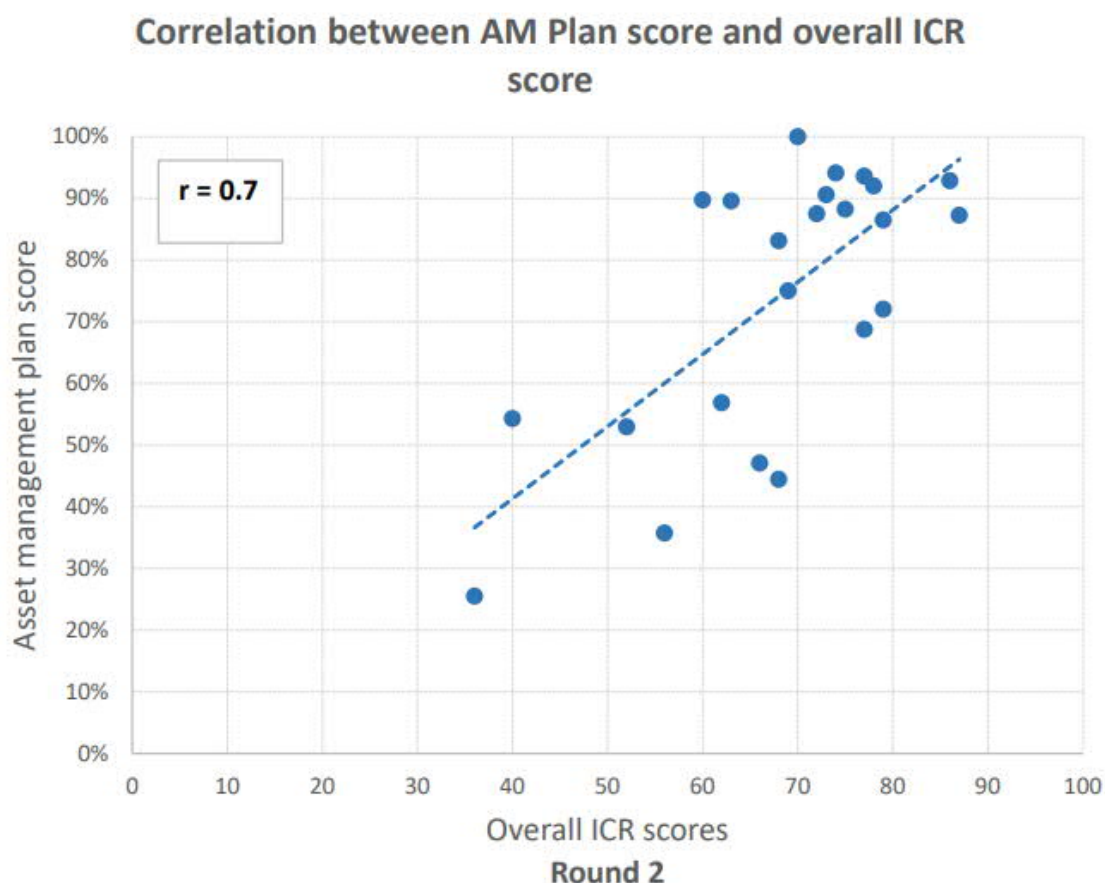


Figure 2-12 Correlation between AM score and overall ICR score (source: Treasury, 2021a)

2.3.3 ROLES AND RESPONSIBILITIES

With the NZ Treasury designated as a system leader for asset management, other roles and responsibilities are defined and allocated to different parties in the system, including the Cabinet and its Committees, Ministers, Department Chief Executives, Boards of Crown Entities and Companies, State Services Commission, NZ Infrastructure Commission, Functional Leaders, Monitors and the Land Information NZ.

The Treasury – Te Tai Ōhanga is responsible for developing and maintaining the integrity of the system as a whole with the capacity to:

- Oversee and provide guidance on asset performance.

- Develop and contribute to a network of asset management excellence across the system.
- Ensure all investment management guidance materials²⁵ are consistent with and support the system objective and system expectations.
- Review the effectiveness and efficiency of the system settings.
- Determine the methodology for Investor Confidence Rating assessments.
- Report on the performance of the system.
- Provide advice on the performance of functional leaders operating within the system.

These responsibilities are performed in consultation with relevant agencies, functional leaders, and the New Zealand Infrastructure Commission – Te Waihanga (NZIC)²⁶. The key operational requirements for asset management (p.12) for these agencies are:

- must manage assets to ensure they deliver current and intended levels of service
- must demonstrate a level of asset management practice and performance that is appropriate to the scale of assets under their management and the criticality of those assets to the delivery of key public services
- must have current asset management plans to inform strategic, tactical, and operational choices
- must capture and use, in internal management and decision-making processes, relevant indicators of past and projected asset performance, such as asset utilisation, condition and fitness-for-purpose
- must report on relevant asset performance indicators in their annual reports.

²⁵ Agencies must develop all significant investment proposals in accordance with published Treasury better business case guidance to provide a common language and a systematic way for stakeholders work with decision makers to invest with confidence

²⁶ NZIC was established to lift the quality of infrastructure procurement and delivery in New Zealand with two main roles in its empowering legislation, covering the provision of advice to:

- government on infrastructure strategy and planning, and
- agencies and local authorities responsible for planning, procuring and delivering major infrastructure projects and any innovative and non-traditional approaches to procurement, alternative financing arrangements, or PPPs.

- must plan for the eventual withdrawal or sale of assets and use approved asset disposal processes²⁷.

2.3.4 ASSET MANAGEMENT

For about 3400 public organisations²⁸ under the Public Audit Act 2002, the Controller and Auditor-General as an officer of Parliament is tasked with annual audits, performance audits and other auditing and assurance duties (OAG, 2022).

All central and local government agencies are expected to ensure assets deliver intended levels of service and report on their performance annually through current asset management plans that inform their strategic, tactical and operational choices that align with the ISO 55x standards. Agencies are expected to capture and use relevant past and projected asset criticality and performance indicators such as condition, utilisation and fitness-for-purpose for internal management and decision-making processes as part of their asset management capability. Agencies' strategic planning and asset management practices must consider asset resilience to the effects of significant risks of climate change, natural disasters or demographic changes dependent on asset type, location and criticality.

Several agencies, such as the Tertiary Education and Health sectors, are required by the Treasury (for funding purposes) to conduct periodic Investor Confidence Rating (ICR) - Asset Management Maturity assessments of their asset management practices based on the framework International Infrastructure Management Manual (IIMM, 2017) and

²⁷ Beyond the requirements set out in this circular, asset disposals can be subject to legal, statutory and Government policy requirements that must be fulfilled prior to disposal. This could require specialised assistance

²⁸ The organisations include government departments, State-owned enterprises, Crown research institutes, the defence forces, district health boards, city and district councils and the subsidiary companies they own, ports, schools, universities, polytechnics, and wānanga (OAG, 2021)

aligned to ISO 55001:2014 requirements. The topics covered are summarised in [Table 2-7](#)

below:

Table 2-7 Key topics of Asset Management Maturity Assessment Tool (Source: <https://www.tec.govt.nz/teo/working-with-teos/tei/asset-management-teis/assessing-the-asset-management-capability-of-tertiary-education-institutions/>)

Theme	Understanding and Defining requirements	Developing Asset Management Lifecycle Strategies	Asset Management Enablers
Topic	<ul style="list-style-type: none"> ▪ AM Policy and Strategy ▪ Levels of Service and Performance Management ▪ Forecasting Demand ▪ Asset Register data ▪ Asset Performance and Condition 	<ul style="list-style-type: none"> ▪ Decision making ▪ Managing Risk ▪ Operational Planning ▪ Capital Works Planning ▪ Financial Planning 	<ul style="list-style-type: none"> ▪ Asset Management Leadership and Teams ▪ Management Systems ▪ Asset Management Information Systems ▪ Service Delivery Mechanisms ▪ Audit and Improvement

For Crown Entities with significant asset management functions, the Monitor will seek answers to the following questions (PSC, 2021, Treasury, 2021a, Treasury, 2018):

- How does the entity ensure its asset management processes and practices are appropriate, effective, and aligned with best practices?
- Does the entity understand the expected impact of investment on future asset performance?
- How does the entity manage its capital investment (including maintenance planning and procedures) to keep assets in service and meet asset management objectives?
- How does the entity determine the appropriate level of service for its customers and ensure that asset performance is relevant to those service levels?

2.3.5 NEW ZEALAND LIVING STANDARDS

In addition to the above requirements, the Treasury developed the NZ Living Standards Framework (LSF) tool applicable to all government entities in 2011 and released the 3rd version in 2021 agencies. Elements of the tool have been translated into various contexts

by different central government agencies and local governments required for attaining government funding. The new LSF describes three levels and a series of analytical prompts (e.g. distribution, resilience, productivity and sustainability) to support the development of public policy on well-being, spending, and other government agency interventions that are aligned to achieving higher living standards and intergenerational wellbeing for New Zealanders illustrated in *Figure 2-13* and summarised below:

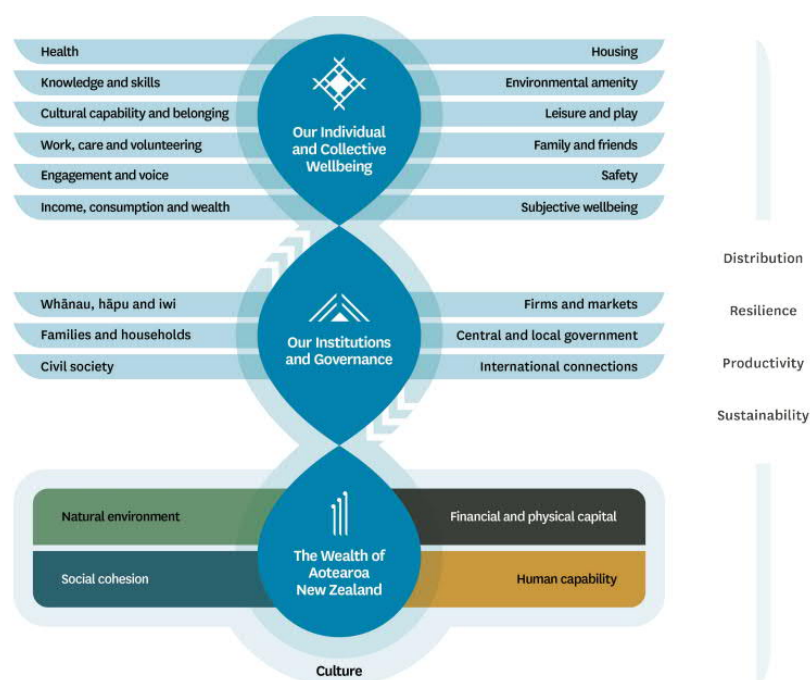


Figure 2-13 New Zealand Living Standards Framework (Treasury, 2021)

- Level 1: **Our Individual and Collective Wellbeing** – Captures twelve domains of wellbeing outcomes for individuals, families, whānau and communities: health; knowledge & skills; cultural capability & belonging; work, care & volunteering; engagement and voice; income, consumption & wealth; housing; environmental amenity; leisure & play; family & friends; safety and subjective wellbeing.
- Level 2 – **Our Institutions and Governance** - Captures the role political, economic, social and cultural institutions play in facilitating the well-being, safeguarding and building our national wealth of individuals and collectives disaggregated into six spheres: whānau

- Level 3 – The Wealth of Aotearoa New Zealand – Captures the four wealth domains: financial and physical capital, social cohesion, human capability and the natural environment

These three levels converge to culture²⁹ to emphasise that all aspects of wealth, institutions/governance³⁰ and wellbeing are cultural and embedded in every part of the framework. The four analytical prompts provide guidance on how to assess the impacts of policies of different agencies on delivering value at the three levels summarised as follows:

- **Distribution:** The distribution of aggregated wealth and well-being across time, place and groups of people; across institutional spheres and individuals, and their perceptions of fairness and equity
- **Resilience:** The adaptability of individuals, communities, institutions, organisations and the environment to adapt or absorb stresses and shocks.
- **Productivity:** The effectiveness of wealth to generate well-being and economic value.
- **Sustainability:** Degree of safeguarding national wealth for the benefit of future generations.

2.3.6 OTHER INITIATIVES

A cabinet paper was delivered to the Prime Minister in May 2022 from the Minister for the Public Office that outlined concerns about agency silos despite designating chief executives with the tasks of improving consistency to approaches in property,

²⁹ Culture represents the accumulated heritage from our ancestors, including knowledge systems, values and beliefs, and their manifestations in objects, practices and concepts

³⁰ The characteristics rules and norms for different institutional spheres include:

- Family and households - Informal family rules and norms
- Whānau, hapū and iwi – Kawa and tikanga in their many manifestations
- Firms and markets – Internal company policies, contracts and cultural norms for business, as shaped and regulated by civil law, competition, employment law, etc.
- Central and local government - Primary and secondary legislation (Public Service Act 2020, Crown Entities Act 2014, State Owned Enterprises Act 1986, Local Government Act 2002), local bylaws, and more detailed rules and enforcement by administrative bodies
- Civil society – Trust charters, professional codes of conduct, club rules, etc.
- International connections – International treaties and arrangements

procurement, digital, data, and information security across departments (PSC, 2022). A decision was made to centralise all the government property functions to enable more accountability for a centrally managed budget for office accommodation. The ministry noted that the centralised system will better align with the government priorities as described in the Living Standards Framework. It was also pointed out that standardised approaches (e.g. fit-outs and construction) to the market, cross-agencies coordination, and the underpinning centralised funding would lead to operational efficiencies, more timely decision-making and greater alignment to strategic outcomes.

The above was an extension to the attempt by the Labour government in 2017 to unify the Public Service in areas where there are commonalities, such as the health and tertiary education systems. In the health system, twenty former District Health Boards (DHBs) were amalgamated into four regional divisions known as Health New Zealand - Te Whatu Ora³¹ Regional. In the vocational education system, sixteen Institutes of Technology and Polytechnics and nine Industry Training Organisations were amalgamated into Te Pūkenga – The NZ Institute of Skills and Technology. There is ongoing reform of how New Zealand’s drinking water, wastewater and stormwater services are delivered (DIA, 2023). Other initiatives in the future include the organisation of local authorities³². However, the new National government has indicated there will be further changes to the public sector include repeals and reversals of changes under the Labour government.

³¹ More information is available on Health New Zealand website: <https://www.tewhatauora.govt.nz/>

³² The report Review into the Future for Local Government (DIA, 2023) He piki tūranga, he piki kōtuku, commissioned by the Ministry of Local Government proposed a range of system changes such as the amalgamation of 78 local authorities to a new unitary model structure or a combined network model structure.

2.3.7 SUMMARY

Various Governments under different political parties have attempted to address various infrastructure challenges through developing public policies for establishing and sustaining an enabling environment for asset management including mandatory reporting and assessments of asset management maturity, amalgamation of District Health Boards to form four regional Health New Zealand entities and the formation of Te Pūkenga to deliver education previously provided by polytechnics, technical institutes and industry training organisations. This approach is consistent with public policy instruments adopted by other countries (e.g. United Nations Development Programme) based on best practices of asset management capability to improve access to assets for different communities (ISO 2022c). Policy instruments identified in this section includes legislation , national guidelines, regulations, codes and different intervention types such as delegations (e.g. statements of expectations), mandates (e.g. ICR assessment) and capacity-building as in the example of the health and tertiary education sectors. These instruments are intended to provide clear strategic objectives (e.g. NZ Living Standards Framework) and clear expectations(key performance indicators) for asset management to ensure transparency and accountability to taxpayers, ratepayers and voters in general. The delegation of authorities to the NZ Treasury, various monitoring agencies and to the public sector organisations is a contributing factor in the enabling environments for asset management (ISO, 2022c)

Chapter 3

METHODOLOGY

3.1 OVERVIEW

This chapter will describe the researcher's philosophical stance and worldviews that led to the systematic choice and rationale of the research approach selected for this thesis. It will describe in further detail how the research unfolds by applying the methods used to achieve its aim and objectives.

As discussed in the previous chapters, even though an Asset Management System (AMS) is regarded as a socio-technical system, previous research has established that current literature on asset management for the built environment tends to only focus on the technical aspects limited to activities associated with asset lifecycle tasks such as plan/design, acquisition/construction, operation, maintenance/renewal, or decommission/disposal (El-Akruti et al., 2018). Adding to the complexity is a large number of variables unique to different organisations or situations that guide the choice of asset decisions (Konstantakos et al., 2019) that poses a challenge of a better understanding of the critical success factors of an effective AMS to manage public assets in New Zealand. As a result, several scholars noted this phenomenon poses significant challenges in the scholarly study of the asset management philosophy as it lacks any well-grounded theory that represents the holistic and integrated characteristics of asset management systems (da Silva and de Souza, 2021, Konstantakos et al., 2019). For example, a built bridge must obey the strict laws of physics concerning the gravitational force, its load-bearing

capacity, the durability of the construction materials and its capacity to cope with extreme weather conditions and traffic volume, etc., over long periods. However, engineering can neither fully anticipate nor control all variables affecting the useful life (as opposed to design life) of the bridge, such as how it is used and looked after, the social aspects of its function and the actual benefits gained over time. This phenomenon can be implied for all assets; on their own, they don't provide value; value must be derived from the perspectives of stakeholders associated with the services (or functions) provided to users, which can be an individual, organisation or society as in the case of public assets (Dyer et al., 2018, Srinivasan and Parlikad, 2020). An extensive literature review also suggested that there is no clear understanding of what value means for asset management nor identification of core processes needed to optimise value for the organisation (Almeida et al., 2022).

Recognising that the public sector asset management organisations (and their asset management systems) are complex socio-technical systems, it is appropriate for this study to adopt a social science research paradigm that can address the complexity of converging technical, social and political perspectives. It is essential to note in social science, the research paradigm is based on the researcher's own philosophical assumptions on ontological views of reality, epistemological views of enquiring knowledge, and axiological considerations of one's values and ethical positions (Saunders

et al., 2016). Hence, this study adopted the qualitative research methods³³ using the theory-building Case Study Research strategy (Yin, 2003, Eisenhardt, 1989, Yin, 2011) and the Straussian Grounded Theory method (Strauss and Corbin, 1998, Bryant and Charmaz, 2007). The chosen methodologies are believed to be the most appropriate for accessing and developing knowledge that is useful for asset management practitioners. While the case study and grounded theory methodologies share ontological and epistemological roots and commonalities, each has a specific emphasis and scope with a particular set of procedures (Ebrahimi, 2020, Pandit, 1996, Yin, 2016) that are most appropriate for this study.

This exploratory and inductive research aligns with Fleetwood (2005) views that:

“the way we think the world is (ontology) influences what we think can be known about it (epistemology); how we think it can be investigated (methodology and research techniques); the kinds of theories we think can be constructed about it; and the political and policy stances we are prepared to take.”(p. 1)

The research approach considers the actual phenomenon under investigation (e.g. enabling or constraining environment) and thus is consequential upon the ontological and

³³ Yin, R. K. 2014. *Case study research: Design and methods (applied social research methods)*, Sage publications Thousand Oaks, CA. asserts there are five features that distinguish qualitative research from other forms of social science research:

- Studying the meaning of people’s lives, in their real-world roles.
- Representing the views and perspectives of participants in the study.
- Explicitly attending to and accounting for real-world contextual conditions.
- Contributing insights from existing or new concepts that may help to explain social behaviour and thinking
- Acknowledging the potential relevance of multiple sources of evidence rather than relying on a single source alone.

epistemological assumptions that affect the researcher's perception, chosen research strategy and methodological choices as in this case (Holden and Lynch, 2004).

It is acknowledged that the overall research did not follow a systematically linear process but emerged from a dynamic and iterative process over three years. This approach aligns with the principles of theory building using both Case Study Research strategy and the Straussian Ground Theory method that posits that experiences of many case researchers often tend to increase their understanding by constantly going back and forth from one type of research activity to another; and between empirical observations and theory which Dubois and Gadde (2002) termed '*systematic combining*', an abductive approach to case research³⁴, where "*the theoretical framework, empirical fieldwork, and case analysis evolve simultaneously, and particularly useful for development of new theories*" (p. 555). Dubois and Gadde (2014) asserts in some situations "*the case selects the researcher*" (p. 1280) when "*a significant empirical observation draws the attention of a researcher to a particular reality, offering opportunities for identification of an exciting research phenomenon*" (Dubois and Gadde, 2017, p.265).

Elkjaer and Simpson (2011) noted that research values drive the reflexive process of inquiry as it strives to reconcile both objectivism and subjectivism, facts and values. The following sections describe this effort as well as the threads of philosophical and methodological assumptions implicit in the research aim, objectives and research

³⁴ Dubois and Gadde (2002) note that the abduction processes affect, and are affected, by four factors:

- what is going on in reality,
- available theories,
- the case that gradually evolves, and
- the analytical framework.

questions to provide a novel perspective of the asset management philosophy within a practical setting of asset management organisations in the public sector.

This chapter is divided into four main sections following this overview section of the methodology selected. First, it outlines the research philosophy of this study, followed by a discussion of the methodical choice and strategy selected and then a discussion of the research process. It then concludes with a discussion of the theory grounding process with the data collected. The structure and topics of discussion are presented in *Figure 3-1*.

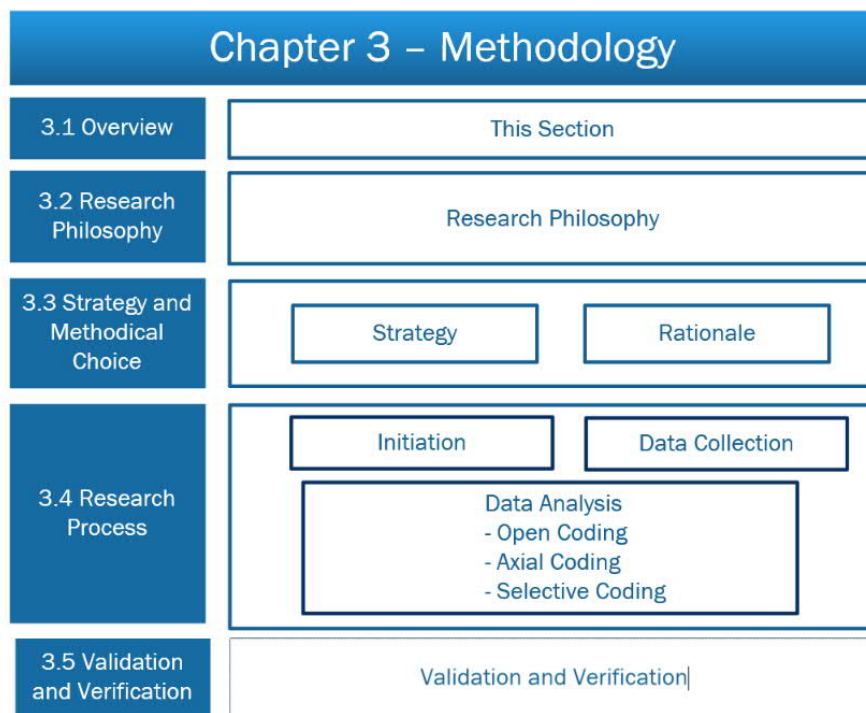


Figure 3-1 - Chapter 3 Methodology Structure

3.2 RESEARCH PHILOSOPHY

Research philosophy, as defined by Saunders et al. (2016), is the system of beliefs and assumptions that reflect the researcher's philosophical commitment to the development

of knowledge. This research aims to get closer to the truth by gathering available evidence to derive a conclusion that provides the best views of a particular event. It is acknowledged in this research that *'truth'* is a very elusive concept that can be portrayed subjectively (one's own view), relatively (one's own view compared to others), objectively (taking a distant perspective) or absolutely (as in philosophical arguments). Hence, this research focuses on reducing uncertainty instead of getting caught up with the notion of *'truth'* through the most appropriate and transparent methods with the resources available (i.e., time and money).³⁵.

It is important to note a belief system embraces a worldview about the desired research aim and objectives and how they could be accomplished. A worldview establishes the ontological³⁶, epistemological³⁷, and axiological³⁸ assumptions that will shape how the research aim and objectives are framed in this study, how the research questions are structured, what methods are used for the data collection and analysis, and the final development of the conceptual framework/model. It is also important to note that

³⁵ Deep understanding of the actors, interactions, sentiments, and behaviours occurring for a specific process through time should be seen as the principal objective by the case study researcher. Deep understanding in CSR includes: (1) knowledge of "sensemaking" processes created by individuals (see Weick, 1995) and (2) systems thinking, policy mapping, and systems dynamics modelling (e.g., Hall, 1991) — what might be labelled appropriately as meta-sensemaking. Sensemaking is how the individual (i.e., person, group, and/or organization) make sense of stimuli. Sensemaking foci include: (1) focusing on what they perceive; (2) framing what they perceive; (3) interpreting what they have done, including how they solve problems and the results of their enactments (including the nuances and contingencies in automatic and controlled thinking processes).

³⁶ Assumptions of an ontological nature as concern with the very essence of the phenomenon under study where the researcher seeks to understand the nature of reality. The reality could be external to an individual (e.g. environment) imposing on individual consciousness or the product of individual consciousness from within or whether the reality is of an objective nature, given 'out there' in the world.

³⁷ For epistemological assumptions concern about the grounds of knowledge, the researcher needs to establish whether "it is possible to identify and communicate the knowledge as being hard, real (objective) and capable of being transmitted in tangible form" or whether "knowledge is of a softer, (more subjective)...based on experience and insight of a unique and essentially personal nature.

³⁸ For axiological assumptions concern with the values and ethics within the research process, Heron (1996) argues that for example, the preference of a researcher adopting a qualitative approach for collecting data as opposed to an anonymous survey questionnaire suggest a reflection of own personal values that believes personal and close interaction with the respondents will produce the desired outcomes .

philosophical disagreements are an intrinsic part of business and management research as a result of various philosophies, paradigms³⁹ and methodologies of the asset management discipline that are drawn from the social sciences, natural sciences, applied sciences, humanities and organisation practice (Saunders et al., 2016). Burrell and Morgan (2017) posit that all theories of organisations, which the focus of this thesis is based upon, assumptions inherent in both the philosophy of science and the theory of society can be distinguished using four paradigms of organisational analysis based on the political or ideological orientation of the researcher and participants as shown in [Figure 3-2](#)

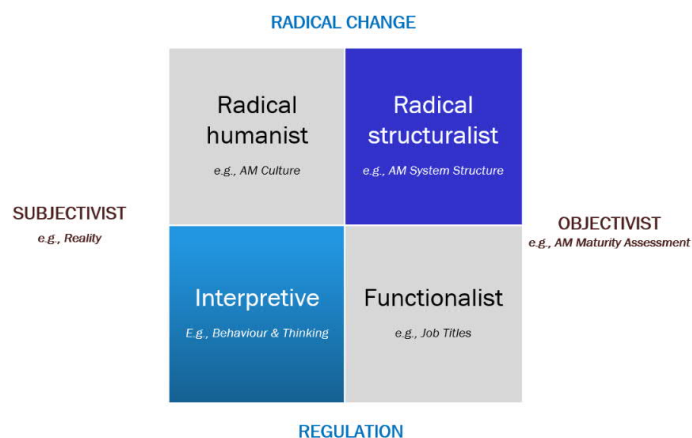


Figure 3-2 -Four paradigms for organisational analysis (Source: Burrell and Morgan, 2016)

Referring to the diagram, the asset management system requirements described in the ISO standards are based on the '*radical structuralist*' paradigm, where the underlying focus is on the system's hierarchical structures and processes related to the interaction between the system elements. The standards take a deterministic stance of the systems

³⁹ A paradigm can be considered as a set of basic beliefs (or metaphysics) that deals with first principles that represent a 'worldview' that defines, for its holder, the nature of the "world", the individual's place in it, and the range of possible relationships to that world and its parts (Guba, E. G., & Lincoln, Y. S., 1994)

engineering approach, which bears the characteristics of the objectivist assumption that asset management organisations are hard, concrete, empirical phenomena and that their capabilities can be measured (e.g., asset management maturity assessments). It could also be said management (as well as management systems in general) is an objective entity where managers have job descriptions that prescribe to their specific duties with operating procedures to which they are supposed to adhere as part of a formal structure, which locates them in a hierarchy with direct reports and they themselves reporting to someone higher up. Schön (2017) observed that a “*technical rationality*” has embedded itself in public service organisations, which he refers to as the “*positivist epistemology of practice*” often associated with the applied sciences (e.g., engineering, systems development, construction) that are linked to the empirical and functionalist methodological approaches.

Hence, for an objective ontological stance of a researcher, the aim would be to discover the laws/rules that govern the proper management behaviour to predict how managers and staff will act in the future. However, as indicated earlier, the social aspects or the views of the actors directly involved in the system from a subjectivist perspective will offer a rich and complex view of organisational realities that account for the differences in individual contexts the research attempts to understand. Hence, this research has chosen the middle ground (Gubrium and Holstein, 1998, Tashakkori and Teddlie, 2010) to study asset management “*eclectically*” by assuming multiple perspectives and by pursuing “*multiple mental modes*” (Greene, 2008). It was also assumed that the middle ground offers worldviews that have more adaptability in this research than either the extreme sides of objectivity (positivism) or subjectivity (relativism/constructivism).

This research initially approached the asset management function with a positivist stance by acknowledging asset management and an asset management system as an established discipline well understood by the participants (in their own perspectives and in their respective roles) in terms of defined variables or system elements such as '*leadership*', '*planning*', and '*resources*' that constitute the asset management systems in their organisations, the research later (after the initial interviews) adopted an interpretive and pragmatic stance to unpack what counts as '*reality*' of everyday asset management practice into ideologies and power relations that underpin it. Alongside subjectivism, this research ontologically embraces the '*social constructionism*'.⁴⁰ 'of the 1980s and the early 1990s (Lynch, 1998, Charmaz, 2000) where it is assumed reality is constructed partially with shared meanings and realities through the social interaction with social actors. Hence this research has adopted a more pluralistic approach (Gibson and Brown, 2009, Charmaz, 2017) as it assumes the likelihood of multiple meanings rather than just a single meaning that exists in the socially constructed interpretations of different participants. Interpretivism.⁴¹ argues that humans are different from the physical phenomenon and cannot be led by definite, universal rules that apply to everybody as suggested by the positivist theorists.

⁴⁰ Bryant & Charmaz, (2014) asserts that , key concepts are considered to originate from the interaction between a researcher and research participants rather than solely from the data as ontologically, social constructivism assumes the existence of multiple realities. Epistemologically, social constructivism emphasizes the role of the researcher by acknowledging the interactive and interpretive nature of data construction.

⁴¹ Different strands of interpretivism place slightly different emphasis on how and what to retrieve that is meaningful to the research such as:

- Phenomenology – focused on existence, the participants' lived experience, their recollections and interpretations of those experiences
- Hermeneutics – focused on the study of cultural artefacts such as texts, symbols, stories, images
- Symbolic interaction – focus on the meanings that emerge out of interactions between people through observations and analyses of social interaction.

When appropriate, the study intends to challenge (deconstruct) the established ways of thinking and knowing within the published ISO standards in the attempt to uncover absences and silences created in the shadow of established truths (Derrida, 2016) as it develops a conceptual framework to optimise value through effective and efficient asset management practices. Jabareen (2009) defines conceptual framework as *“a network, or a plane of interlinked concepts that together provide a comprehensive understanding of a phenomenon or phenomena”*, and they possess ontological (e.g. the way things are), epistemological (e.g. how things really work), and methodological (e.g. underlying processes) assumptions (Guba and Lincoln, 1994). Building a conceptual framework is a process of theorisation rather than a description of data, as theory uses concepts (Strauss and Corbin, 1998). Ngulube et al. (2015) assert that the building blocks of theory are models, concepts, constructs and propositions⁴². Silverman (2004) claims concepts are derived from models and a theory is *“a set of concepts used to define a phenomenon”*, as he depicts the notion diagrammatically in [Figure 3-3](#).

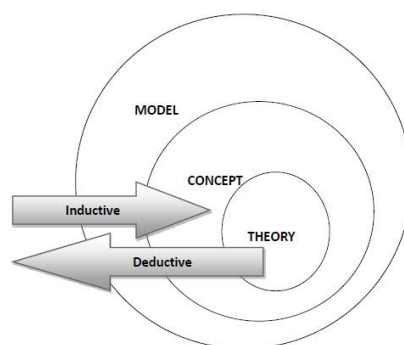


Figure 3-3 Model-theory continuum (source: Silverman 2004, page 79)

⁴² Creswell (2009) seems to suggest that the difference between the two terms is dependent on one’s academic field. For instance, psychologists tend to use the term construct instead of variable (p. 50).

The figure shows two arrows pointing in opposite directions: the *inductive* approach from an *interpretivist* perspective (i.e., starts from observations to theory) and the *deductive* approach from a *positivist* perspective (i.e., starts with a theory to hypothesis). There are many definitions of theory after more than sixty years when (Lewin, 1945) noted: "*Nothing is so practical as a good theory,*" Whilst there have been numerous debates on the definition of a theory, academics generally agree it is made up of four components (Wacker, 1998): (i) definitions of terms or variables, (ii) a domain where the theory applies, (iii) a set of relationship of variables and (iv) specific predictions or factual claims (Hunt, 1991, Meltzer et al., 2020, Reynolds, 2015).

For example, Reynolds (2015) suggests theories take three general forms:

- A set of laws: Statements that describe situations and relationships about which scientists are so confident—repeatedly confirmable by empirical data⁴³—that they consider these theories absolute "truths."
- **A set of definitions, axioms or propositions:** A highly interrelated and straightforward set of definitions and statements, any one of which can be ultimately derived from the others.
- **A set of descriptions of causal processes:** A description of situations in which one or more causal processes are expected to occur or identify the effect of one or more independent or dependent variables

Theory is important for many disciplines as it provides a framework for analysis, enables an integrated body of knowledge for analytical and empirical testing and the applicability

⁴³ One way to categorize theories using the set-of-laws concept is to consider abstract theoretical statements as having different degrees of empirical support. Those with no support are considered hypotheses, those with some support are considered empirical generalizations, and those with overwhelming support are considered laws (McDonald, D and Schneberger, S., 2006).

in the pragmatic world; as (Van de Ven, 1989) notes: “*Good theory⁴⁴ is practical precisely because it advances knowledge in a scientific discipline, guides research toward crucial questions, and enlightens the profession of management*”. In simple terms, Bacharach (1989) describes the goal of a theory⁴⁵ as to “answer the questions of *how, when (or where), and why... unlike the goal of description, which is to answer the question of what (or who)*”. In other words, the ‘*definitions of variables*’ answer the *who* and *what*; the ‘*domain*’ describes the *when* and *where*; the ‘*relationship of variables (elements)*’ explains the *how* and *why* and the predictive claims specify if the event *should* or *would* occur.

This research also aligns with ‘*pragmatism*’⁴⁶ and ‘*symbolic interactionism*’⁴⁷ as the epistemological and ontological foundations of the Grounded Theory concept (Chamberlain-Salaun et al., 2013). Pragmatism is a humanistic movement in philosophy that emphasizes the role of humans in creating objective and meaningful reality (Elkjaer and Simpson, 2011). Symbolic interactionism is an empirical social science perspective on the study of human group life and human conduct where meaning and the concepts of

⁴⁴ Quine, W. V., & Ullian, J. S. (1980) describes a common set of virtues for a good theory: (i) uniqueness, (ii) parsimony, (iii) conservatism, (iv) generalisability, (v) fecundity, (vi) internal consistency, (vii) empirical riskiness, and (viii) abstraction. Quine, W. V. & Ullian, J. S. 1980. Hypothesis. *Introductory readings in the philosophy of science*, 404-414.

⁴⁵ There are three basic strategies for constructing or developing theories (McDonald & Schneberger, 2006): (i) derive theory from empirical research, (ii) develop a theory and test by empirical research and (iii) a composite of the first two which is the basis of this research. A composite approach would divide scientific activity into three stages:

- Exploratory: Investigate potential phenomenon to study
- Descriptive: Develop empirical generalisations or intersubjective descriptions from the exploratory research
- Explanatory: Develops explicit theory to explain generalisations form in step two as a continuous cycle of construction, testing and reformulation.

⁴⁶ Peirce, James, Dewey and Mead (1860s-1940s) are widely regarded as the originators of classical Pragmatism who sought practical ways of accounting for human conduct and meaning-making in all of its dynamic and social complexity. They sought practical solutions by linking knowledge and action that departed dramatically from the prevailing rationalism of their philosophical time, which they saw as too abstract and too academic to be of practical value Elkjaer, B., & Simpson, B. (2011).

⁴⁷ Symbolic interaction allowed the researcher to interpret actions and enable rich descriptions for developing theory which incorporates concepts of self, language, social setting and social context derived from participants’ behaviours, words and actions.

self, action, and interaction are vital interweaving themes that feature in various interpretations of the term (Shalin, 1991) and in the assumptions of Corbin's and Strauss' Grounded Theory method (Birks and Mills, 2015, Strauss and Corbin, 1998).

Closely related to these themes is the '*insider/outsider personality*' debate raised in line with the positivist thinking that the '*outsider*' perspective is considered optimal for its "*objective and accurate*" account of the field, while insiders, who possessed deeper insights (e.g., knowledge or skills) tends to hold a biased position and be "*subjective.*" However, many scholars, post-structuralist and post-modernists (e.g. Banks, 1998, Merton, 1972, Naples, 1996, Ellis, 2004, Gergen and Gergen, 2000, Gergen, 2015) have argued this *insider-outsider* distinction is a false dichotomy since outsiders and insiders have to contend to similar issues of *self* and the '*situated knowledge*' possessed as a result of location in the social order (e.g. education, hierarchical position). One could argue that, in reality, the researcher is a co-participant when positioned in relation to participants and vice-versa; the participants position themselves in relation to how the researcher is perceived or behaves (Strauss and Corbin, 1998, Brannick and Coghlan, 2007, Karra and Phillips, 2008).

Research integrity must be maintained through *self-reflexivity* by the researcher through the recognition and acknowledgement (being transparent) of the potential interactive effects between researcher and participants using field notes/journals (e.g. Eisenhardt, 1989, Yin, 2009) or memos (e.g. Bryant and Charmaz, 2007, Strauss and Corbin, 1998) throughout the research process, including the social roles or advocacy positions as they evolve in the field.

Both CSR and GTM advocate the researcher's closeness to the field to produce a complete and in-depth understanding of the data collected (Guba and Lincoln, 1982, Maxwell, 2012). Strauss (2008) advocates the broader understanding of social context provides insights into participants' arenas helps explain the macro-level interactions that may influence individuals and groups of individuals' actions and interactions of the '*social order*', which the researcher had done over a three-year period as part of the research strategy outlined in the next section.

3.3 METHODOLOGICAL CHOICE AND STRATEGY

3.3.1 RATIONALE

It was concluded in the preliminary literature study that asset management is multi-disciplinary, multi-dimensional and cross-functional within an organisation, and an asset management system can be viewed as either a closed or open system that requires an applied research approach. This assumption would require both the researcher and the study subjects to better define the problem in a practical context against existing or new theories to be developed through the research. The approach, as described by Starkey and Madan (2001) and Limoges et al. (1994), noted that it is less concerned with the discipline agenda and more with knowledge relative to the nature of the issues in management research. Also, there may be a likelihood that the management of assets may even differ within organisations that are affected by contextual factors such as supplier characteristics, market dynamics, and legislative and regulatory requirements (El-Akruti et al., 2018). As it is not feasible to construct a controlled environment for asset management research due to the lack of researcher control over the different contexts, this research applied the case study approach as described by Yin (2003, 1984) to

“investigate a contemporary phenomenon within its real-life context.” where boundaries between phenomenon and context are not clearly evident and when multiple sources of evidence are needed.

El-Akruti et al. (2018) also noted that literature has highlighted that *“the case study research approach can be used to develop theory, explain causal links in real life situations that are too complex for survey or experiment-based approaches to record and to describe a social or organisational intervention and the real-life context in which it has occurred; and to explore those situations in which the interventions being evaluated has not clear outcomes”*(p.1334). Through the use of a case study research approach, constructed models and frameworks can then be used to build theory by the development of arrays of hypotheses based on the synthesis of existing or new knowledge representing patterns or processes about circumstances or systems (Platt, 1992, Ragin and Becker, 1992, Walton, 1992, White, 1992). A combination of *‘contextualist’* (Pettigrew, 1983) and *‘retroductive’* (Blaikie, 2007) approaches were embedded in the case study approach as described by El-Akruti et al. (2018) in their contextualist-retroductive case study design for strategic asset management. Hence, critical success factors for value optimisation, effective asset management systems and implementation into the appropriate business models (or conceptual frameworks) were investigated in this research alongside the contextual factors influencing the organisations studied such as supplier characteristics, market dynamics, legislative and regulatory requirements where appropriate.

Dooley (2002) noted the two key challenges for theory building in applied challenges of *researcher-practitioner partnership* and the use of multiple research paradigms to enrich theories (Lynham, 2000) can be addressed through case study research that requires

firstly, contextual application with the participant, secondly, qualitative or quantitative data that can be adapted for multiple research paradigms and interpretation (Torraco, 2002) and lastly, any contradictory data collected through cross-case or multi-paradigm data analysis that could produce a creative and novel theory (Eisenhardt and Graebner, 2007).

The initial literature study also indicated that whilst there are numerous separate literatures on the '*resource-based*', '*value-based*' or '*risk-based*' view of systems thinking, there is none that is directly related to the multi-disciplinary nature of the ISO 55x suite of asset management standards. This has not come as a surprise as the standards were only published in 2014, and there are only three hundred ISO 55001 certified organisations worldwide at the end of 2020. Hence, there the need to create an intellectual structure of the asset management domain by analysing what particular body of knowledge researchers orient themselves in their contribution to the research on the management of physical assets before and after the standards were published. A systematic initial literature study, bibliometric study and analysis of references used in published articles, textbooks and conference papers to craft the research questions indicated a wide use of other disciplines, such as finance, behavioural science and economics contributed to the asset management knowledge.

This research with references to the recently established ISO 55x and associated standards on project management, facility management, systems engineering, information management, maintenance management, buildings and construction assets management, etc., have also provided a comprehensive understanding of the application of the asset management discipline in different organisational and industry contexts. The

research framed along the five research objectives (RO1 to RO5) will lead to the development of new and practicable frameworks and methodologies for tackling current asset management system challenges in the built environment sector. More importantly, the research attempts to close several gaps identified in the preliminary literature study that informed the proposed research questions.

A Case Study Research strategy was appropriate for this in-depth inquiry into the asset management philosophy as the boundaries between the phenomenon (e.g. asset management in the public sector) and the context within which it is studied (e.g. public good vs value-for-money, assets vs service) are not always apparent (Yin, 2014). The research design was intended to identify what is happening and why it is so to better understand the effects of the situation. Both literal and theoretical replications⁴⁸ (Yin, 2014) are expected as the research has adopted a multiple case study of broadly four organisational groups (i.e. local government, central government, entities owned by these organisations and organisations funded by these organisations bounded by legislation) within a common phenomenon of managing public assets with a significant asset values of more than fifty percent of public asset value. The intention was to generate insights that lead to rich, empirical descriptions and the development of theory using multiple information sources within the same case. It also enabled a deeper understanding of processes and other concept variables, such as the participants' self-perceptions or emic view of *"what is happening"* and *"why I did what I did"*, as well as the

⁴⁸ A literal replication entails comparing findings in multiple cases according to their similarities, thereby strengthening the analytical generalizability of previously stated propositions, while theoretical replication concerns contradictory results which can be accounted for according to theoretical explanations (Yin, 2009).

etic perspectives of the researcher⁴⁹ or others outside the cultures or institutions being studied (Yin, 2016).

The research was also mindful of how insider positionality can dually benefit and disadvantage the researcher⁵⁰ and made considerable efforts to ensure greater rigour to the study aims and objectives. Anderson et al. (2006) suggest that theory building can be enhanced by uncovering the logic of relationships as it explains how and why an observed relationship occurs that can be supported by multiple cases that provide greater confidence (Yin, 2011) and result in a more elaborate theory (Eisenhardt, 1989).

Complementing the Case Study Research strategy, the Straussian Grounded Theory method (Strauss, 1987) is considered appropriate for research concerned about the gaps between theory and practice (Ebrahimi, 2020, Eisenhardt, 1989) and in instances where there is insufficient theoretical guidance, such as the asset management discipline. The term '*Grounded Theory*', first coined by Glaser and Strauss (1965), is both a way to conduct research and also the product of that research, i.e. a theory of the phenomenon grounded by empirical data collected during the research (Bryant and Charmaz, 2007). This method enables, firstly, conceptual development through the contextual description (as detail as the research objectives and questions demand); secondly, it allows interpretation of how meaning is applied and attributed to the phenomenon within an

⁴⁹ During the research period, the researcher was a student member of several asset management professional organisations (IPWEA, AM Council, WPIAM, FMANZ, TEFMA, obtained certification as a Lead Internal Auditor (ISO standards) to improve on data collection and analytical skills; in addition to the (ISO 55x) Certified Asset Management Assessor (CAMA) obtained in 2015 and as a certified senior practitioner for over twenty years, holding senior management level in the sector.

⁵⁰ Naples (1996), discussing the insider-outsider debate, ultimately claims that “[i]nsiderness or outsidership are not fixed or static positions, rather they are ever shifting and permeable social locations that are differentially experienced and expressed by community members”(p.140) as the researcher negotiate rapport within the spectrum of social identity.

asset management organisation; thirdly, it provides for individual experiences to be explicated and analysed; and lastly, it facilitates the theoretical development of a conceptual framework or model (Bryant and Charmaz, 2007, Strauss and Corbin, 1998).

From its original application in sociology and information systems, there have been increased application of Grounded Theory in various disciplines including construction management (e.g. Rahmani and Leifels, 2018), built environment (e.g. Allen and Davey, 2018), asset management (e.g. Suakanto et al., 2021), facilities management (Michell, 2010), engineering (e.g. Johnson et al., 2018), quality management (e.g. Leonard and McAdam, 2002, Tetteh et al., 2021), public management (e.g. Hafer, 2022) and strategic management (Sousa and Hendriks, 2006). The grounded theory method, according to Star (1989) is '*a way of thinking*' that involves the cognitive effort of (i) seeing, hearing, and making sense of the research problem; (ii) deciding where to conduct the research; (iii) identifying the sources of data i.e. participants and environment; (iv) selecting the method to analyse the data and (v) constantly thinking about what the data is revealing (Morse et al., 2016).

According to Darke et al. (1998), both methods chosen for this research are similar in terms of not being limited by the preliminary literature review; the interviews conducted are the primary source of data that can be supplemented by secondary data (e.g. archival records), the compatibility of the unit of analysis (Case Study) with theoretical sampling (Grounded Theory) and the generalisation of theories and concepts through abstraction of the data. Grounded Theory provides added rigour for analysing interpretative data through comparative analysis, theoretical sensitivity and theoretical sampling rather than

pattern matching and explanation for qualitative case study research in the social sciences (Darke et al., 1998, Eisenhardt, 1989, Yin, 2014).

3.3.2 STRATEGY

This study adopted the qualitative research methodology using the Case Study strategy and the Grounded Theory methodology associated with the critical realism⁵¹ and interpretivism⁵² philosophies. The aim is to better understand the dynamics within single settings (e.g., asset management system, public management), preserving its wholeness, unity and integrity (Hammersley and Foster, 2000, Stake, 2008). The use of an interpretivist or constructivist stance using semi-structured interviews emphasises transferring a *'thick description'* of contextualised findings for the reader to make informed comparisons (Hamel et al., 1993). To achieve this requires *'the exercise of judgement (not following of procedures or rules) and the making of an interpretation'*(Schwandt, 1994). However, case study findings are often mediated by the values of the researcher and others (participants) influencing the inquiry, thereby emphasizing the interaction between the research and the case under study under a critical paradigm perspective (Guba and Lincoln, 1994). It was also assumed in this study, theory building is enhanced by uncovering the logic of relationships or social mechanisms that explain how and/or why one phenomenon leads to another (Anderson et al., 2006). Focusing on mechanisms enables the researcher to move beyond thinking about

⁵¹ According to Stutchbury (2022), critical realism provides a way of thinking that reality as being like an iceberg where most of reality is invisible to the observer as casual mechanisms exist below the surface from experiences and events. These mechanisms are identified through a process of inference based on the analysis of data collected within the context under investigation. This research investigates how the shape of asset management systems emerges (morphs) from key stakeholders and the intended and unintended consequences of their actions. In studying what people do and why they do will reveal informal (invisible) social structures, understanding these structures will enable the researcher to better understand why people can and cannot do certain things,

⁵² Interpretivism, similar to critical realism, developed as a critique of positivism, emphasises that humans are different from physical phenomena because they create meanings that can be studied by interpretivist researchers (Junjie, 2022) The purpose of an interpretivist research is to create new, richer understanding and interpretations of social worlds and contexts, in particular, relating the socio-technical nature of asset management systems in the New Zealand Public Sector.

individual variables for each case and the specific links between variables to consider the bigger picture of action in its entirety. According to Hernes (1998), mechanisms are about *“the wheelwork or agency by which an effect is produced and do merely address what happened.”*

Qualitative methodology has had its most significant influence in formulating the position of a researcher that recognises the importance of human behaviour's internal and external perspectives as they figuratively put brackets around a temporal and social domain of the social world. These brackets define the territory about which descriptions are fashioned, essentially idiographic maps of the territory that must be read and interpreted by the researcher. Van Maanen (1979) refers to *“a reflexive product of the map maker's invention”*. In this sense, operating in a qualitative mode is *“to trade linguistic symbols in the attempt to reduce the distance between indicated and indicator, between theory and data, between context and action.”* In other words, according to Weingand (1993), *“qualitative methodology allows the researcher to get close to the data when seeking solutions to problems, thereby developing the analytical, conceptual, and categorical components of explanation from the data itself or from the perspective of the subjects of investigation – rather than from the preconceived, rigidly structured, and highly quantified techniques that confine the empirical social world to operational pre-definitions and structure.”* There is a typology of five qualitative approaches to inquiry available to the researcher which Jacob (1987) describes as *“qualitative research traditions”*:

- Ecological Psychology – studying the “psychological habitat” created by an individual’s emotional reactions (subjective and objective aspects) to the environment that defines their “behavioural setting”.
- **Holistic Ethnography** – the study of beliefs and practices of all or part of a culture or community and how various parts contribute to the culture as a unified, consistent whole.
- **Ethnography of Communication** – by studying how context (physical aspects of the environment, culturally defined events, and other participants) influences the patterns and rules of interpersonal interaction (verbal and non-verbal). Contexts are defined by “what people are doing and where and when they are doing it” (Erickson and Schultz, 1997)
- **Cognitive Anthropology** – by studying the principles by which cognitive schema are organised (semantic systems) based on the mentalistic definition of culture conceptualised by participants (Spradley, 1972)
- **Symbolic Interactionism** – by studying processes of symbolic interaction in order to understand individual behaviour made up of various minds and meanings that characterise human societies (Meltzer et al., 2020) in the attempt to develop a theory that accounts for behaviour (Glaser and Strauss, 2017).

These approaches of inquiry, when used in both Case Studies (Yin, 2014, Eisenhardt, 1989) and Grounded Theory (Charmaz, 2000, Bryant and Charmaz, 2007, Glaser, 1992, Strauss and Corbin, 1998) methodologies emphasise the “*discovery of theory from data*” starts at the very beginning of the overall research strategy where the rationale is established, the research aim and objectives are contextualised through the development of required questions; right through to locating and identifying relevant data to be

collected, before being analysed and transitioned between concepts and ultimately develop a substantive theory or conceptual framework⁵³.

Addressing the broad and challenging research aim: *To improve the effectiveness and efficiency of asset management practices of New Zealand public infrastructure assets through the development of a conceptual framework for value optimisation.*, the following research objectives were established:

- To identify critical properties, e.g., patterns of cause-effect relations that link value creation or value capture activities with asset management decision-making in the built environment. (RO1)
- To identify relevant theoretical frameworks that support the conceptual business model for optimising organisation value through the successful development and implementation of an effective asset management system. (RO2)
- To establish the linkages of both tangible and intangible benefits embedded within asset lifecycle management decisions. (RO3)
- To evaluate the key attributes of a business model that enables all stakeholders in the sector to improve their capability and capacity for value optimisation when managing public assets. (RO4)
- To validate recommendations for future research and development of an asset management knowledgebase for managing New Zealand public physical assets. (RO5)

The four core open-ended questions corresponding to the research objectives used in the semi-structured interviews are

⁵³ It is also acknowledged that as the researcher's understanding develops, abductive reasoning is then used to generate emerging concepts that in some cases may lead to the correction or modification of research questions throughout the research process to focus more precisely on achieving the desired outcomes (Morse et al., 2016).

- What are the key considerations for defining value from the perspectives of internal and external stakeholders of (i) the asset, (ii) the asset management system and (iii) the organisation? (RQ1)
- What are the key considerations for prioritising asset management strategies/asset decisions? (RQ2)
- What are the critical cultural/social factors for the successful development and implementation of an asset management system? (RQ3)
- What are the enabling structures and processes for an effective and efficient asset management system? (RQ4)

These questions support the Case Study Research strategy and the Grounded Theory methodology that enables the description and identification of the significant social processes and generates concepts to be used to document and explain the phenomenon or “*what is happening in a given setting*” (Richards and Morse, 2012, Morse et al., 2016, Corbin, 1990, Weingand, 1993).

The approach followed what Dubois and Gadde (2017) term as “*systematic combining*”, where non-linear, holistic, path-dependent development methods are used by the researcher aimed at theory generation “*by constantly going ‘back and forth’* from one type of research activity to another (e.g., data collection and analysis) and between empirical observations and theory”. *Figure 3-4* illustrates two simplified basic processes of matching empirics and theory, moving between activities related to the analytical framework and the data sources and analysis within the case, with the aim of discovering new phenomena.

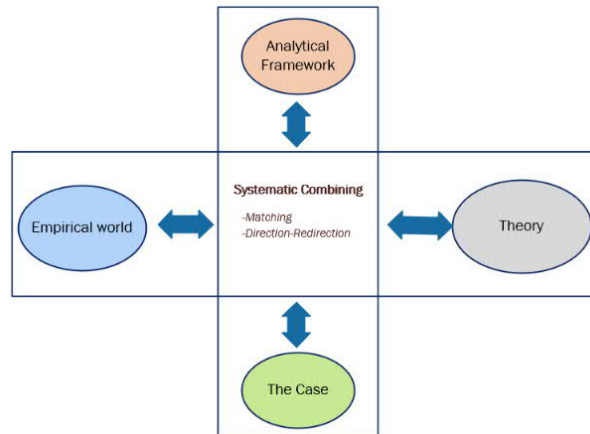


Figure 3-4 Basic building blocks of Systemic Combining (source Dubois & Gadde, 2017)

With this approach, the boundary settings of the study are often preliminary as new findings may require expansion of the study in both time and space. However, the principles applied for boundary expansion remain consistent throughout the data-gathering process under what is known as a “*tight and evolving framework*” within the tool (case study)⁵⁴. Within this framework, the research will adopt the general procedure (not sequentially) for theory building and the empirical support for theory (Wacker, 1998):

- **Defining the variables:** Define who and what is included and specify exclusions in the definition
- **Limiting the domain:** Observe and Limit the conditions by when (antecedent event/time) and where (situation/spatial) are expected to occur.
- **Relationship (model) building:** Logically assembles the reasoning for each relationship for internal consistency
- **Theory predictions and empirical support:** Set conditions for specific predictions.

⁵⁴ In relation to the analytical framework, mainstream approaches to case research make a distinction between “tight and pre-structured” frameworks applied in deductive studies and “loose and emergent” frameworks typically used in inductive studies (Miles & Huberman, 2002).

Aligned with the evolution of the asset management discipline and foundation of the standards described in [Chapter Two](#), this study took a pluralist approach that recognises the diversity of research philosophies and paradigms and contributes to something unique and valuable to the research. However, it was also mindful of the specialisation and fragmentation traps⁵⁵ of the intellectual structure of this research, as suggested by (Knudsen, 2005) and took a balanced stance to avoid them.

3.4 RESEARCH PROCESS

Meso- and meta-data were captured and synthesised via an organised process illustrated in [Figure 3-5](#). Aligning with the systematic combination of abductive reasoning of the Case Study Research strategy and the Grounded Theory method, the staged research processes of initiation, data collection and analysis, theory building, and conceptual framework development are discussed as follows.

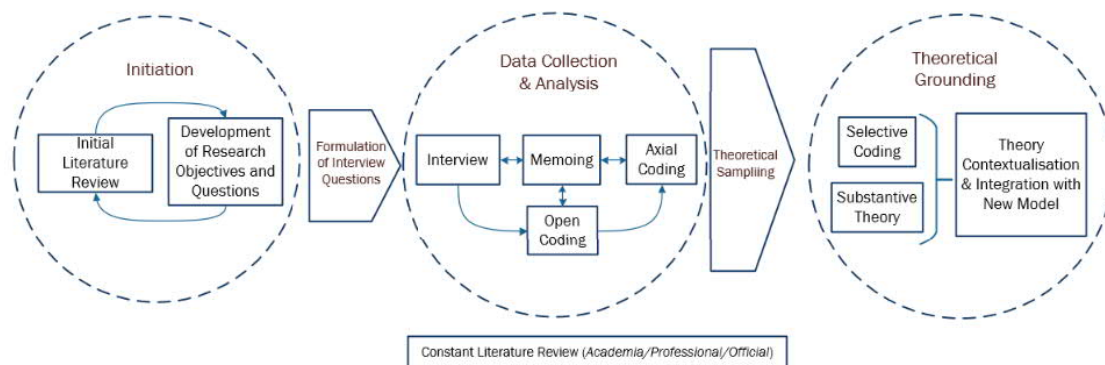


Figure 3-5 Research Process

⁵⁵ Knudson (2005) argued that both the unification strategy and the pluralist strategy may lead to intellectual structures that have suboptimal traits by either having too little or too much pluralism. Fields with too little pluralism run the risk of being caught in a specialization trap, while fields with too much pluralism run the risk of being caught in a fragmentation trap. Both of these traps emerge as a result of self-reinforcing processes where either the activity of extending an existing research program (normal science) or the activity of searching for new research programs (extraordinary science) get reinforced and sooner or later become dominant in the field (p. 217).

3.4.1 INITIATION

The first dotted circle represents the iterative process of initiation that included preliminary literature reviews of the relevant ISO asset management standards and related theories as part of the “*sensitising concept*” activity. The initial review was considered an orienting process (Urquhart, 1999) where the researcher familiarises with the current thinking in the field but did not take a position about the research. As suggested by Urquhart and Fernandez (2006), the initial literature review was conducted on the understanding that once the theory was generated from the data, the literature review was revisited.

Concurrent with the initial literature review, the researcher was fully immersed in the asset management phenomenon of the New Zealand and Australian public sectors in search of an appropriate research topic participating in symposiums, forums and webinars during the Covid lockdowns. Field notes collected during the events were used to triangulate assumptions of the research topic's relevance in the attempt to close existing gaps (if any) in the extant literature on the asset management discipline and the development of a conceptual framework that would provide benefit to asset management practitioners⁵⁶. Bryant and Charmaz (2007) suggest that in the interest of pragmatic research, it is not the routine events that should be the focus of any research but problematic ones. Strauss and Corbin (2015) noted that the selection of events that

⁵⁶ The researcher immersed himself over a 12-month period in the profession such as developing and teaching four asset management related subject modules of a Diploma and Graduate Diploma in Facilities Management, attending over 50 webinars (local and international) and 6 conferences; reviewing selected publications for the Asset Management journal; contributing author of a book chapter on asset management; reviewing and contributing author of the GFMAM publications; peer reviewer (on behalf of AM Council) of the current ISO 55000/1 standards; involved in judging panel of two Australian asset management awards; and presented at the Asset Management Council (NZ Chapter) Symposium in Auckland in March 2021 to better understand current issues of the public sector and topics of interests for the research to solicit potential research candidates and referrals.

imply a disorder in action breaks through the continuity of routine actions can become the initiating events for the generation of something new where any novel debate and possible conflict is the outcome (Strauss and Corbin, 1998). This notion correspond with what was observed and carefully noted in the interviews when most participants often highlighted current issues, problems or challenges before articulating what they have done or could have done to address them.

Following the selection of the event, Strauss (2008) suggests a researcher's thought processes throughout the research should always follow the '*coding paradigm*' that attempts to determine '*why*' this event occurred, under '*what*' conditions, '*how*' the conditions manifested themselves, and with '*what*' circumstances. Hence, the preliminary literature review, as described in [Chapter 2](#), was only used to develop a generalised sense of reference or '*sensitising concept*' to ensure the appropriate area of study, the right choice of methodology and the rationale for the research are present (McGhee et al., 2007).

The above preparation led to the formation of the research aim of value optimisation, an area of concern for many organisations (and practitioners) faced with funding constraints and aging assets. These concerns consist of multiple concepts embedded in complex relationships within organisations and their environment. The use of a paradigm helped the researcher identify contextual factors and to link them using a set of research questions to collect relevant data. The paradigm is a perspective and follows the logic expressed by persons in their everyday perception of things, consisting of the basic

components⁵⁷ of conditions, inter/actions and emotions, and consequences (Strauss and Corbin, 2015). The research questions were formulated subsequently based on the '*value concept*' that underpins the ISO 55x asset management standards. These questions aligned to the ISO asset management system framework widely adopted in the sector became the '*a priori*' specifications of constructs, a key requirement for building theory for both the Case Study Research (Eisenhardt, 1989) and the Grounded Theory methodologies (Glaser et al., 1968, Strauss and Corbin, 2015)

Guided by this '*a priori*' construct, (Eisenhardt, 1989, Yin, 2003, Glaser et al., 1968, Strauss and Corbin, 1998, Bryant and Charmaz, 2007), it was appropriate for the selection of cases and participants in the case study research approach to be based on theoretical and not statistical reasons. To obtain different opinions and opinions across the public sector, the research engaged with participants from four groups in the sector: local authorities (councils), central government (crown) entities, organisations owned by councils or the crown, and organisations not owned but publicly funded (partial or fully) through rates, levies or taxes. All the participants' organisations had asset holdings of a few hundred million to over \$80 billion in value, collectively they make up more than fifty percent of NZ infrastructure asset value. These organisations of various sizes and responsible for different asset types/classes are subjected to different levels of constraints informed by different legislation (e.g., Local Government Act) and mandatory performance reporting requirements as discussed in [section 1.2](#) and [section 2.3](#).

⁵⁷ Conditions relate to a conceptual way for the researcher to group answers to the questions about why, where, how and what happened where the participants articulate the circumstances that lead to a particular decision. The inter/actions and emotions of participants reveal the physiological responses by individuals to issues, events, situations that are often not found in quantitative research. Consequences are outcomes of emotional responses that are revealed unintentionally and often from impromptu responses.

It was neither possible nor advisable to establish a precise sample size at the start of the data collection process as the research was inductive in nature, which implies that the theory will evolve as data is collected and analysed (Eisenhardt, 2002, Richards and Morse, 2012). In other words, the Grounded Theory method emphasizes that the primary purpose of research is to generate theory and that the process of contemporaneously collecting, coding, and analysing data '*is controlled by the emerging theory*' not a predetermined number of cases or events (Glaser et al., 1968). Hence, it was appropriate that '*critical realism*'.⁵⁸ was considered in the research as it seeks to explain what was observed and experienced in terms of the underlying structures of reality that shape the observable events (i.e. value optimisation) articulated by the participants (Mir and Watson, 2001). For the findings to be valuable, participants cannot be randomly selected as they must be able to contribute to an evolving theory with experientially relevant credentials (Rudestam and Newton, 2014). To gauge the level of interest and recruit suitable participants, the researcher spoke for 30 minutes at the Asset Management Council One Day Symposium in March 2021 on the topic: *Insights on my PhD research on asset management at Massey University*. Useful feedback was gathered on the potential titles, topics or interests from some of the 100 attendees in person and online. A minimal criterion was established during the presentation that require participants to be:

- From a public sector organisation with a substantial asset/property portfolio
- Over ten years of senior asset management experience
- Have established and managed asset management systems for at least 5 years

⁵⁸ Critical realism is a way of thinking where critical realists using analytical tools to support data collection and analysis, tend to focus on the contingent relationships between phenomena and structures (Mir and Watson 2001)

Retaining interviewee confidentiality, the participants in the final selection listed in the [Table 3-1](#), have between fifteen and over thirty years of working experience in the asset management industry from both the public and private sectors in different countries. The participants held roles at different levels in their organisations, including Tier 1 (Board Director/CEO), Tier 2 (GM/Department Head) or Tier 3 (Unit/Team Leader) with varied backgrounds in finance, property/asset/facility management, engineering, science and technology. All the participants had established asset management systems in their organisations (past & present), with the majority currently managing these systems in their respective roles and/or being involved in governance roles on various committees, boards, and industry groups. The list provides a summary of the participants' according to interview schedules spread out over several months affected by the COVID restrictions across the country and the occupation of the Parliament grounds by protestors that caused some interviews to be rescheduled and others cancelled completely.

Table 3-1 Summary of research participants by interview dates

Ref	Interview Date	In-person / Online	Authority	Sector	AM Experience
LG1	18/1/22	Online	Tier 2	Local Government	Over 30 years
LG2	19/1/22	Online	Tier 3	Local Government	Over 20 years
OTH1	19/1/22	In-person	Tier 3	Local Government	Over 20 years
LG3	20/1/22	Online	Tier 2	Local Government	Over 30 years
CG1	25/1/22	In-person	Tier 3	Central Government	Over 20 years
CG1	25/1/22	In-person	Tier 3	Central Government	Over 20 years
CG2	25/1/22	In-person	Tier 3	Central Government	Over 30 years
OTH2	31/1/22	Online	Tier 3	Utilities	Over 15 years
OTH3	2/2/22	Online	Tier 2	Central Government	Over 20 years
CG4	9/2/22	In-person	Tier 3	Central Government	Over 20 years
OTH4	9/2/22	In-person	Tier 2	Central Government	Over 20 years

Ref	Interview Date	In-person / Online	Authority	Sector	AM Experience
LG4	10/2/22	In-person	Tier 3	Local Government	Over 20 years
LG5	11/2/22	In-person	Tier 3	Local Government	Over 30 years
CG8	28/2/22	Online	Tier 3	Local Government	Over 20 years
GCE3	2/3/22	Online	Tier 3	Local Government	Over 20 years
CG4	3/3/22	Online	Tier 3	Central Government	Over 30 years
GCE3	7/3/22	Online	Tier 3	Central Government	Over 20 years
OTH5	4/4/22	Online	Tier 3	Central Government	Over 20 years
CG5	14/6/22	In-person	Tier 1	Central Government	Over 30 years
CG6	27/6/22	In-person	Tier 2	Central Government	Over 20 years
LG6	4/8/22	Online	Tier 3	Local Government	Over 15 years
LG7	19/8/22	In-person	Tier 2	Local Government	Over 30 years
CG7	2/9/22	Online	Tier 2	Central Government	Over 30 years
OTH6	14/10/22	Online	Tier 3	Central Government	Over 15 years

3.4.2 DATA COLLECTION

The Research Participant Information Sheet and Consent Form ([Appendix B](#)) were emailed to participants prior to the interviews. Copies were brought to the interviews (in-person) or shared on-screen (online) to help the interviewers stay focused on the goal of the study and the objectives of the research questions. All audio or video recordings of interviews conducted online, or in-person were transcribed to enable line-by-line open coding. The second dotted circle in [Figure 3-5](#) shows the iterative process of data collection and analytic procedures of open coding, axial coding and selective coding, leading to theory matching those overlaps with the third dotted circle theory grounding. Data was analysed as soon as it was collected, which involved moving back and forth between data collection and data analysis to enable constant coding and comparative analysis.

Semi-structured open-ended interview questions were designed to focus on understanding the given social and practical settings for optimising value from effective management of public physical assets in the built environment. The Interview questions ([Appendix C](#)) were provided to the participants prior to the interviews, which were of a duration between 45 to 90 minutes, online or in-person. Most of the conversations were audio or visual recorded and fully transcribed, with the exception of a small number requested by participants not to be released under any circumstances for confidentiality and to maintain complete anonymity.

Although the development of the research questions was influenced by the '*a priori*' construct, many participants were allowed to introduce other viewpoints deemed more significant for the study depending on time availability⁵⁹. Questions and answers constructed by the study participants were included in the coding process that enabled the respondents to better narrate the sequence of past and present events and their current and future endeavours as appropriate.

Publicly available information relevant to the research objectives was readily accessible for the organisations selected. More specific details of the organisation, including confidential documents, for example, Asset Management Plans, and Strategic Plans, were

⁵⁹ The scientific literature on thinking concludes that approximately 95 percent of thought is subconscious (Wegner, 2009; Zaltman, 2003) and that people have only limited access to their own thinking processes, not to mention the thinking processes of others. The process of answering questions always involves a degree of introspection and "auto-driving" (see Heisley & Levy, 1991) by an informant. The person answering questions must retrieve some bits of information stored in long-term memory, organize and edit the bits, and create a verbal or written response in a form that she believes that the researcher is able to understand. Auto-driving indicates that the interview is "driven" by informants who are seeing and hearing their own behavior. Auto-driving addresses the obtrusiveness and reactivity inherent in consumer behavior research by explicitly encouraging consumers to comment on their consumption behavior as "y photographs and recordings represent it" (Heisley & Levy, 1991, p. 257).

provided by the participants in confidence before or after the interviews to support their responses. No further information was deemed necessary that could be acquired under the Official Information Act 1982. Other secondary data included various standards (from ISO and Standards New Zealand), academic and professional publications (technical & non-technical), conference proceedings, webinar recordings, and feature articles of the organisations in the sector, including those from participants in this research were used in the data analysis. The research included, whenever appropriate, historical, geographical, and social context in order to understand 'why' and 'what' is happening, 'how' the realities are being experienced, and 'what' actions are currently taking place⁶⁰.

The memoing⁶¹, positioned in the centre of the process, emphasises the continuous loop to the initiation process of refining interview protocols to incorporate relevant issues into the next set of interviews and inquiries. Field notes and memos during the interviews and after the interviews accompanied the transcripts as the primary data source. A general list of questions was considered in the notes and memos.

- What is the context of the participant at a point in time, e.g., user, employee, owner or steward of the asset and/or asset management system, etc?
- What are they doing or trying to accomplish?

⁶⁰ Bridging practice and theory in the application of international asset management Standards for managing New Zealand public physical assets requires the research to take a pragmatist approach that consider concepts as relevant when they support their practice or actions (Kelemen & Rumens, 2008). In other words, these concepts are not regarded in abstract terms but in terms of the roles they play as instruments of thought and action, or their practical consequences in specific contexts.

⁶¹ Memos were written accordingly whilst reviewing the transcribed data to reflect on the perceived meaning of what the respondent had indicated in the conducted interviews. Clarke (2017) describes memos as "*sites of conversation with ourselves about our data.*" Memoing according to Mason (2019) is the researcher reflexivity on the data corpus as in thinking critically about what you are doing and why, confronting and often challenging your own assumptions, and recognizing the extent to which your thoughts, actions and decisions shape how you research and what you see.

- What specific means or strategies do they use or are they thinking of using?
- What assumptions are they making for the environment, customer, tools, etc.,?
- What do I think is going on here?
- Should the information provided be included or excluded in the model?

The initial interviews of the first three participants led to the addition of ISO definitions of the terms asset, asset management and asset management system in the participant information pack in addition to the interview questions that enabled a consistent shared understanding of what will be discussed. Interestingly, however, some participants persistently chose to ignore these ISO definitions, in particular, the term asset management system, which was supposedly regarded as completely different from asset information management system and are not interchangeable terms. There were no other changes to the interview questions or pre-interview information in the subsequent interviews while noting the fact that there were significant differences in value drivers affecting various asset types, the asset management systems and organisations facing the four different groups of organisations within and across sectors. An example of how memoing relates to the coding of interview findings is illustrated in [Figure 3-6](#).

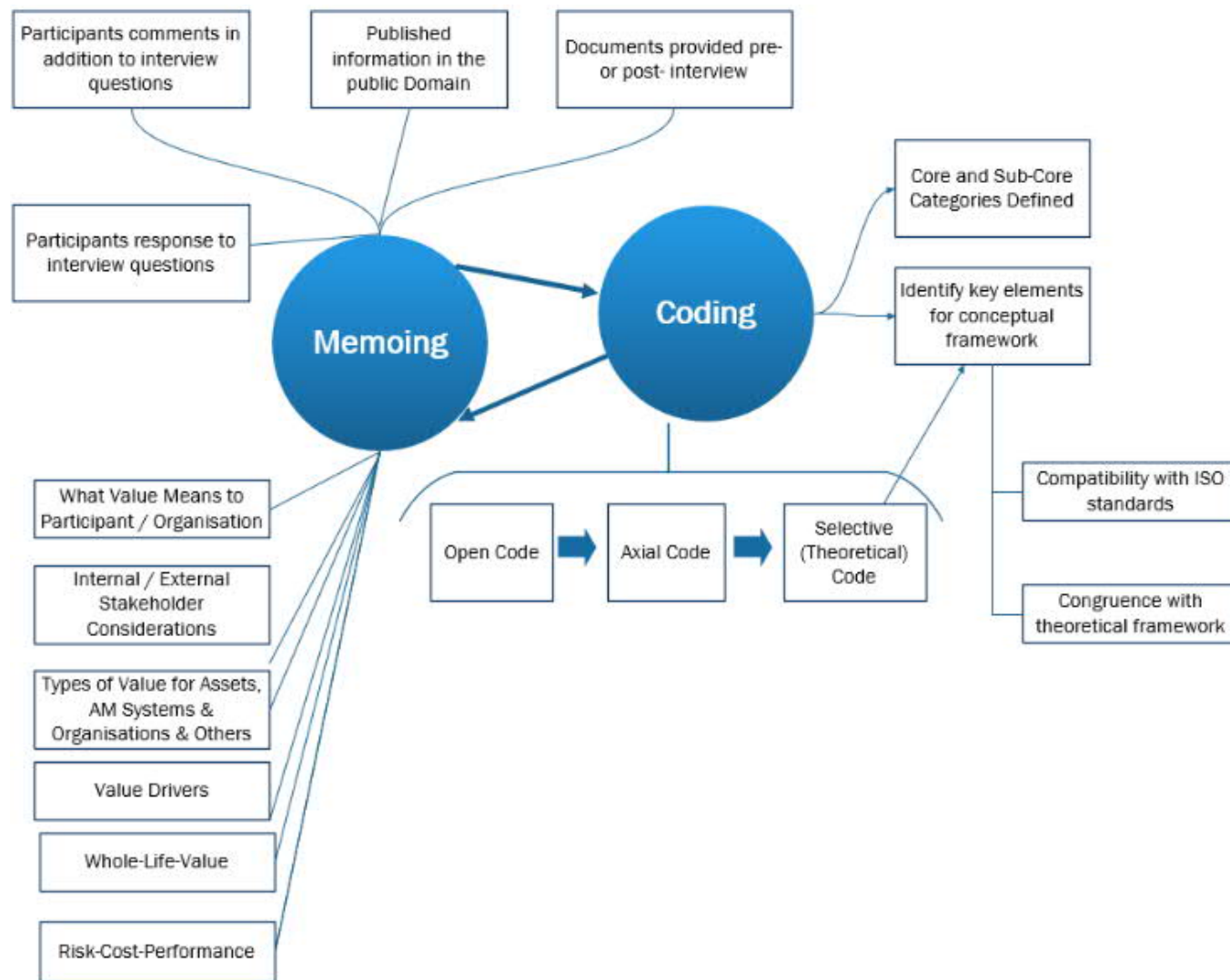


Figure 3-6 – Value Considerations Memoing-Coding Relationship

Unlike quantitative research⁶², grounded theory methodologies suggest there is no need to review all literature before entering the field (conducting the interviews) to prevent the researcher from being constrained by it and losing the opportunity to discover new facts or becoming “*literally paralysed*” (e.g. Morse et al., 2016, Yin, 2014, Strauss and Corbin, 1998). Many qualitative researchers suggest not beginning the research with a predefined theoretical framework or set of concepts (Corbin, 1990), which in this instance was not a particular concern as there was a lack of grounded theory in the asset management discipline. Hence, the initial literature reviews in [Chapter 2](#) is the output before the interview data was collected and analysed.

According to Strauss and Corbin (1998), theoretical saturation is reached when three elements are fulfilled: “*no new or relevant data seem to emerge regarding a category [...] the category development is dense insofar as all of the paradigm elements are accounted for ... [and] the relationships between categories are well established and validated*” (p. 187). Theoretical saturation was reached after 24 participants from 20 organisations were interviewed between January to October 2022 as listed in [Table 3-2](#).

⁶² Kelemen and Rumens (2008) noted that despite the fact “acres of text have been devoted to debating the plausibility of eradicating subjective components (for example, presumptions, fears, worries, prejudices, and so on) from researchers’ minds so they may observe reality in an objective manner...we already know that that certain theoretical perspectives have unveiled the incoherence of objectivity and rejected the notion of a universal truth, effectively pulling the rug out from underneath academic claims to objective quantitative data.”

Table 3-2 - Participating Organisations

Public Sector	Entity	Number
Central Government	Department	3
	Crown Entities	2
	Tertiary Institutions	3
	Schedule 4A Companies	2
	Mixed Ownership Model	1
Local Government	Council	5
	Council Owned Entities	3
Other	Utilities	1
Total		20

3.4.3 DATA ANALYSIS

Analysis is a dynamic process of examining something to find out what it is by breaking apart a substance by its various components and then examining their properties and dimensions. In this study, analysis of the interviews commenced immediately after completion of each interview through the coding processes of the transcripts. Strauss and Corbin (1998) suggested data collection and analysis should occur concurrently rather than in a linear sequence. Similarly, in the Case Study Research (Yin, 2014), the five-phased recurring cycle of data analysis includes compiling, disassembling (open coding), reassembling (axial coding); interpreting⁶³ (selective coding) and concluding.

The data collected was compiled using Endnote (for literature reviews), MSWord (for interview transcripts) and MS Excel (for coding). The iterative coding processes can be broken down into a series of activities illustrated in *Figure 3-7*.

⁶³ Analysis involves interpretation as Denzin and Lincoln (1994) states: "Interpretation is a productive process that sets forth the multiple meanings of an event, object, experience, or text. Interpretation is transformation. It illuminates, throws light on experience. It brings out, and refines, as when butter is clarified, the meanings that can be sited from a text, an object, or slice of experience...So conceived, meaning is not in a text, nor does interpretation precede experience, or its representation. Meaning, interpretation, and representation are deeply intertwined in one another" (p. 322) Denzin, N. K. & Lincoln, Y. S. 1994. The art of interpretation, evaluation, and presentation. *Handbook of qualitative research*, 1.

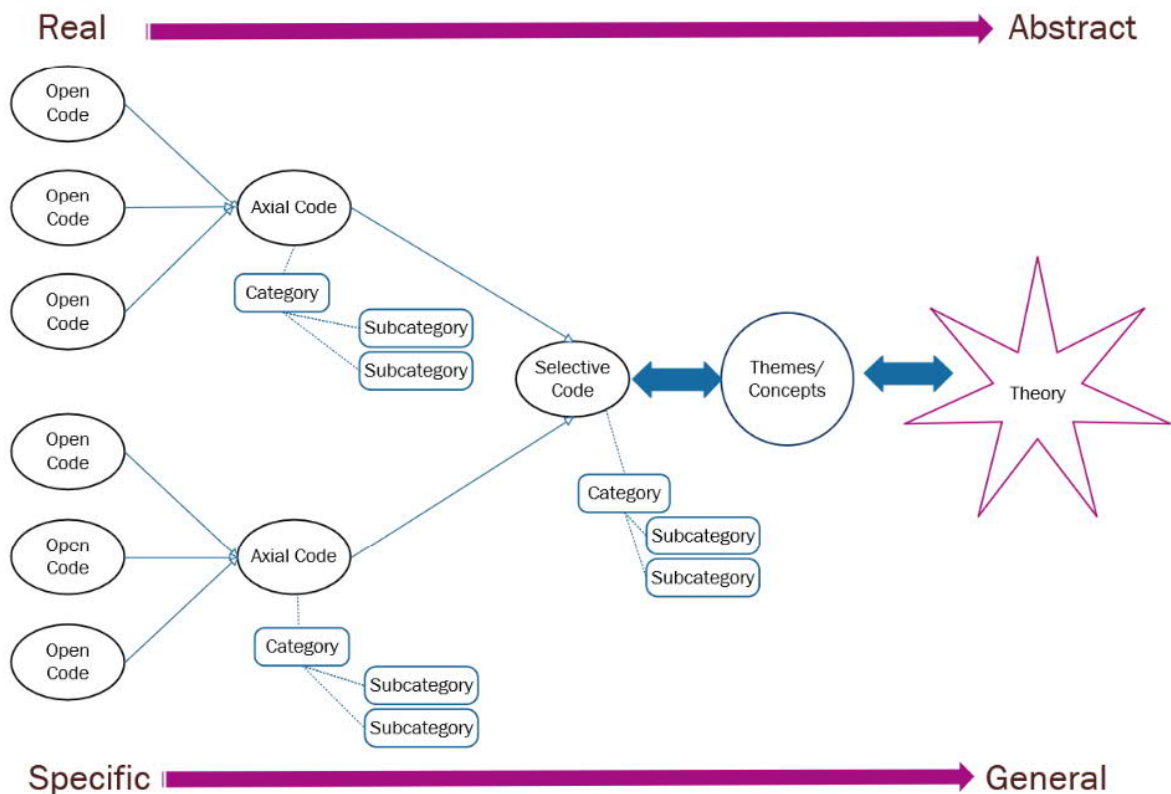


Figure 3-7 Iterative Coding Processes of the Research

3.4.3.1 Open Coding

Open Coding relates to the discovery of thoughts, ideas and meanings contained in the transcribed interview data, which the participants may not be consciously aware of when offering their verbatim responses. The analytical process involves reading and re-reading phrases and sentences line-by-line, further broken down into discrete parts that could be a phrase, word, or word groupings and assigned a name or 'code' according to the researcher's perception of the meaning or taken directly from the participant as in '*in vivo*' codes (Glaser et al., 1968).

During open coding, different categories that pertained to a phenomenon within the case organisation or when the respondent referred to conditions, actions and interactions, or

consequences of past employment and experiences and also potential actions in the future were identified. Rather than keeping the data running together as long, unbroken passages, some text was separated into short paragraph-length units with line breaks in between them whenever the topic or subtopic appears to change because, in real life, “social interaction does not occur in neat, isolated units” (Glesne, 2016). Gee (2014) call these “unit breaks” and their rearrangement into poetic-like verses for discourse analysis “stanzas of text” and emphasize that “formatting choices are a part of the analysis and may reveal or conceal aspects of meaning and intent” (p. 240). An example shown in [Table 3-3](#).

Table 3-3 Coding Example (CG6)

Interview Response	Open Code
<p>When I say maximized value, it's obviously within constraints. It's like any optimization problem. So, and ultimately that's cost-risk-performance trade-off.</p> <p>So, how do you value risk? How do you value performance? And obviously, how you do value costs because that can have different perspectives as well.</p> <p>Now, for public goods organization, if you looked at the cost element, it's not necessarily to the organization that is, it's the economic cost to the public or that particular part of the market that it's serving. So, that electricity industries, a great example there, in terms of the economic tests are, and in terms of the market, participants which includes over the distribution companies, the lines companies, the generators, etc</p>	<p>Maximised value within constraint</p> <p>Optimisation problem is ultimately cost-risk-performance trade-off</p> <p>Value risk</p> <p>Value performance</p> <p>Value costs</p> <p>Different perspectives of Value</p> <p>Public goods organisation cost element not necessarily to the organisation</p> <p>Economic cost to the public or particular market it is serving</p>

As the research progressed, newly identified codes from subsequent interviews were either added to the overall list of codes or assigned the same or different labels as following responses where a large number of the responses shared common properties.

3.4.3.2 Axial Coding

The advanced stage of open coding or axial coding relates to linking categories around a category axis according to their core meanings. Once open codes accumulated, they were categorised and grouped under more “*abstract conceptual categories*” (Strauss and Corbin, 2015). The codes are then assigned categories as they are analysed through the comparative analysis of data with data, data with code, code with code, code with category, and category with category within-case and across-case comparisons. The original list of concepts was significantly reduced as coding and analysis of data became more selective and focused (axial coding). The axial coding structure comprises categories and subcategories developed around one category at a time in terms of the paradigm items (Strauss and Corbin, 1998). An example of the conceptual categories developed in axial coding is illustrated in [Figure 3-8](#) and further discussed in [Chapter 4](#).

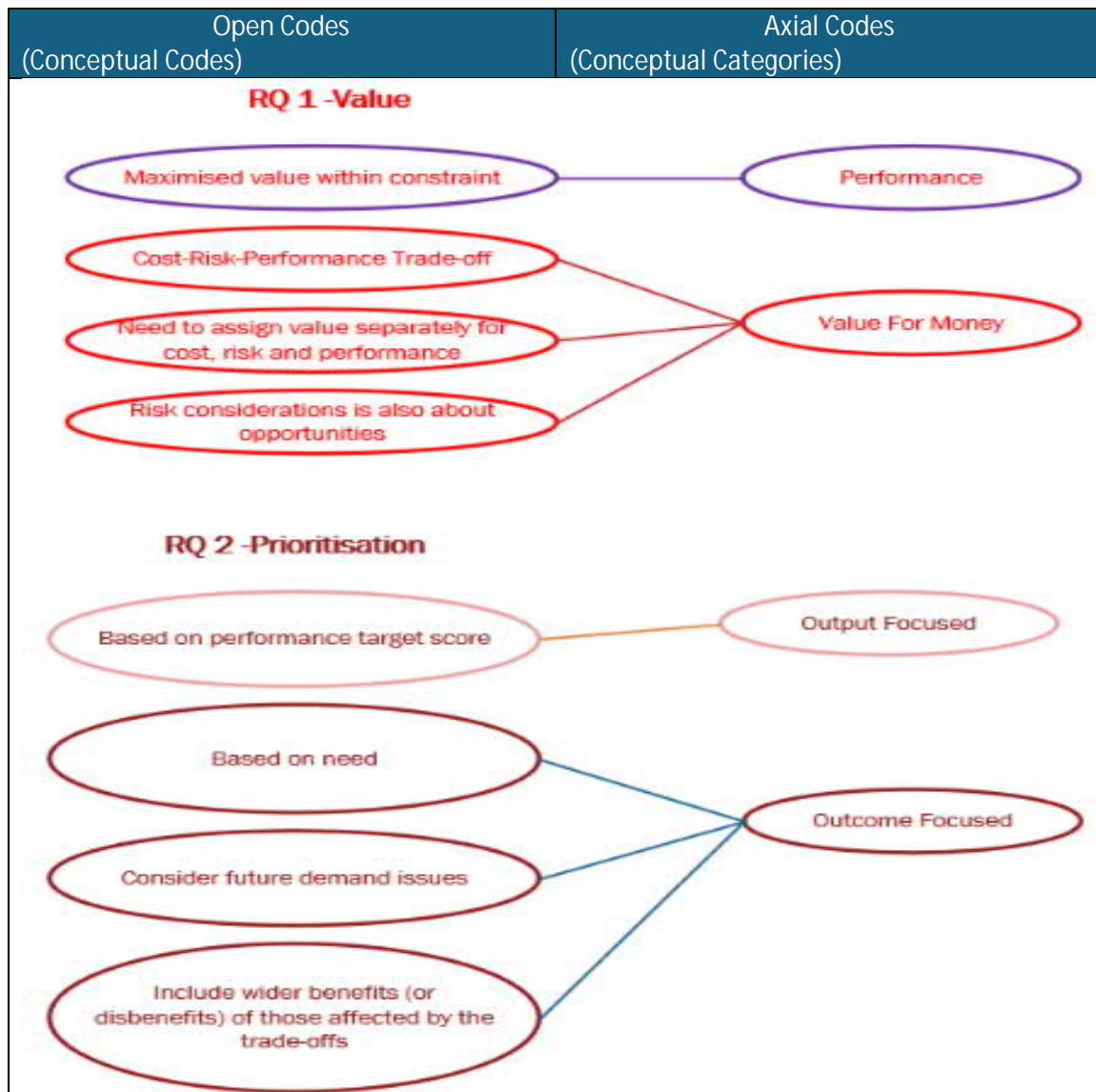


Figure 3-8 - Developing Axial Codes from Open Codes Example

3.4.3.3 Selective Coding

Strauss and Corbin (2015) define selective coding (or theoretical coding) as the process of integrating and refining categories towards forming the substantive theory once significant categories have been identified. This was conducted over several months until theoretical saturation was reached after the 24th interview, where no new categories emerged. This process enabled the development of an epistemologically sophisticated view of potentially emergent categories as part of theorising. Charmaz (2011) describes

this stage as *'mini theoretical'* coding, where the selected coding and analysis stops when the researcher has sufficiently elaborated and integrated the core variable, its properties, and its theoretical connections to other relevant categories. The responses of the interviews are considered by Strauss (1987) as *'theoretical sampling'*, which is insufficient to represent the entire phenomenon of the field study. The Straussian approach therefore calls for the researcher to carry out more analysis and discover other relevant categories and relationships among them through deeper comparative analysis in order to improve the conceptual theory presented (Charmaz, 2000). These codes were subsequently tagged to clauses of the ISO standards wherever possible, and/or existing theories and concepts where applicable for model development. Unmatched codes or those with many-to-many relationships were integrated into the proposed model (framework).

Theoretical coding is a key part of the grounded theory method that involves the systematic use of collected data to generate hypotheses and concepts (Corbin, 1990, Strauss and Corbin, 1998, Morse et al., 2016, Bryant and Charmaz, 2007, Glaser, 1992). At this stage, the analysis moves beyond conceptual description to abstract substantive theory elaboration involving interpretations or explanations of a delimited problem in a specific area, such as value optimisation in the New Zealand public sector through asset management. In other words, substantive theory denotes a set of well-developed categories (themes, concepts) that are systematically derived from coding that represents statements of relationships used to form a theoretical framework that explains a phenomenon (Hage, 1972). This process can be considered a tool that provides a stimulus to a *"good idea"* (Glaser, 1965) or statements that draw upon and have

theoretical power constrained by a specific context (Bryant and Charmaz, 2007), such as the selection of individuals or organisations.

The theoretical coding process, according to Holton and Walsh (2016), captures the researcher's innate ability to perceive latent patterns that organise relevant related concepts to explain how the emergent theory resolves a problem or concern. These theoretical codes conceptualise different parts of the data – codes, categories, memos and their relationships and integrate them into a theory. Behavioural patterns can be identified inductively, and concepts derived from the data without incorporating intentional constructivist elements (Simmons and Martin, 2017) or any predilections or biases (conscious or unwitting) of the researcher or published literature. The most common theoretical code explains the basic social process between core categories throughout the stages of a phenomenon that have a time dimension, a beginning and an end (Glaser, 1978). Other theoretical codes include casual-consequence or independent-dependent variables, dimensional or characteristic properties and interactive effects between variables (Strauss and Corbin, 1998). It is crucial for the researcher to be very familiar with the codes to enable theoretical sensitivity as they "*earn their way into the theory*" (Glaser, 2005).

As the theory integrates, it solidifies with fewer modifications needed and usually involves clarifying the logic of the theory, combining interrelated categories and reducing the original list of categories for coding. Theory grounding results from the constant comparative process from open coding to selective coding and generally involves three types of comparison. First, incidents are compared to others to establish the underlying uniformity and varying conditions of generated concepts and hypotheses. Secondly,

emerging concepts are compared to more incidents to create new theoretical properties of the concepts and more hypotheses. Finally, emergent concepts are compared to each other to establish the best fit between potential concepts and a set of indicators, the conceptual levels between concepts; that refer to the same set of indicators and their integration into hypotheses to become theory (Glaser and Holton, 2004 para. 53)

According to Glaser et al. (1968), the process of conceptual discovery is continuing and involves continuous dialogue and should not be regarded as a once-and-for-all activity but as modifiable statements for all time (Bryant, 2017). Glaser et al. (1968) noted that a grounded theory should “fit” with the setting from which it has been derived from data collected and ‘should be judged not in terms of correspondence to reality but with regards to whether they are useful in serving certain purposes and practices (Bryant, 2017). The goal of theoretical sorting is to ‘... *find the emergent fit of all ideas so that everything fits somewhere with parsimony and scope and with no relevant concepts omitted*’ (Holton and Walsh, 2016).

3.5 VALIDATION AND VERIFICATION

Morse et al. (2002) assert that “*Without rigor, research is worthless, becomes fiction, and loses its utility*”(p. 2). Morse et al. (2016) noted that “... *over the past two decades, reliability and validity have been subtly replaced by criteria and standards for evaluation of the overall significance, relevance, impact, and utility of completed research*” but argue that establishing trustworthiness only at the end of the study as suggested by Guba and Lincoln (1981), “*the investigator runs the risk of missing serious threats to the reliability and validity until it is too late to correct them*”(p.3-4). Hence the researcher had focused

on the verification processes throughout the study and adopted the evaluation criteria designed for naturalistic inquiry⁶⁴ by Guba and Lincoln (1981) for the entire research process:

- **Credibility:** Internal validity is demonstrated through an isomorphism between the data of an inquiry and the phenomenon those data represent through means such as prolonged engagement, persistent observation, peer debriefing, triangulation, referential adequacy materials and member checks.
- **Transferability:** Generalisability (external validity) is demonstrated in the data collected, and findings can be similar when transferred to other contexts with similar properties through theoretical purposive sampling and thick description.
- **Dependability:** The research process is systematic, well-documented and reliable. Reliability under the rationalist paradigm is a matter of replicability where a study under the same circumstances in another space and time will reach similar outcomes. Stability under the naturalist paradigm denotes predictable but not exact replication, as the focus is on emergent designs. Dependability can be achieved through the use of overlap methods, stepwise replication, and dependability audits (modelled on the fiscal audit process).
- **Confirmability:** Qualitative confirmability of the data is not about the quantitative agreement, as objectivity must be placed on the data and removed from the inquirer (regardless of certifiability or qualification). Confirmability can be achieved through triangulation, practicing reflexivity, and confirmability audits (counterparts of confirmability audits).

This study acknowledged that the research *“is only as good as the investigator”* and is dependent on the *“researcher’s creativity, sensitivity, flexibility and skill in using the*

⁶⁴ The “naturalistic inquiry” describes a paradigm that rests on several assumptions:

- there are multiple realities that diverge rather than converge as more and more facts emerge that are interrelated
- the inquirer and the participant influence each other, and the researcher needs to be mindful of keeping an optimal distance through reflexivity
- an action may be explainable in terms of multiple interacting factors, events and processes that shape it and are part of it through a holistic approach of assessing patterns

verification strategies that determines the reliability and validity of the evolving study.”

(Morse et al., 2016). To enhance this skillset, the researcher undertook training to become a certified ISO Quality Systems Auditor in 2021 that required the adequate use of sensitivity, openness, creativity and insight to eliminate any ideas that are poorly supported regardless of the excitement, passion and potential they appear to provide initially by the participants and the researcher, and unconscious bias.

In addition to the evaluation criteria for naturalistic inquiry (Guba and Lincoln, 1981), the researcher adopted the following verification strategies suggested by Morse et al. (2002):

- **Methodological Coherence:** Ensuring congruence between the research aim, and the research methods. In other words, the interdependence of the entire study demands that the research aim, and its objectives matches the questions (data), which matches the data and analytic procedures in a non-linear manner and iterative. This ensures the final output is derived from the analysis of the data, with each result verifying the previous and the methodological assumptions as a whole.
- **Appropriate Sampling:** Rather than a random selection of asset management specialists, the research involved participants who best represent or have in-depth knowledge of the asset management discipline and philosophy. The study did not pre-determine the number of participants, budget or time constraints for data collection to reach theoretical saturation. Saturation and replication (Morse, 1990) occurred after the 24th participant.
- **Concurrent data collection and analysis:** The researcher attempted to abstract and synthesize collected data deductively while executing the technicalities of data coding and memoing to ensure reliability and validity. The entire process is illustrated in [Figure 3-9](#).
- **Thinking Theoretically:** Triangulation was applied throughout the research process such as reconfirming key points of the interview with official documents provided by the participants before or after the interviews, ideas emerging from one sector are reconfirmed with new data within the sector/organisation and subsequently

between sectors/organisations. Macro-micro perspectives were considered, constantly checking and rechecking, triangulation between new and collected data and subsequently with current and new theoretical concepts for the asset management philosophy to build a robust foundation for the framework.

- Thinking Theoretically:** Ensuring that the final theoretical framework is comprehensive, logical, parsimonious, and consistent (Meadows and Morse, 2005, Glaser, 1978) and ensuring the result is “an outcome of the research process, rather than being adopted as a framework to move the analysis along” (Morse et al., 2002)

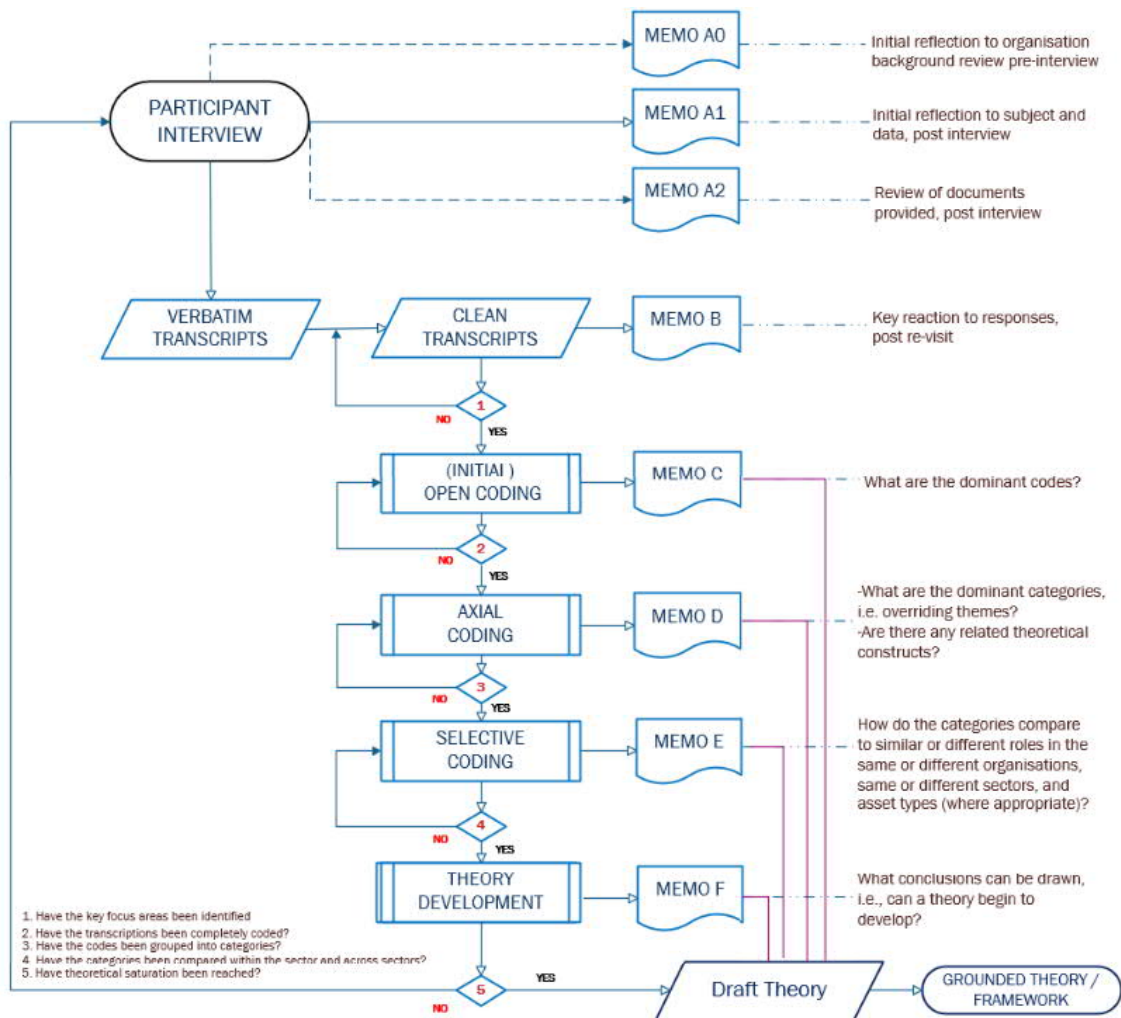


Figure 3-9 - Process flow for grounding theory from collected data

Finally, in addition to the making available audio and video recording to ensure validity and reliability to support the transcripts and memos, a validation process was conducted where the researcher brought the proposed model back to participants and other appropriate subject matter experts that could not participate in the initial interviews. Responses were incorporated in [Chapter 5](#) and [6](#).

Chapter 4

PRESENTATION OF FINDINGS

4.1 OVERVIEW

This chapter summarises the findings and analysis of the primary and secondary research data broadly based on four research questions (or themes) in the context of the ISO asset management standards (ISO 55x) and the value optimisation activities in the public sector. The purpose is to better understand the strategies and day-to-day behaviours of asset management professionals involved with public assets, their prominent characteristics, and influential contextual factors for optimising organisational value in or from their built environment. The open codes and axial codes that generated the selective codes (core and sub-categories) are described using empirically grounded incidents (e.g., quotations from interviews supported by secondary sources publicly available or provided in confidence). The number of incidents presented in this chapter for each category and associated properties is not an overall representation of incidents that occurred (see Appendix E-H for selected examples of over 100 pages of original transcripts). These have been selected to clarify the conceptual framework presented in [Chapter 5](#). The chapter is structured into four parts according to research themes and corresponding interview questions as listed in [Table 4-1](#).

Table 4-1 - Research Themes and Corresponding Questions

THEMES	RESEARCH QUESTIONS
1. Value Considerations	What are the key considerations for defining value from the perspectives of internal and external stakeholders of (i) the asset, (ii) the asset management system and (iii) organisation? (RQ1)
2. Prioritisation Considerations	What are the key considerations for prioritising asset management strategies / asset decisions? (RQ2)
3. Social / Cultural Factors	What are the critical cultural/social factors for the successful development and implementation of an asset management system? (RQ3)
4. Enablers	What are the enabling structures and processes for an effective and efficient asset management system? (RQ4)

It was observed some participants did not wish to respond as individuals but rather as representatives of a larger stakeholder group or part of an organisation during the interviews. With reference to the research questions provided prior to the interviews, responses from participants would often relate to how they had established their asset management systems at present or what they have done in the past. Many participants provided insights on how they managed these systems to optimise value as they perceived it for their organisations. Some participants focus on current challenges or issues and provide potential solutions to address them. These discussions indicated the “*what*” that must be considered for a successful asset management system and the “*how*” and, in most cases, provided the “*why*” based on the context of their organisation or personal circumstances. Others tend to discuss what they “*would*” like to do or “*could*” have done in light of current challenges and issues when given the opportunity or in the right environment.

The responses of the participants within a particular sector were often quite similar regarding external influences (e.g., legislation, stakeholders' demands) that significantly impact their asset management systems. For example, the New Zealand Local and Central government sectors are highly regulated with specific mandatory requirements to demonstrate effective and efficient asset management practices. High-level analyses of responses indicated distinct patterns of cause-and-effect relationships for managing public assets within a sector, such as the influence of government policies and guidelines for regular reporting to the Office of the Auditor-General (OAG) or Crown Monitoring Agencies. Organisations that receive funding from the Treasury are also subjected to regular Investor Confidence Rating (ICR)⁶⁵ assessments. For local government, the legislation has also mandated the development of 30-year Infrastructure Plans, and most local authorities have also developed asset management plans to demonstrate the adoption of best practices. These requirements have led to specific and consistent terminologies used in the discussions, such as the Land Transport Benefits Framework issued by the NZ Transport Authority - Waka Kotahi (NZTA, 2023).

Several participants referred to specific documents provided during or after the meetings to support their responses. The list of documents referenced in the interview (not exhaustive) include:

- Government Policy on Land Transport (NZTA, 2021)
- Investment Decision-making Framework Review – Final Report (NZTA, 2020)

⁶⁵ The ICR is a three-yearly assessment of the performance of investment-intensive agencies in managing investments and assets that are critical to the delivery of NZ government services based on the based on the asset management maturity framework aligned to the International Infrastructure Management Manual (IIMM) of IPWEA and ISO 55x standards.

- A framework for shaping our transport system (MoT, 2018)
- Value for Money Framework Review (MoT, 2020)
- Managing the assets that distribute electricity (OAG, 2017)
- Asset Management Competency Framework (NZTA, 2019)
- TEC Capital Asset Management Standard (TEC, 2011)
- Cabinet Paper- Improving property, procurement, digital, data and information security across the Public Service (PSC, 2022)
- Cabinet Paper - Investment Management and Asset Performance in the State Services (TEC, 2019)
- Cabinet Paper - Investment Management and Asset Performance in Departments and Other Entities (DPMC, 2023)
- Several strategic plans and asset management plans (*Confidential*)

The considerations and practices identified varied considerably depending on the individual's level of authority within the organisation, personal experiences, training and education in asset management. For example, there were differing views of what asset management is or should be and what value means from the individual or organisational context. Varied opinions were often based on educational backgrounds (e.g., from no formal qualifications to PhDs) and specific professional disciplines (e.g., engineering, financial, information technology, facility management) and the different roles within the organisational hierarchy such as board member, director, chief executive, general manager or head of department past and present. There were many suggestions that a different approach could be better or more appropriate for asset management practices in New Zealand. Some relationships appear to align with existing theoretical concepts, while others seem to counter conventional arguments. These will be discussed in the following sections as to how they will inform the development of a conceptual business model.

Though all participants received the four open-ended questions before the interviews, responses to the specific categories or themes often overlapped during the interviews as when the respondents realised they had missed an important point earlier and wished to add to the earlier arguments. At other times, participants veered off the intended discussion topic as they were keener to discuss current challenges or issues and their perceptions of how asset management should be conducted and implemented for their organisations, profession or sectors. Participants sometimes used their own terminologies to steer the interviews around issues and concepts that best represent their involvement and interactions within the asset management systems (e.g., asset data governance or the asset information management). Some participants noted how the four questions, though separate, were closely related, while others questioned if these particular questions could have been combined. For example, social/cultural factors could also be regarded as enablers for effective and efficient asset management practices.

Table 4-2 below shows a list of selective codes that were devised from the axial codes during the multi-staged coding process described in [section 3.4.3](#).

Table 4-2 - List of Selective Codes

Value	Prioritisation	Social/Cultural	Enablers
-Performance -Value for Money	-Outcome Focused -Output Focused	-Societal-Political Legitimacy -Organisational Culture -Organisational Climate	-Capacity and Capability -Asset Management Intelligence

These codes with associated categories and characteristics were established through empirical indicators and concept indicators produced from line-by-line and axial coding with constant referencing to literature and existing theories. Continuous comparative

analysis over the empirical indicators of inter-related individual themes became the grounding for identifying the concept indicators for the proposed framework. Most of the empirical indicators (open and axial codes), detailed descriptions, and comments on these codes are found in appendices E-H. This chapter will highlight significant meanings, and the phenomena used for the model development through the conceptual abstract processes applied⁶⁶. The methods include classifications and linking characteristics and properties to provide a *'big picture'* or *'systems'* view. This approach enabled a more expansive explanation of the phenomena and integration of factors, structures and processes within each theme and between themes towards the theory/model development.

Finally, the entities responsible for the public assets are expected to separate political involvement from organisational governance and technical management (Webster et al., 2019). A few respondents provided political comments that have been excluded from the transcripts. Overall, the gathered responses provided a deep insight into how value is perceived and optimised through asset management in the organisations studied. These insights were often not evident in the publicly available publications and confidential documents provided by the participants to support their responses. The findings reflected the complexities of the business and political environments of organisations that manage public physical assets. [Figure 4-1](#) depicts the complexity and overlapping characteristics of high-level categories of value considerations observed from the interviews.

⁶⁶ Glaser (1998) noted that all of the interchangeable indicators that represent each concept and property have to be presented, as this would reduce the conceptual level of the theory.

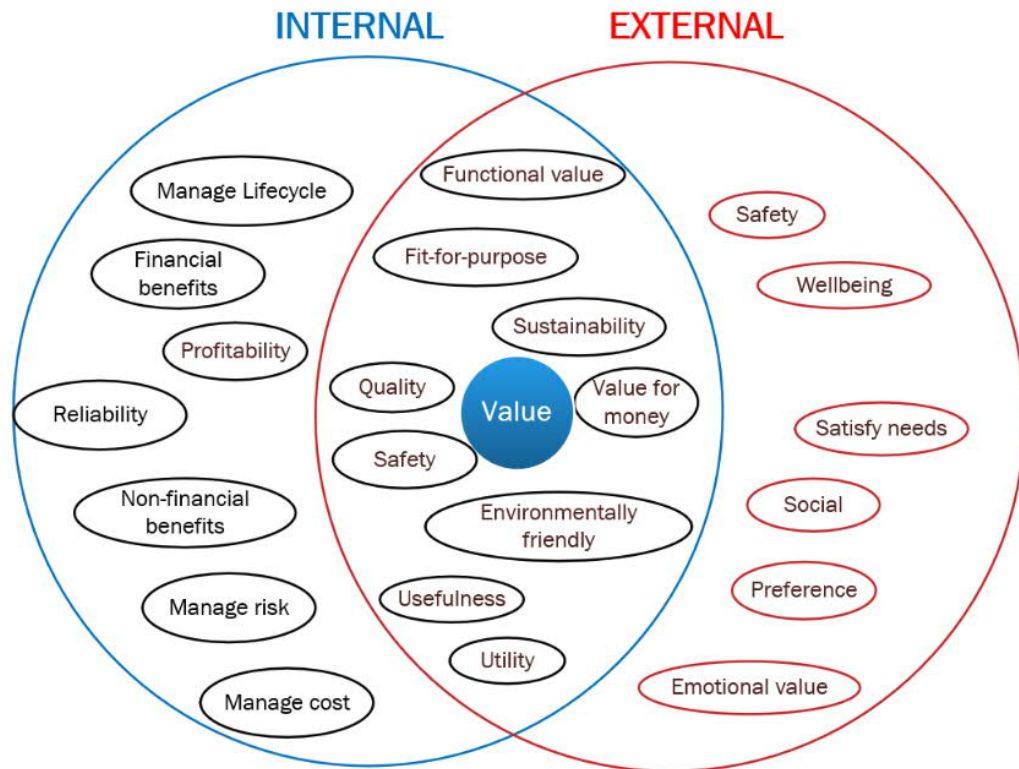


Figure 4-1 An example of complex overlapping value considerations from internal and external perspectives

This chapter is divided into four main sections following this overview section according to the research questions posed (or themes). [Section 4.2](#) presents the views of defining value to be optimised from the first research question (RQ1). [Section 4.3](#) investigates how initiatives are prioritised according to perceptions of value from the second research question (RQ2). With the third research question (RQ3), [Section 4.4](#) aims to uncover social and cultural perceptions (if any) for value and prioritisation considerations. Finally, with the fourth research question (RQ4), [section 4.5](#) discusses the enablers required for value optimisation. The structure and topics of discussion are illustrated in [Figure 4-2](#).

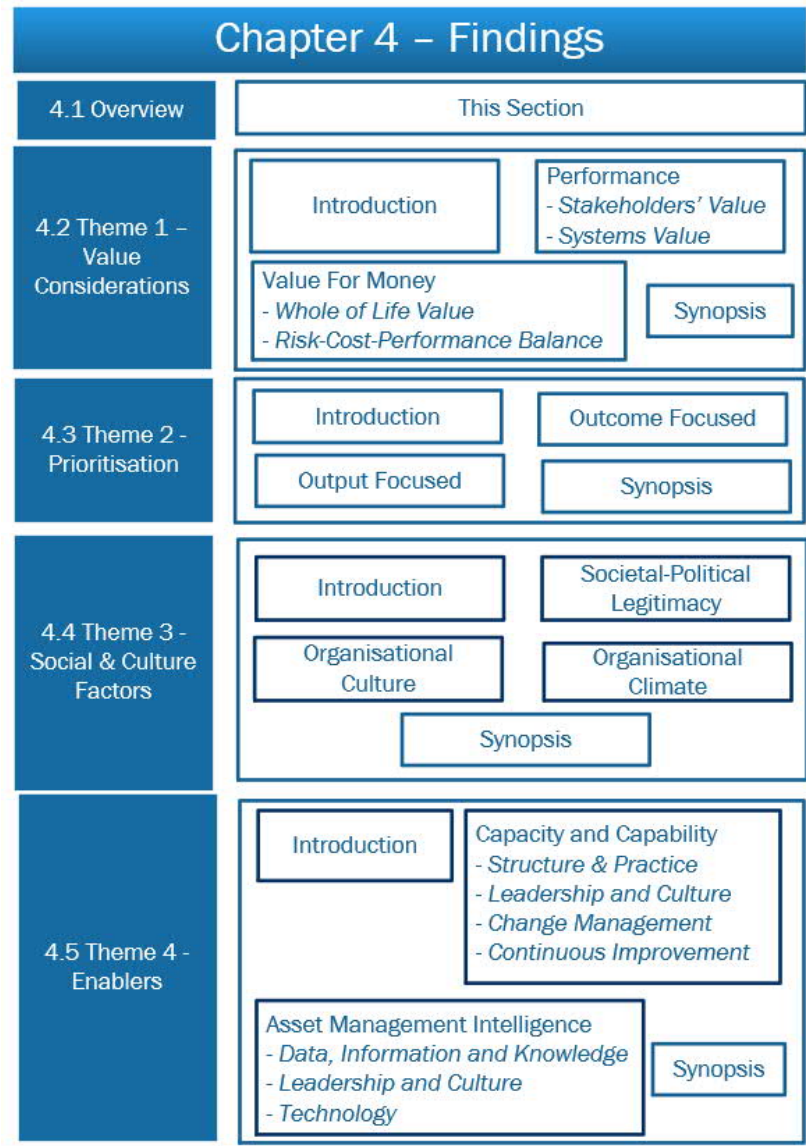


Figure 4-2 Chapter 4 Structure

4.2 THEME 1 – VALUE CONSIDERATIONS

4.2.1 INTRODUCTION

RQ1: What are the key considerations for defining value from the perspectives of internal and external stakeholders of (i) the asset, (ii) the asset management system and (iii) the organisation?

The purpose of the research question RQ1 is to ascertain how practitioners define value as they establish an asset management system in their organisations. The publication of a value-based ISO 55x series of asset management standards and various publications from both industry and academia discussed in [section 2.2](#) has raised awareness of a long-standing challenge of asset management professionals and researchers in their attempts to better define value in an organisation to be optimised through asset management, particularly, in the public sector. Many asset managers in the interviews acknowledged that it is a challenge, as noted below.

“I still don't fully understand what value means. It seems like a simple concept, but it's got so many different perspectives.” (CG3)

“I was struggling a little with value because value means different things to different people.” (LG1)

One respondent noted:

“Defining value is a relative term and will depend upon your position in the overall scheme of things and the perspective that you have from that position. For an engineer, value would be about lifecycle cost; for a tenant, it is related to a far more subjective self-interest focus.” (OTH3)

In addition to the above comments, it was observed that the value concept is dependent on the organisational context and can also be interpreted differently by top management. Amadi-Echendu (2021) construe that asset management does not focus on the asset itself but on the value that the asset can provide (which can be tangible or intangible, financial

or non-financial) as determined by the organization and its stakeholders⁶⁷ in accordance with the organizational objectives. The realisation of value is measured through the achievement of both organisational and asset management objectives, which, in practice, is rarely determined by a simple measure but a mixture of both financial and non-financial metrics. In addition to the monetary and economic value that is quantifiable, public-sector organisations are expected to incorporate the United Nations Sustainable Development Goals (UNSDG) into their asset management practices that also need to consider social benefits or social outcomes that are non-monetary such as safe drinking water, environmental protection, heritage preservation, reliable public transport and electricity services, etc. However, these value-generating activities all come at a cost. Public entities still need to demonstrate financial viability and sustainability to generate future revenue, service debt and demonstrate value for money. To achieve this, the value of the asset must be clearly defined and realised through a lifecycle management approach, and effective decision-making processes must be implemented that reflect stakeholders' needs and expectations (ISO, 2018).

Unfortunately, the very nature of the word or term '*asset management*' often insinuates that asset management is limited to the engineering and technical community and usually tends to focus on implementing a primary '*managing assets*' approach such as life-cycle costing, reliability-centred engineering and digitisation technologies, and often limited to

⁶⁷ Stakeholders can be defined as groups and individuals who can affect, or are affected by, the strategic outcomes of a firm (Freeman, 2010; Jones and Wicks, 1999). Whilst organisations have stakeholders specific to their own situations, legitimate (or normative) stakeholders can be defined as those groups to whom the organisation owes an obligation based on their participation in the cooperative scheme that constitutes the organization and makes it a going concern. They include customers, communities in which the firm operates, suppliers of capital, equipment, materials, and labour (Phillips, 2003)

assets under the organisation's direct control. One respondent also noted the lack of engagement because asset management is considered not relevant to others:

"... the word asset management is probably not as relevant in our organization as something like a value chain or a delivery model or something. It is effectively a business process and is trying to establish that understanding that it is just a process that we're trying to deliver here. I think the word asset management, because people don't understand it, they don't want to engage in it." (CG3)

Woodall (2003) observed that *'the literature on value per se is as broad as it is extensive and is represented as much in the fields of economics and philosophy as it is in the domain of business'*, and asset management is no exception. Morar (2013) and Smith and Colgate (2007) noted that value can be seen from both the customers' and suppliers' points of view. Most participants acknowledged that whilst they are stewards of public assets, they are also users of public assets and services (e.g., public transport, community facilities, water supply, rubbish collection) and would respond as customers as appropriate. Align to the notion of use or exchange value ([section 2.2.3.3](#)); one respondent expressed a view on the complexity of the term value:

"What I like about the question is around who decides what value is, and who has the biggest say in that, whether that's the external stakeholder, whether that's the business itself or whether that's the customer and who decides?" (LCE1)

By default, all respondents attempted to clearly distinguish between internal and external stakeholders as per the research question, though one participant noted it was not as straightforward:

“In relation to internal and external stakeholders, I think they're actually not fix and are very different, but they cross over at certain aspects and other aspects are separate”. (OTH1)

The stakeholder perspective envisions an organisation is at the centre of a network of stakeholders (Barringer and Harrison, 2000, Rowley, 1997) acting as a complex system for exchanging goods, services, information, technology, talent, influence, money, and other resources (Freeman, 2016). Mitchell et al. (1997) found that there was not much disagreement on what kind of entity can be a stakeholder in persons, groups, organizations, institutions, societies, and even the natural environment are generally thought to qualify as actual or potential stakeholders. The view taken about the existence and nature of the *'stake'* presents an area of argument because it is upon the basis of *'stake'* that *'what counts'* is ultimately decided. Stakeholder theory attempts to articulate a fundamental question in a systematic way: *'Which stakeholders deserve or require management's attention, and which do not?'* However, stakeholder theorists differ considerably on whether they take a broad or narrow view of an organisation's stakeholders (Windsor, 1992). Some respondents attempted to differentiate value separately for the asset, the asset management system and the organisation, while others often reverted back to a more generic or agnostic version of what they regard as value to substantiate the strategies and responses to the subsequent questions.

For research question 1 (RO1), the categories, selective codes and axial codes were derived from several hundred open codes that represented the key considerations of defining value from the perspectives of internal and external stakeholders of the asset, asset management system and the organisation, A selection of key responses from participants

are provided in [Appendix E](#). While codes were identified separately by the four sectors of Local Government (LG), Central Government (CG), Government/Council Owned entities (LCE) and Other Government/Council Funded Entities (OTH) listed in [Table 3-2](#), an integrated approach was used for the following sections as shown in [Figure 4-3](#).

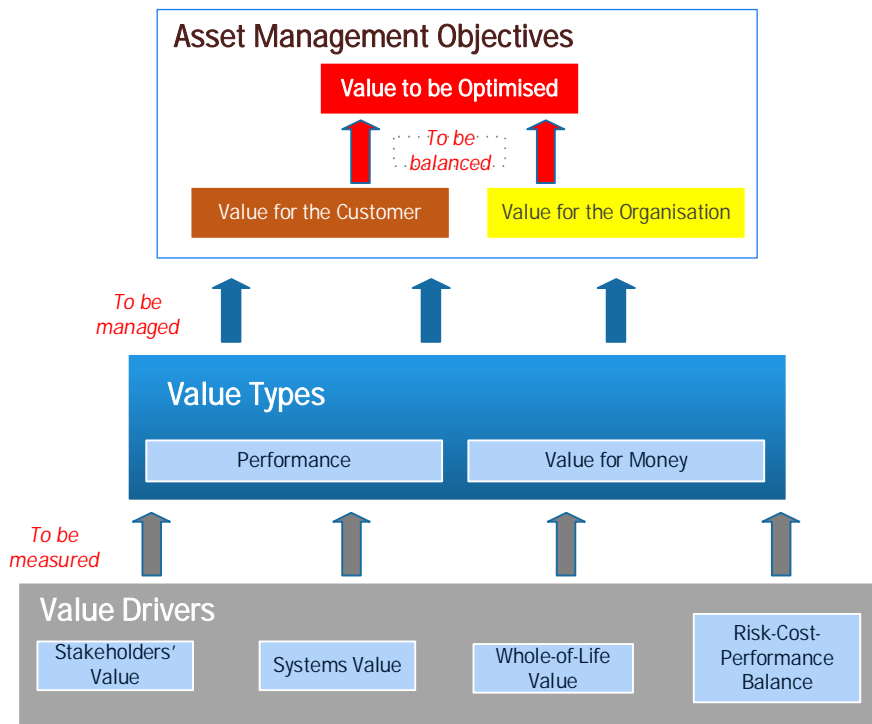


Figure 4-3 - Value Considerations

The two core categories of Value Optimisation are 'Value for the Customer' and 'Value for the Organisation'. The categories are based on two supporting categories or 'Value Types': 'Performance' and 'Value-for-Money', in which the drivers of Performance are categorised under 'Stakeholders' Value' and 'Systems Value'. For 'Value For Money', the drivers are grouped under 'Whole-Life-Value' and the 'Risk, Cost and Performance Balance' that emerged during the axial coding process. It is worth noting that all codes are mutually interrelated and that it is not possible to draw definitive relationships (or drivers) with a

particular category or categories. Identified properties characterised each of these categories in terms of its attributes and behaviours derived from empirical indicators provided by the participants. The following sections will present some of the key conceptual indicators from the coding processes described in [Chapter 3](#).

4.2.2 PERFORMANCE

4.2.2.1 Stakeholders' Value

Stakeholder theory considers a more complex value creation that different stakeholders seek, and it is understandable that stakeholders' interests are often in conflict (Williamson, 1989) but while that may still exist naturally, organisations tend to perform better when stakeholder interests are perceived as joined, or at least overlapping then only conflicting (Dyer et al., 2018, Freeman et al., 2010). It was evident in the interviews, multiple agendas and perceptions of importance or criticality have resulted in varied considerations, including quality (e.g., reliability, safety), fit for purpose (e.g., profitability) and functionality (e.g., sustainability, environmentally responsible). One respondent noted:

"I've identified probably three kinds of value. The first one was the ability to generate revenue, the second one was internally; you need to make sure that you are performing, or the asset management system is performing to its expectations. And then the third is the value from the users' perspective and the indirect benefits that you can provide to other communities and other authorities or organizations that are also interface with, basically, our neighbours, so to speak outside of our boundaries".
(CG3)

Service quality and usage quality to a certain extent, is based on perception (Barney et al., 2021, Peteraf and Barney, 2003, Peteraf and Barney, 2011, Barney, 1991), and

perception is influenced to a great degree by whether stakeholders believe they are getting a good deal from the organization compared with what they might expect to receive through interactions with other firms that serve similar purposes as depicted by [Figure 4-4](#)

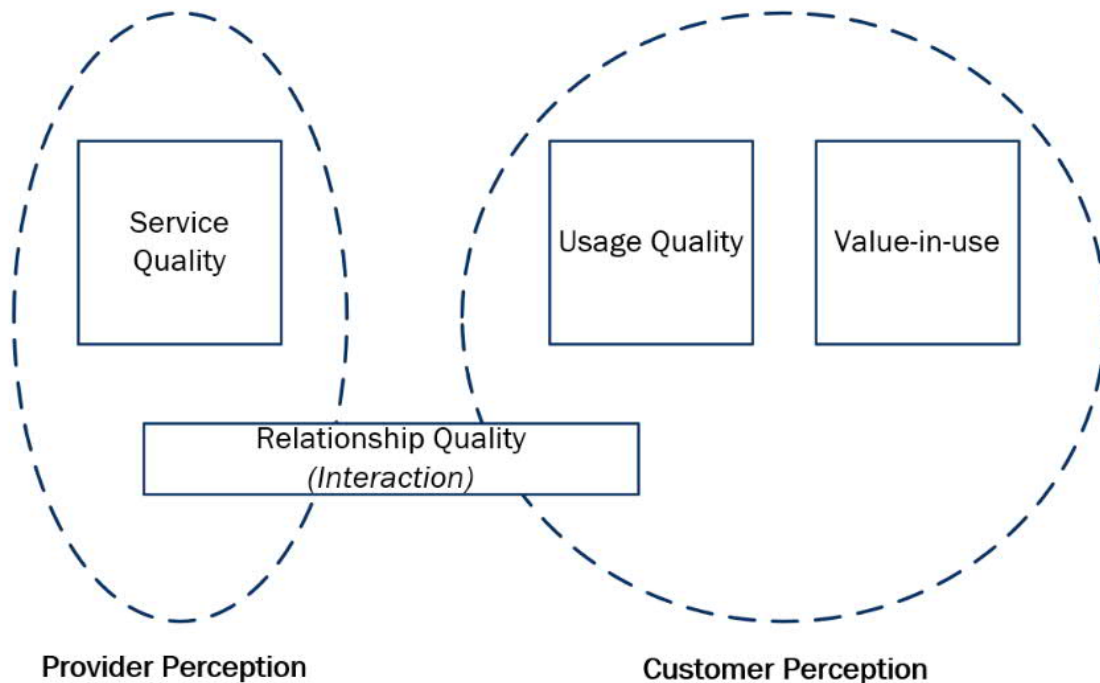


Figure 4-4 - Value Perceptions - Provider vs Customer

Notwithstanding whether the participants responded as customers or managers, asset performance was a common consideration as the perceived value of the asset, as well as for the organisation. However, success in performance can be seen through different lenses, as noted below:

“Externally, I don't think many people care as a customer. If I'm paying my rates to XXX Council, I don't actually care whether you've got an asset management system or not. I just want to know I'm paying the least amount possible for the level of service that I expect, and how you achieve that as an organisation.”(LG1)

On the other hand, *'use value'* or *'utilitarian value'* is subjective and dependent on experience or in comparison to what was sacrificed, both monetary and non-monetary, such as time, energy, effort, disruptions and inconvenience (Cronin Jr et al., 2000). Based on a multi-dimensional approach to studying consumer behaviour, Sánchez-Fernández and Iniesta-Bonillo (2007) identified the existence of a functional dimension determined by a *'rational economic evaluation'* and *'quality of services or products'*, as well as an *'affective dimension'* that could be further separated into an emotional and a social dimension, as one respondent noted:

"... customer level service when it comes to asset management can be as much as travel time, reliability, can be roughness of the road, how many potholes, things like that, it can be safety. And when we think about asset management, the safety level service could be your road marking, could be your road lighting assets, but it could also be, coming back to more technical levels of service around skid resistance, about SCRIM (Sideway-force Coefficient Routine Investigation Machine)." (CG3)

'Fit-for-purpose' was a term widely used by the participants in relation to both internal and external stakeholders or from the perspectives of the value of the asset, asset management system and organisation. The terms used mirror those found in the publicly available documents of their respective organisations. However, there were distinct differences in what constitutes performance for different sectors, the services provided by the assets and the attributes of the assets involved, as some participants in the central government noted:

"... we run a level of service assessment tool on what we call fit-for-purpose assets, which looks are five key elements of asset management ... which we report it through Treasury. It looks at location, making sure we're in the right place, looks at branding

or expression. How well does it express New Zealand? ... it looks at building quality, flexibility and functionality". (CG1)

Similarly, Sweeney and Soutar (2001) argued that in addition to emotional and social value, there are two dimensions of '*functional value*'. One is based on the price and perceived short- and long-term costs, and the other is based on the perceived quality and expected performance in the future, similar to the ISO 55x emphasis on the importance of a value-based and strategic focus on asset management. However, one participant noted it's not always the case:

"... for some people, cost becomes so important that they're willing to sacrifice other bits. It depends on the maturity of that community and the maturity of the individual is to how much they're willing to pay". (CG5)

4.2.2.2 Systems Value

Beer (2002) noted that '*the purpose of a system is what it does*', and if it is not delivering its purpose, it needs to change to achieve effective and efficient system performance. The socio-technical design of complex systems involves delineating the interaction of people, determining required resources in terms of people capabilities, and clearly defining roles and responsibilities that drive measures of success. In other words, an accurate measurement of success lies not in the inputs or resources deployed but in the transformation of outcomes, e.g., support/service core business functions, safety, compliance, sustainability, etc. (Peculis, 2017, Peculis et al., 2008, Peculis et al., 2021). This notion aligns with the resource-based view of the strategic focus of asset management.

"I would emphasize that there has to be a very strong notion around the purpose. If you know what the purpose is then you can define whether you're getting value or not. If you are saying that the purpose is around safety. And if you don't feel safe, then you know you are not getting the value because it's not as safe. Or if you're looking for speed, if you wanna get from point A to B in a public transport or using roads In and you're not able to do that... water supply is not available all the time, it's only available few hours a day or there's not enough pressure .. You need to know what the purpose is and how is the value going to be measured."(CG5)

From a systems perspective, one participant noted the multi-level meaning of value.

"In terms of lifecycle value, you can roll this into multiple levels. At the highest possible level, the provision of this asset. It enables the economic growth of the country. From a GDP perspective, the road enables the transport, logistics and supply sectors to operate, which is about \$12 billion. Then, as an organization, we are an enabler for the construction industry, which is about another \$6 billion to the GDP. So, there's a high-level value that's our function, our assets provide. And then as you start rolling it back down into the more technical sort of say, service, we're providing an access, a safe and reliable, efficient access to a system which can then enable your goods for people to travel to where they need to eat, whether that's connecting other networks, or connecting you to major destinations or communities. There are the different levels".(CG3)

Crespo Marquez et al. (2020) established that ideally, different value drivers should align with their metrics so that value can be realised without any compromises or discrepancies. Still, in reality, these value drivers can conflict with each other. An example provided by a respondent was lowering the speed limit on open roads for safety reasons that disagree with the value driver of journey time reliability and optimal economic value for truck drivers. The decision, in this case, also highlights the quantitative and qualitative nature of

value, where decisions can be driven by facts such as journey time at a certain speed or the potential prevention of fatal accidents avoided. In this instance, it was identified that lowering the speed also reduces renewal costs and the asset's deterioration rate, which may not be a concern for the driver but presents an opportunity for the organisation. In this example, the output of efficiency for the organisation (costs) and the outcome of safety (society) conflicts with the outcome desired by the user, which is reduced travel time. Another example was the qualitative nature of value, such as reputation or image for the asset owner that potentially would benefit from potential economic value through increased trade and investment (an outcome).

One participant provided an example on the interpretation of key performance indicators (KPIs) in the workforce:

"... we have a series of the statement of performance expectations, each has a target, a statement or targeting measure. Under that measurement, we have the same targets and measures from a central government perspective and slightly different ones from a local government ... those are the drivers that underpin what we do. How we do it though is where the benefits come through, for example, many of our staff are Māori and Pacifica where there is some similarity to the makeup of their tenants. Many of our staff are locals, some of our staff were tenants or are currently tenants as well."(LCE1)

For local government, level of service indicators was the common definition of performance:

"For value, the key considerations are, basically starting at levels of service, so determining what the community and what the asset owners and what their asset

users are wanting or expecting or expecting out of the assets and then having to balance the costs and what are we actually trying to achieve there. Some of it comes down to the criticality and risk of those assets. So, for certain assets like for water and for example, the maintenance program is really important. Very hard to do inspections of underground of water underground assets because it's always in use. So, it's really about or actually around reducing risk, making these things work behind the scenes without anybody knowing that they're actually there, and so everything just carries on, so you could deliver the levels of service, or actually just making those things not having the big effects for the external stakeholders". (LG2)

For central/local government-owned or funded entities, the performance includes a return on investment (output) in addition to public value (outcome).

"... expectations of external stakeholders I would say is it's probably, they expect return on investment" (OTH5)

"... a lot of the decisions naturally were commercially driven" (LCE2)

"..competition in a private sector has again, you know the currency is money" (CG5)

The above views were often expected as in the private sector, value is generally defined as the total return to shareholders (Bughin and Copeland, 1997), measured as *'Return on Invested Capital minus the Weighted Average Cost of Capital'*. Economic value is created as an output when businesses use resources or capital (intellectual, human, physical and financial) to develop an operational surplus to generate a profit (return) through the price mechanism for customers. In this for-profit framework, the price mechanism relies on an individual's self-interest derived from consuming goods and services and their willingness to pay. There is a clear distinction between means and ends.

Scott and Falcone (1998) noted that the fundamental differences between public and private sector organisations relate to the diversity of goals and outcomes, access to resources and the nature of economic or political constraints. Despite the business models of many private sector organisations continually being revised to search for avenues to generate value, such as adopting the Environmental Sustainability Governance (ESG) framework or other Climate Action initiatives as a competitive advantage, the overarching goals of creating returns have remained constant.

This notion was evident in the organisations owned or funded by the local authorities and central government to a certain degree, as public value is the key rationale of their existence, as one participant noted.

“Increasingly, even businesses have realized that they need to compete for more than to make the money to be competitive, they need to demonstrate other values. They need to demonstrate their commitment to the environment. They need to demonstrate their commitment to how they look after their staff.” (CG5)

The above views align with the findings of the study by Woodall (2003), where it is presumed that value-oriented properties reside with both the object (product or service) and the subject (user or consumer) that manifest when both interact. He identified exchange value and intrinsic value as object-based and influenced by their characteristics and environment, such as the risks and impact of the failure of flood protection devices.

With a focus on risk, respondents noted:

“Value is defined by risk and serviceability. In other words, if the asset fails, what's the risk?” (LG4)

From a managerial perspective, managers can focus on things that actually get measured in addition to economic value, which provides managers with the information for better stakeholder engagement and enhances their managerial ability to use such insights to create more value. This approach is about creating more value for all stakeholders at the right levels by the organisation. Agency, resource dependence and transaction cost theories are particularly helpful in explaining why power plays such an important role in the attention managers give to stakeholders.

“The system is more of a delivery function, so to speak, so it's an enabler of delivering their life cycle as well as a gateway into managing risk, the management risk, lifecycle risk, quality, reputation, health and safety type risks. So, all of those aspects will play a value into the system. From an organizational perspective, you rolled it up again, talk about risk of meeting objectives and outcomes and stuff like that.” (CG3)

4.2.3 VALUE FOR MONEY

4.2.3.1 Whole of Life Value

Value for Money (VfM) is not a tool or a method but a way of thinking about using resources well and is synonymous with either economy (i.e., reducing the cost of inputs) or efficiency. However, effective and effective use of resources cannot be assessed through only one of these dimensions in isolation as it is about balance. Reducing the costs of inputs and making efficiency savings can either support or undermine value for money, and most importantly, VfM does not need to be about monetising everything and applying cost-benefit or cost-effectiveness analyses (most commonly in health or education). The Green Book of the HM Treasury (Guidance, 2011), which the NZ Treasury makes references to in its guidance materials, defined Value for Money as

'a balanced judgment based on the Benefit Cost Ratio which brings together social costs and benefits including public sector costs over the entire life of a proposal, together with decisively significant unquantified deliverables, and unmonetised risks and uncertainties, to deliver a proposal with SMART objectives. The judgement is made in the context of the proposals role, in supporting government policies and strategies of which it is a part, and its fit with wider public policies.' (Treasury, 2015)

The central government's concept of Value for Money (VfM) was first introduced in 2009 for the Government Policy Statement (GPS) on land transport (NZTA, 2021a). It has evolved over time and has been adopted in many agencies as a standalone strategic priority alongside safety, access, and environment. Within GPS 2018, VfM was defined as *'delivering the right infrastructure and services at the right level at the best cost'*⁶⁸. Aligned to the above notion, the Office of Auditor-General describes VfM as *'using resources effectively, economically, and without waste, with due regard for the total costs and benefits of an arrangement, and its contribution to the outcomes the entity is trying to achieve'*. The latest GPS 2021 included VfM as part of its principles for investing and the responsibilities of delivering the GPS involve multiple agencies such the Ministry of Transport, Local Government, NS Transport Agency – Waka Kotahi, Kiwirail, Ministry of Housing and Urban Development and its entities such Kāinga Ora and Tamaki Redevelopment Company. How it is applied by other agencies has evolved over time but fundamentally it is based on the following principles:

- take a consistent to cost benefit analysis with common values and assumptions

⁶⁸ In the New Zealand Government Procurement guidelines, VfM (based on whole-of-life cost) is a standalone qualitative criterion alongside capability and capacity (of the supplier to deliver), technical merit (or fit-for-purpose) and lastly, financial viability & risk assessment. The principle of VfM does not necessarily mean selected the lowest price, but rather the best possible outcome for the total cost of the goods or services.

- take a long-term and broad view of societal impacts, costs and benefits⁶⁹
- rigorously assess these by monetising and discounting impacts to ascertain the impact value.⁷⁰

According to Jackson (2012), VfM is about striking the best balance between the “*three E’s*” – economy, efficiency and effectiveness or, in other words, the optimum combination of whole-life-cost and quality (fit-for-purpose) to meet the user’s requirement as noted by one participant:

“... the four expectations of the government for our buildings are ... value for money, ... valuing people, ... fit-for-purposegood quality work experience”(CG2)

Bourke et al. (2005) noted there are several drivers for the shift from cost to value, mainly the public sector (and their suppliers) as an interactive ‘*cradle-to-grave*’ assessment of value for the different stages of an asset’s useful life (functional) costs and benefits. At the same time, value drivers differ in importance as value evolves between industry sectors and stakeholders.

4.2.3.2 Risk-Cost-Performance Balance

Based on the above discussions, “*balancing of risk-cost-performance*” was a widely used phrase to define value realisation by most of the participants that were consistent with the ISO 55x standards and with the published asset management guidelines provided by the

⁶⁹ Treasury published the ‘Managing Benefits from Projects and Programmes: Guide to Practitioners’ to provide guidance for providing information to Treasury on the actual level of benefits achieved compared with those initially identified. The Benefits management framework has four high level phases: Identification, Analysis, Planning and Realisation & Reporting aligned to the Better Business Cases Framework

⁷⁰ An impact value provides a numerical value in relation to one or more impacts of an initiative which may be a cost (e.g., the costs of an emergency department visit), a benefit or a saving (e.g., the removal of the Jobseeker Support benefit with increased income for individuals). Subjective wellbeing values based on NZ General Social Survey developed by Kāinga Ora and Sport NZ and the values of Australian Social Value Bank can be used with the tool.

relevant authorities (e.g., NZ Treasury, Ministerial office) there were also based on the standards subjected to their own interpretation with what it actually means in practice.

Some of the responses include:

“Internally, for xxx Council, asset management is about optimizing the decision and managing the budget, level of service and risk triangle. That's the one I always come back to, is all those three elements are fundamentally linked in terms of asset management . It is relatively simple, it's understanding what you've got, understanding what condition it is and how long it's gonna to last, and then identifying a program of works that will address, either keep through maintenance, keep the asset going to meet its full lifecycle or intervene at appropriate times to keep levels of service; and the risk element is just how much risk you're prepared to take in terms of premature or partial failure over your assets.”(LG1)

The challenge in practice is to determine the ideal moment to renew an asset to optimise the remaining, as one participant observed:

“My observation about the public sector, as a whole, is that it underinvests in its assets over time... the behaviour is not a result of just the last two years of investing in the built asset or built environment as people thought, it may well be over 20 or 30 years of neglect.” (OTH1)

On the issue of sustainable development, participants noted there needs to be an optimal balance between their economic, environmental and social benefits and impacts in the long term.

“...Particularly in regulated environments with that is exactly the discussion because no one wants to set up a service that's not sustainable. So, this is all about sustainability. If you look at the dimensions I'm talking about, I'm talking about

societal, I'm talking about environmental, talking about financial. And asset management is the heart at the heart of sustainability.” (CG6)

4.2.4 SYNOPSIS

Given all the varied responses from participants, it is little wonder that no accepted definition of value from an asset management perspective for the public sector has emerged. The variables highlighted for this question also provide an explanation as to why no widely accepted theory has been generated and no constructs have been articulated for the realisation of value with asset management. Despite the variances in the meaning of value, two themes are dominant – value for the customer (perceived or received value) and value for the organisation (value by the customer for its existence). The latter also includes the value of the asset or the asset systems, as illustrated in [Figure 4-5](#).

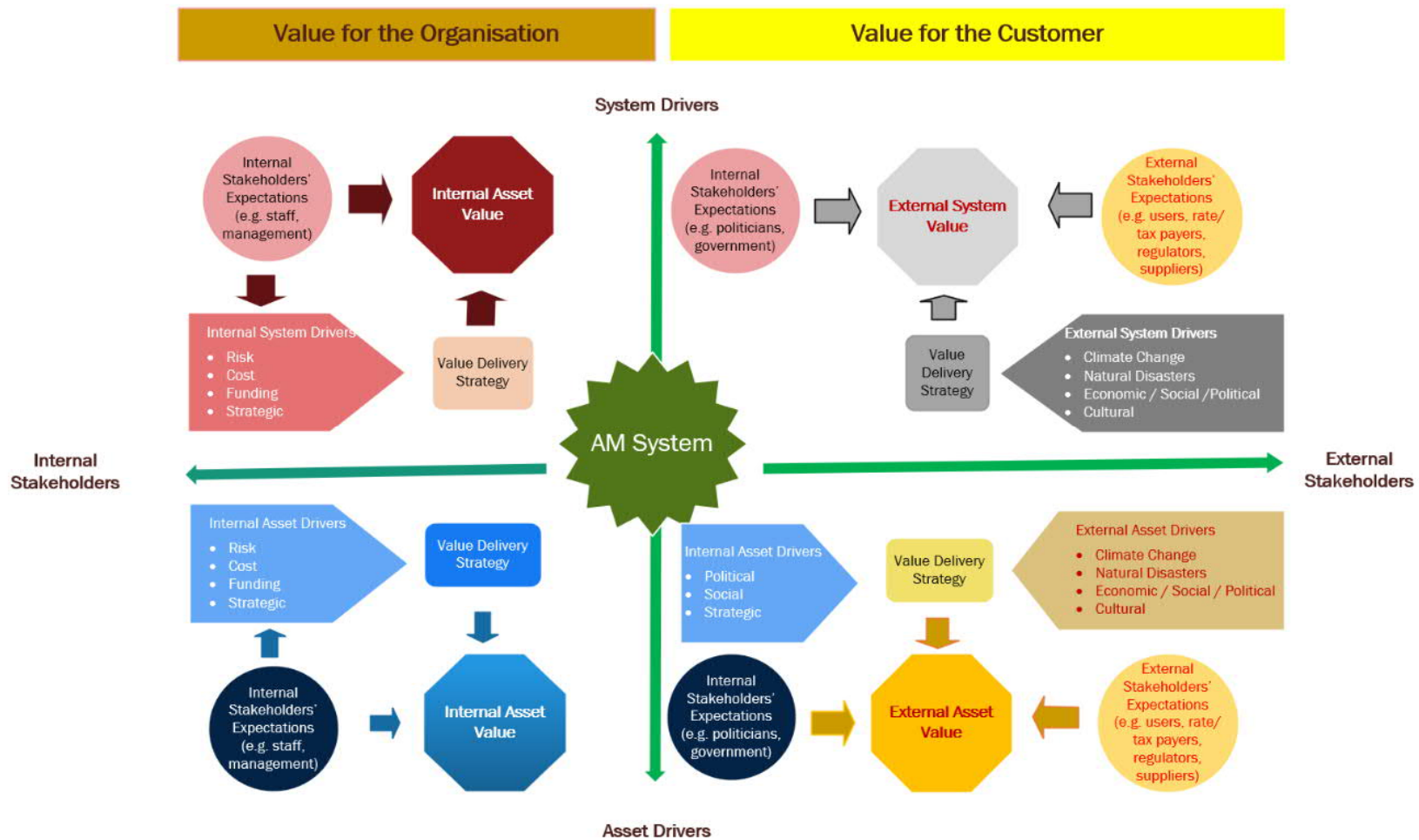


Figure 4-5 - A Framework of Value Considerations and Creation (source: Authors)

To better understand value from an organisation context, it might be useful to have a closer look at the interrelation and interconnection between assets, business model and stakeholders for performance, and the distinction between outputs and outcomes, which for some participants, they are the same that is not necessary the case based on *service–usage quality* argument. Outcomes could be positive, negative or even a combination of both for certain stakeholders; they may have internal consequences (e.g., employee motivation, morale, confusion) and/or external effects (e.g., environmental, social, customer satisfaction, trust). On the other hand, outputs are predominantly outward-oriented and often targeted at a narrow set of individuals or beneficial groups with clearly defined value parameters or criteria that can be measured. In this research, value can be categorised under Performance and Value for Money. Performance reflects the user/consumer's expectations regarding asset/service usefulness, reliability and relevance. Value for Money relates to the whole-of-life value consideration and the optimal balance between the cost and benefits of producing the asset/service throughout the asset lifecycle. Benefits can include the addition of positive outcomes, as well as the reduction of negative outcomes (e.g., risks and disbenefits). There are a few common themes related to value creation or value realisation gathered from the responses of the first research question.

First, value creation or realisation at the asset and system levels are affected by several value drivers (enablers) such as information (or lack of) and the quality of service or product. Although outputs from an organisation's business model or activities could normally be planned or intended, not all results or outcomes can be realised because of

the non-linear interaction between internal and external factors required for value creation and realisation. Politicians, customers (users), and the environment can cause unintended outcomes from the organisation's modus operandi that could manifest themselves in the short, medium and long term and may be positive or negative with internal and external consequences.

Second, the value of a service/product and its manifestation outcomes can occur over multiple timeframes and often become uncertain or unpredictable over the longer term. However, longer-term considerations cannot be ignored in the short or medium term that have the potential to enhance, dilute or deny the opportunity for intergenerational value creation or even in some instances, create an unwarranted financial burden for others in the future.

Third, different value types are created, such as the physical assets, resources required to manage the assets (e.g., people, technology, systems), the organisation's intellectual property in relation to managing and using the assets and other intangible assets, such as reputation and brand. These value items are created from a wide range of interactions, activities, relationships, and influencing factors (causes and effects) that occur in the economic, regulatory, societal and environmental (natural and built) context. The interactions between employees, customers (consumers), suppliers, regulators and other stakeholders are also affected by the natural environment or one that is created as a result. Hence, value can be made for the agent organisation and others externally, beyond benefits directly associated with the financial value and those indirect benefits to the broader ecosystem.

Finally, value needs to be considered holistically and systematically concerning internal and external stakeholders to create as much value or greater good as possible for the customer and the organisation. While the ISO 55x standards state that value is realised by balancing cost, risk and performance, this research advocates that optimal value is achieved when there is a balance between value for the customer and the organisation as interrelated and dependent on each other. The challenge for this balance lies in the implicit and explicit (but traceable) connections that are observed through day-to-day business activities, organisation culture, priorities and decisions made by all levels in an organisation that will be explored in the following chapters.

4.3 THEME 2 – PRIORITISATION

4.3.1 INTRODUCTION

RQ2 - What are the key considerations for prioritising asset management strategies / asset decisions?

The purpose of *RQ2* is to understand how initiatives are prioritised based on the definitions or perceptions of expected value to be realised and factored into asset management decisions. As discussed in [section 4.2](#), most participants observed the differing concepts of value and how different stakeholders derive value from the assets, asset systems, and the organisation. This phenomenon implies that decision-makers at all levels of the asset management system have to take a multi-dimensional approach, apply different weightings of value drivers, and weigh the preferences of various stakeholders during their decision-making process. This occurrence aligns with the views of Hjelmbrekke and Klakegg (2013) that value is not a single phenomenon; it is multifaceted and means different things

to the different stakeholders of the organisation, specifically its customers, suppliers, employees, investors, and any other interested parties in general. One participant noted challenges related to balancing short-term outputs vs long-term benefits.

"We've seen examples of that where assets have been built and budgets have been limited ... if you're not building it and future proofing it for and allowing for population growth, you're creating an asset that has some limitations... Arguably, yes, of course you could extend it later if that's possible, but why is it design for the short term? I think future proofing and in the design of certain assets is going to be a key element of ensuring value in the short term and value in the longer term." (LG3)

ISO 55x seeks to address this by advocating that an organisation should prioritise and decide how to perform these activities (who, what, where, when and why) using a decision-making process that is based on established criteria and metrics, the appropriate information, the nature, level of complexity, the impact of the decision and the time constraints (ISO, 2018) as discussed in [Chapter 2](#).

As discussed in [section 4.2.3.2](#), context-dependent value drivers, broadly encompassing cost, risk and performance considerations, can also be considered expressions of the asset's needs, the organisation and stakeholders (Parlikad and Srinivasan, 2016). In other words, the value drivers can be considered as value inputs from the business (organisation), stakeholders and society to help asset managers and decision-makers prioritise activities with the most significant impact or value.

Managing value in practice requires addressing conflicting priorities and the asymmetric sharing of costs and risks, opportunities, benefits, and disbenefits as above. One respondent sums up clearly the challenges of achieving this 'balance':

"...ultimately, your final investment plan though, will be constrained by available money and that's constrained optimization and the constraint is available funds. The art of a good asset manager is actually to put the case forward to be able to demonstrate the overall value proposition. So, you always have options and that the options are there to designed to have that discussion to fit within the funding constraints. But if we tackle things from a funding constraint perspective initially, and simply think I've only got this amount of money to spend, and I'm just going to spend it on that, then you're missing the boat because you actually haven't gone to the effort of understanding what the value impact to your customers is." (CG6)

Unlike the private sector, the participants have less discretion to define the purposes and objectives of their organisations and the ways they intend to attain their goals. They are often surrounded and engaged by their 'authorising environments' (Mason, 2017, Eppel, 2011) that includes a large number of people in positions (e.g. Ministers, Mayors, Councillors, Boards, Committees) who authorise what actions need to be taken and what funding is available for use as noted below:

"We have a strategic asset management plan that is informed by both data and legislative shifts that then prioritize where our year-by-year capital goes and how that aligns with our master program or master plan. So, for example, I have many million dollars per annum that is spent on statutory improvement, so it might be sprinklering a building, might be improving the passive fire, might be addressing disability and accessibility issues. It might be dealing with hazardous substance management, so that is capital that's invested to address statutory gaps and risk within the portfolio, both statutory and non-statutory or statutory and policy driven." (OTH4)

The authorising environment also includes those who can influence decisions (e.g., regulators, financiers, sponsors, and community) alongside particular individuals who make these decisions. Together, these individuals can hold managers accountable for the decisions they make on both asset and organisational performance. In the public sector, the elected representatives of the people and those who influence them are more active in their oversight than shareholders in the private sector. With regard to management discretion, one participant noted:

“Why is investment and forced choices relevant for local and central government? It’s because someone has to pay it back eventually. Within local government you’ve got a whole preoperative reprioritization process. Every annual plan, long term plan looks at getting stuff done. A lot of that is asset related expenditure and investment. But there’s a prioritization process. You know we can’t seal every road in the district or across the nation, so there’s a whole prioritization of roading assets or roading programs and expenditure. So what sectors? What critical factors? I mean the senior leadership team use to make those decisions; or is it? Is it something that the governors or the governing body decides on? It’s a bit of both. I mean you know that’s because sometimes the political bid projects get priority for the wrong reasons.”
(OTH5)

The cause of this difference between private and public organisations lies in the principal funding source of capital and operating revenues, which are the taxpayers and ratepayers. For most quasi-public organisations, purchasers of services and financial markets are mainly considered secondary sources. Another difference is unlike the for-profit sector, customers have to be sold ‘a story of public value’ (Moore and Khagram, 2004) and justify or approve the decision ‘upstream’ why and where funds should be allocated. The other source of difference with the private sector is that managers in the public sector face the

challenge of measuring performance in objective terms (similar to defining what value is) that prevent or avoid arguments.

Nevertheless, most participants attempted to identify both subjective and objective measures of performance to describe the prioritisation considerations, often citing that it is not as straightforward as applying a formula or using a tool. However, information was a common factor that had a significant impact on the decision made, as one participant noted:

"Tough one to answer. It depends where the decision makers get their information from. If they are getting the information from the risk department, they will have a particular view. If they get it from the customer services department they will have another view. If they get it from the finance department which most of the decision makers do, their concern will be, can we get enough money to run the business."
(LCE3)

One participant from a governance perspective noted:

"The biggest challenge for decision makers is making sure that they have the right information at their table. If one reads the Institute of Directors resources, they would argue that those decision makers, all those governors, should possibly be doing more to make sure that they have the complete picture for the decisions they're making. Not just the view of the Risk Department or the Finance department or whatever the latest customer satisfaction survey is saying." (LCE3)

Although one participant noted the difficulty of applying the criterion in practice:

"In terms of prioritisation, if I understood the kind of area the question is sort of like this, is there weighting to these decisions? You? How do we decide that one over the

other? And I think again, it's kind of comes back to those accountable for either the risk or accountable for achieving the objectives. And they tend to take advice from the likes of the information leaders. Ultimately, they set the direction and make the decision based on their accountabilities. And typically, I think information is seen as an enabler or a risk." (OTH2)

For research question 2, the axial codes and selective codes (categories) were created from several hundred open codes for key considerations for prioritisation of asset and non-asset initiatives from the perspectives of internal and external stakeholders of the asset, asset management system and the organisation are provided in [Appendix F](#) . Considerations that the interviewers felt were of importance for prioritisation often set at the organisational level and how they relate to the importance ranking of projects and programmes are illustrated in [Figure 4-6](#).

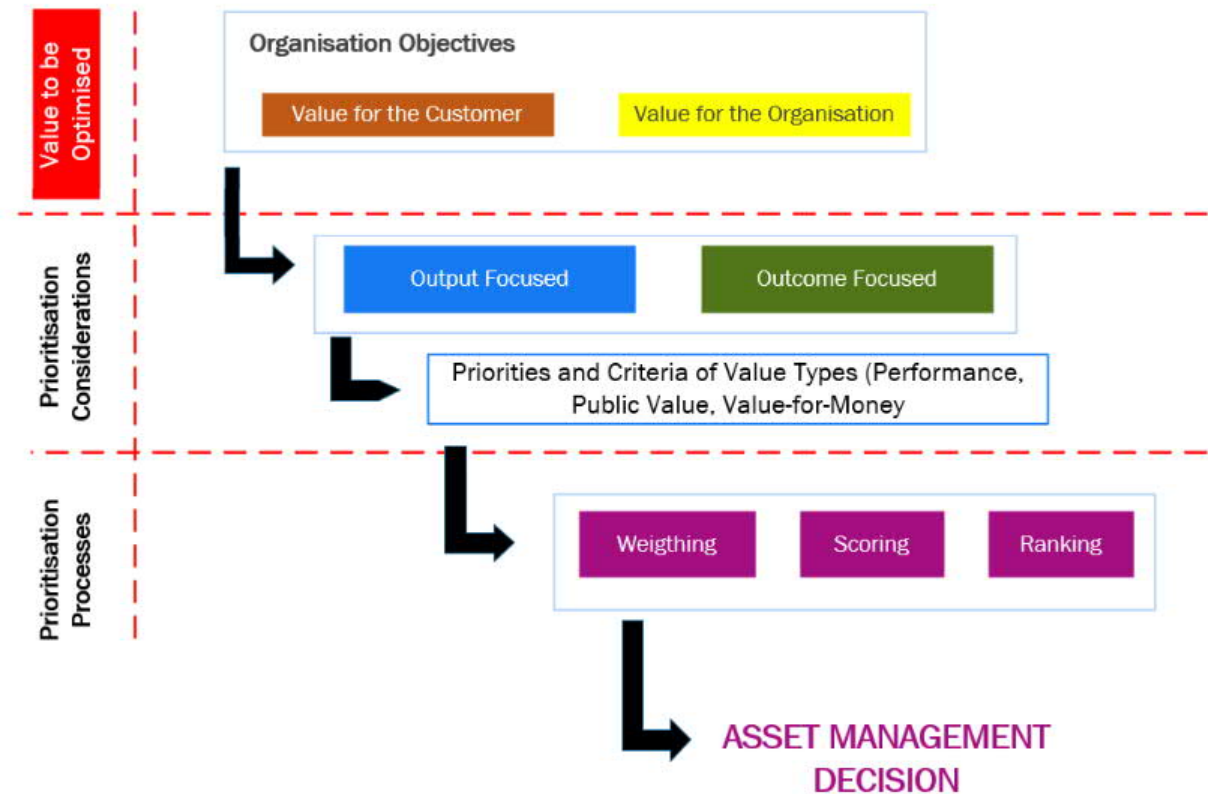


Figure 4-6 Generic Prioritisation Process

The core categories of value prioritisation consist of two sub-core categories 'Outcome Focused' and 'Output-Focused' and depending on the initiative of realising or creating value for the Customer or value for the Organisation. The generic prioritisation of weighing, scoring and ranking of specific criteria was often based on the organisation or asset management objectives that ideally should be articulated in the Strategic Asset Management Plans but was often not the case as observed. The following sections will discuss the key considerations that emerged from the coding processes and participant responses.

4.3.2 OUTCOME FOCUSED

Measuring outcomes of government actions is acceptable in principle or theory, but it is often a costly and challenging exercise that may not deliver any real benefits or value. Furthermore, most social returns or outcomes take years to eventuate and even intergenerational for the value to be realised. Collection of public satisfaction may not be appropriate for every area, such as law enforcement, regulation, tax collection or rehabilitation of criminals. To deal with this issue, managers are often forced to conduct measures of value other than social outcomes or public satisfaction of public sector activities but are forced back onto measurement of visible and concrete activities and outputs such as asset performance as a proxy of organisation value. While these measures are relatively simple and inexpensive to define value, they are actually a means to an end as opposed to the desired outcome, the organisation's value. Furthermore, as Woodhouse (2019) argues, implementing an asset management system may not necessarily 'improve performance' but rather 'lower risk'. In other words, for the sake of simplicity, Sousa and Meireles (2022) noted that performance can be regarded as the expected outcome or result of an option taken, and risk is basically the potential performance variability of that option due to the inherent uncertainty that cannot be completely removed. Traditionally, prioritisation for value maximisation is about optimising performance with risk considered implicitly and has evolved into specific performance metrics to address climate change and other natural hazards such as floods, heatwaves, and seismic and volcanic risks in certain parts of New Zealand. The discourse of resilience and risk, whether they are different (Linkov et al., 2016) or resilience as an extension of risk (Furutai and Kanno, 2018), presents the common notion that managing risk should also include not only the direct and

immediate risk but also the indirect and cascade risks over time. However, it was not clear from the interviews what prioritisation methods have been adopted to optimise value (Negulescu et al., 2020). For local government, priorities would typically be included in Strategic Asset Management Plans guided by the priorities in the mandatory 30-year Infrastructure Strategy and 10-year Long-term plan under the Local Government Act 2002

"There is the 30-year infrastructure strategy and Long-Term Plan, and the Auckland Transport Alignment Programme (ATAP). For example. We're looking at the whole transport network, we're looking at a whole northern network, we're looking at growth and what infrastructure is required for that. We're looking at assets that no longer be required and are hard to justify or have maintenance issues that we just don't think we need them. So that's a continuous process that happens through the Long Term Plan every three years, it happens through ATAP, it happens Watercare programme and then Healthy Waters." (LG7)

The long-term plans and strategic asset management plans often define what needs to be prioritised, as evidenced by the examples below.

"...we have a refurbishment budget that is driven from a strategic asset management lens" (OTH4)

"...we are legislated to reinstate following emergency works in emergency event. The SAMP will just will possibly allude to it. It is a funding requirement for us to do it. We carry a contingency so to speak for it and that contingency is risk-based, so they'll look at the forecast of historical and looking changing climate changes and then work out roughly what it is, and we are to manage as best we can within that." (CG3)

"In terms of capital programs, we have a prioritisation system for all our project group, what business case has to be developed and what priorities we need to base on strategically. It's revised every three years, so then you're able to trade off, water,

wastewater and transport, some of properties and parks. We get very little community input in the prioritisation process. Expectations, it's almost a level of service conversation, it flows through the asset management plan. Our 30 Infrastructure Strategy has the strategic view of the council vision, along specific overlay of your asset management planning between LTP cycle.”(LG5)

“To prioritise what we did was in each Long-Term Plan, we have a criterion on how to prioritize ... Infrastructure group manager is given a bucket of money, based on the information I provide. So, when it comes to the long-term plan, he will ask all of us to identify the projects that need to go ahead and then how much money we need for operational as well as capex.”(LG4)

Responses from the interviews highlighted several key themes that the proposed conceptual value optimisation model could potentially address, such as the lack of consistently applied technical or ranking methodology.

“... the challenge we have with prioritisation tools is that at the end of the day it's actually out of the politicians who decides the priority, that's actually an issue for council and I'd say for central government around prioritisation projects when you see a change in government, that are either being to be invested in or diversify. We're behind in my view, Australia and Singapore. And in terms of actually applying a technical prioritisation or ranking methodology, is not that straight forward for public infrastructure... you've got this wonderful Strategy here, but it doesn't actually address that fundamental issue. Australia has struggled with it and they're in a much better place than we are where they will base their prioritisation on proper consideration, Business Case prioritisation rather than a political whim.” (LG7)

The central government makes decisions at the Parliament or Ministerial level before instructions are disseminated to the agencies. For example, a mandated approach was required for central government agencies as described in a 2018 cabinet paper (MBIE,

2018) that outlines an agreement in principle for all government office accommodation to be focused on meeting the Government's expectations with respect to a citizen/community focus; a drive to collaborate between agencies; provide workplaces that value people; and value for money for the taxpayer. These mandated changes led to a multi-year program focus on the drive to regional growth, the future of work, and a standardised approach to fit out and design. Key elements of the program include (page 3):

- A focus on sector alignment in regional centres, reducing the footprint in the Wellington and Auckland regions, and assisting agencies to move functions to regions where appropriate and practical.
- The establishment of non-agency-specific workplace solutions, such as coworking spaces.
- New Zealand Government branded offices, with agency brands secondary, and a consistent approach to fit-out and design for agencies.

In another example with the application of the Treasury's Investment Management System and Living Standards Framework, the Transport Outcomes Framework of the Ministry of Transport (NZTA, 2021b) was established to define a set of outcomes for the transport system that enables a strategic, long-term and integrated approach for transport agencies around Aotearoa New Zealand to achieve the outcomes or results together, by developing indicators for each outcome to orient and track progress in key focus areas around the country to improve people's intergenerational wellbeing and liveability and quality of life in New Zealand's cities, towns, and provinces. (*Figure 4-7*)

Transport Outcomes Framework

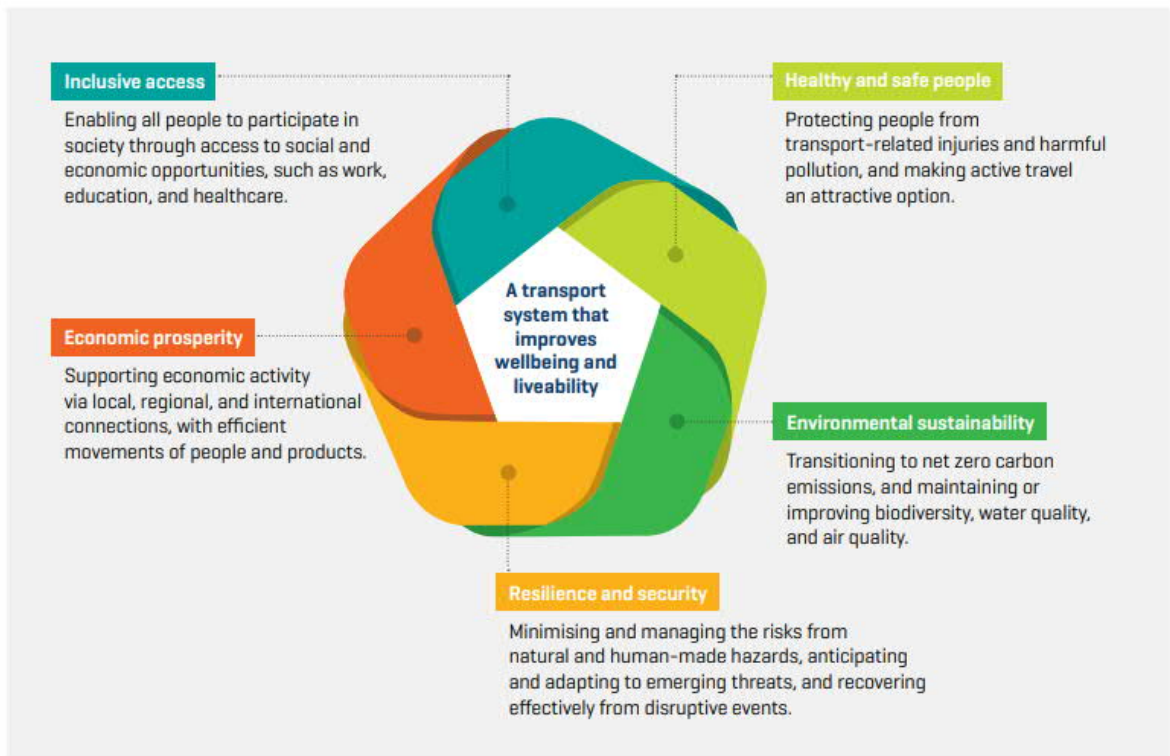


Figure 4-7 Transport Outcomes Framework (Source: NZTA- <https://www.transport.govt.nz/area-of-interest/strategy-and-direction/transport-outcomes-framework/>)

This framework enables the prioritisation efforts of authorities to yield expected results or value through optimal trade-offs between outcomes that include:

- Inclusive access – Accessibility is shaped by location and distance (how far people need to travel to access what they need/want), personal capabilities (physical and financial abilities); travel options available, and time required by each option. Transport needs to be closely integrated with land use planning to maintain and improve access in the long term. Transport planning should focus on moving people and products rather than vehicles.
- Economic prosperity – Transport supports economic activity by connecting a business's value chain (staff, customers, suppliers, other businesses) that impacts transport options available, journey times and costs, and the capacity and reliability of each option.

- Healthy and safe people – Transport safety considerations must be considered in the design, development, and usage of safety devices and the reduction of harmful pollutants from vehicles.
- Environmental sustainability – Supports reduced or low carbon emission of land, air and maritime travel modes.
- Resilience and security -Maintain transport security to prevent intentional or accidental harm to people

An application of this framework could be summarised from this viewpoint:

“Waka Kotahi has moved to become a principle-based investor. About 2000, or early to 2010/12, Waka Kotahi moved more towards the planning, investing for outcomes, and do more of your upfront planning. In 2014, they move to adopt the Business Case principles as well, so being really clear on what the problems are. And so, with that, you then develop up the investment business case, which is your AMP. And then you put that customer lens, the outcome lens and it turns into an activity management plan... the Investor and Delivery have to work closely to identify all of the activity class funding requirements and investment levels moving forward. And the investor has to work out how best to deliver on the government's aspirations. We are to prioritize our investment to best help them meet those activities. So, we've funded for activity classes, there are multiple, it's about a dozen activity classes, so they're different activities from public transport through local road maintenance, etc. ... funded from the government funding pool. We are required to meet expectations through a statement of performance each year or a statement of expectations. So, the proposal we put forward to the government, the government will put forward its signals.”
(CG3)

However, as noted by several participants, there is often the challenge of balancing on the short term and not long-term objectives.

“Balancing the political realities of the world we live in and how we are currently structured can be addressed through medium- and long-term focus. If you are looking only at the short term, it is not asset management. It is basically asset maintenance and reactive work. The fundamental consideration for prioritisation is looking at the medium to long term revenue model. The questions to ask are: How much do we need to run these assets? How big is the asset base in the future? At what age will they be? What are the likely scenarios around future operational context with regards to seismic standards, climate change, sea level rise, demand, energy reliability, etc.? If you don’t ask those questions, you’ll then find yourself the revenue model has disappeared. Take xxx, everything was going great until about one year into the 2018 funding plan where there were a few big project blowouts and then they were on the backfoot since.”(LCE3)

Society often places a strong value on ‘public issues’ such as *distributional equity* and the *stewardship* role of the public sector for future generations, which is different from for-profit organisations, which have a legal obligation to the future value of shareholder’s equity that is not guaranteed.

“Equity is an important consideration, ... among your current safe, it's a public good, Council or the Government investment. Then you gotta take into account the current community better off with the infrastructure you're building, the asset that you're building is going to have a long life. Then you've also got to understand how the burden of that investment is met by the future generations compared to the current generation.”(CG5)

Some may argue governments only have an ethical responsibility to protect the interests of the next generation. This reflects the current challenges mentioned at the beginning of poor asset management practices and only short-term focused on decision-making when most of the assets in question have long life spans.

“The fundamental thing about prioritisation is the time horizon and my observation is that the time horizon is short as it is within a political cycle. I’m aware the government in 2014 made legislative changes in 2014 to help encourage councils and other public infrastructure providers to think more strategically, to look out at least 30 years. The problem with that was when the Department of Internal Affairs first launched that, it was very much a check box exercise. The value of ‘why are we doing it’ got lost. The reason being governance or decision makers didn’t want to be told how to do their job. They didn’t understand the value proposition why the 30-year strategy is quite important. It was a huge failing. Councils today have a 30-year strategy and how well is this really addressing the issues. Chances are it is not happening on their watch and as a decision maker, you will be out of a job, possibly within 3 years. So, why do you care about the long-term issues, once you are out-of-office, you are off-the-hook. That’s a disconnect between good long-term decisions.”
(OTH2)

4.3.3 OUTPUT FOCUSED

ISO (2018) suggests the importance of a decision-making framework comprising processes and decision criteria in an organisation to ensure consistency and alignment between decisions. Considering the requirements of the ISO 55x standards, the synopsis in [section 4.2.4](#) and discussions on prioritisation by the respondents, the Strategic Asset Management Plans (SAMP) reviewed mainly capture the expected outputs of the asset management systems as depicted in [Figure 4-8](#)

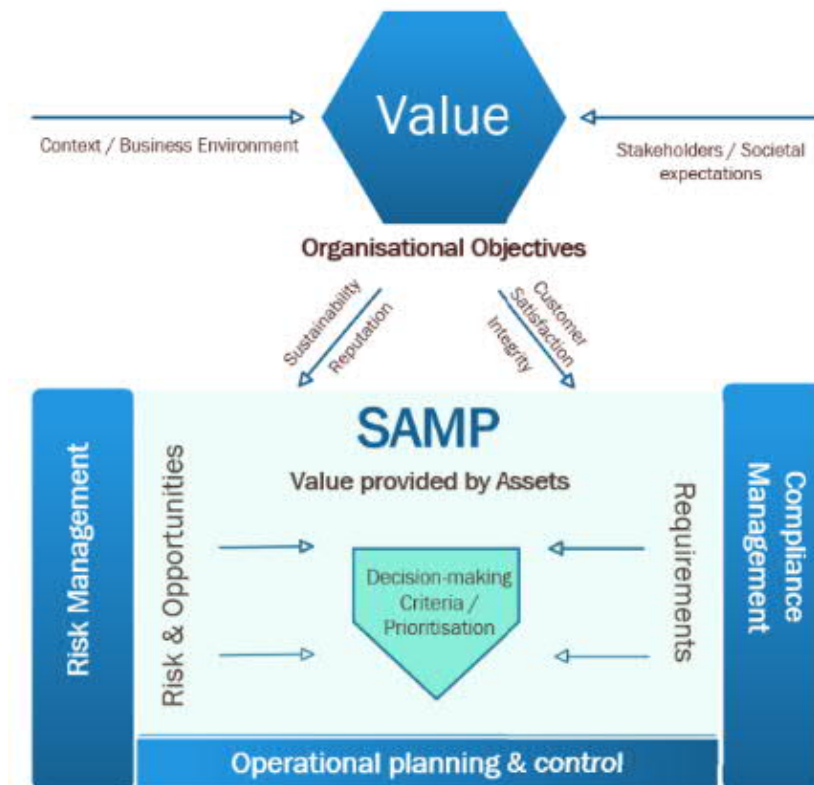


Figure 4-8 - Asset Management Decision-making Framework (adapted from ISO, 2018 - Annex D)

As shown above, the ranking and selection of asset management strategies as part of the prioritisation process requires a consistent value optimisation criterion for consideration determined by the organisation based on internal and external factors that define what the value is, how it informs the organisational objectives and its alignment with the SAMP.

In for-profit organisations, there is a clear distinction between means and ends even though the boundaries and structures continue to evolve (e.g., joint ventures, strategic alliances, partnerships) as creating returns to shareholders (central/local government) pretty much remains the same. For public sector organisations, dependent on the organisational context, the operational criteria used for prioritisation generally relate to cost, service levels (satisfaction), sustainability (climate change), risk (legal, financial, reputation) and compliance (regulatory, safety) and revenue for quasi-public entities

governed by an autonomous board with profit expectations. As noted in the response, what relatively is a simple asset becomes complex when every possible operational criterion for prioritisation is considered:

“Well, it's a big problem and in service delivery, what is effectively a very simple asset deliver varies hugely and the performance of delivery varies. It is a fine balance, it's all needed, it all comes down to how much you got first to spend. You can prioritize, you get as much effort to identify where the areas of need, but it comes down to how much funding that you have to deliver those.” (CG3)

There is also a need to recognise existence of capability (or lack of) to execute effective prioritisation.

“... Asset managers aren't the best communicators, and generally asset managers don't put themselves at the decision maker's table.”(LCE3)

For public organisations having a similar yardstick (though there are substantial overlaps, often have multiple objectives with no 'single bottom line' (Kelly et al., 2002). Another challenge is the balance between tangible and non-tangible benefits where decisions are based on economic measures and not on broader living standards or social value, as one participant noted:

“... we've got feedback that we get that in some of our stuff, the tired levels of service might not be significant.... people will use the library less if it's ugly to use and not welcoming. People will use assets less, and then what is the impact on social value in the communities if they don't have a social place to be able to use or things don't look great. So that's probably one of the challenges with prioritizing.”(CG6)

There is also the distinction between balance and compromise (trade-off) between different objectives that is often difficult to make like-for-like comparisons, as one participant noted:

“When you talk about asset management, you've got this, let's call it, the science and the theory of asset management, but then it has to be applied in an organizational setting most effectively. And that's when the prioritization and the compromises kick in. I mean, there is a balance and there is a compromise. Is there something that you use to make those decisions, or it becomes sort of, you know, case by case, we talked about, you know, upgrading the equipment, there is risk that is probably not in accordance with the regulatory. But at the same time there are benefits that is not realize immediately but you know, quite a long way off. So how do you sort of, you know, balance those expectations. So, there are a number of inputs to all of these decisions, and it would depend on for example, there's a number of factors that could be, you know, the scale of the discussion we are talking about, a \$200 million dollar building or we're talking about a hundred-thousand-dollar HVAC replacement. So, it isn't always one solution.”(OTH3)

An interesting comment is that there will always be winners and losers as noted below and the key message must be present is the rationale behind such a decision.

“My unit is involved in balancing the different capital needs across the entire business. There will always be winners and losers and managed through understanding of risk and benefit. Peter always gets robbed to pay Paul you know, and I accepted that a long time ago. But no, that's not the sort of conversation you want to have. They are difficult conversations, but it's about people hopefully getting the point of recognizing 'why'. It's all about the 'why'. So why did we make that decision? I mean and it's how you might be the one that didn't get what you wanted. You understand, you go, why, understanding why we've done, what we've done and agreed what we've agree.”(CG3)

The risk of asset failure, as opposed to the risk of poor service, was the common consideration of participants in the study. Mitigation and avoidance of risks were often considered as value drivers (reducing risk or de-risking) and considered together with the risk appetite (e.g., compliance requirements due to the asset's age and physical condition).

“Key considerations. I mean as a starting point, in order to define what your strategy is or decisions need to be ... requires quite a comprehensive risk metrics that didn't just have planned performance, but would include like financial loss, reputation and environmental factors. So, all of those things' present risks and opportunities, but you know also how's your asset performance in relation to each one of those we would consider. Some of those if it came down to plant damage that's easier to quantify, if it comes down to reputation, there's harder to quantify and but you need to. What we did find, we needed to quantify each of them so then to commercialize them and put a dollar value against such risks. So you can then, someone objectively assess them against each other.”(OTH2)

Other performance considerations were generally related to cost avoidance and service levels within funding constraints as opposed to increasing the quality or scope of services that could generate and create more value. However, there are consequences of cost avoidance with poor asset performance, as one participant noted:

“We've had a degraded Network with low investment level. So, our existing assets are degraded, and we've got a program to improve it. But our degradation is probably 10% of network, 10 to 15 years. I feel sorry for XXX because xxx network has got 20 years of neglect funding.” (CG3)

Another participant noted:

"...if you don't have enough money or enough resources, then you do have to prioritize and say, of all those things that need to be done, which are the things that are most important or when you address them or put the funding or the effort or the resources we'll give you the biggest bang for the buck, you know. So, in terms of timing, which is best right now, and which could be done later, which need to be done first, because they could be better building blocks for the bits that come later. It requires a lot of experience." (CG5)

Revenue growth was hardly mentioned by most participants with the exception of those that had profit or surplus as a critical success factor of the organisation as one participant noted:

"One more thing comes to mind as we classified our projects over, we had the health and safety, but most of them are in the risk reduction space. But we did have other ones that were in the enhancement space. And so yeah, have we spent \$2,000,000, we might increase their annual revenue by \$1,000,000. So, it pays itself off in two years, that kind of thing. That seems like a really good investment because we are enhancing what we're doing, we're generating revenue. But you then have to weigh that up against risk reduction projects that needed to be done within the year. So ideally you do this one that's going to make you more money over time, but sometimes they had to be put further on the back burner in order to just manage your level of risk. So, understanding your risk tolerance, your risk appetite and saying we're, we prepared to go and how much risk can we carry? Who carries? Then how do we provide assurance to ourselves that risk is well understood and well quantified." (LCE2)

In practice, it is not straightforward to quantify risk to ascertain what is at stake, the cost of risk control or the consequences, such as financial losses to the organisation as noted by several participants:

"The challenge is you need to move to some form of eventually to some form of quantified view of risk. So, they've been able to achieve that in the electricity sector. It's much more difficult and roading and rail. So, for example, with an asset we know roughly how the assets degrade over time given the environment. So, you come up with asset health indices that correlates to a probability of failure curves. Now it's an average of your averages. It's really stochastic. The world is stochastic, but what you do is, try to take a pseudo deterministic perspective to give yourself a failure curve, probably take it, you know, the criticality. So, the criticality covers all of those dimensions are mentioned before, safety, environment, cost, performance. And most organizations already have risk matrices where those different dimensions are aligned, and you can put a dollar figure to those. And, as I said before, this is not a full answer because it's the little, put your legal perspective, your safety perspective. Be clear when it comes to safety. But if I know what my consequences and I know what my probability is, I can work out my annualized value of risk for that particular asset. So, in terms of its potential failure, I know that it might cost me \$250 annually or two hundred fifty thousand dollars per year. Then could we apply for opportunity costs as well as, yes, and in fact you do if you want to put in a new service you'll actually say well what is the value that the same will actually deliver to the end consumer, so it's just this other side of the same quote."(CG6)

An ambiguity of how risk is defined when considering the positive or negative impact of risks adds complexity to conforming to the 'Assurance' fundamental of asset management, as one participant noted:

"So, I mean ISO 31000, the risk management standard, I think it's the right one. It's about a risk being either a positive or negative effect and impact on an objective. So, the way it seems to work in asset management is things that almost like hygiene factors, are things that we're not trying to pursue, but things that we don't wanna get wrong if you get it wrong, it's a big deal, but if we do it excellently, we're not going to necessarily get you know extra revenue or better performance. So, it's almost like

the hygiene factors, whereas I think that's not, I don't feel it's aligned with the ISO 31000 risk definition, and I think it's also therefore not aligned with what everyone's thinking of risk, if risk is a positive or negative impact on achieving our objectives such as deliver high performance assets for a low cost or best possible cost. There's a whole lot of risks that impact on those which are both positive negative, but that's not really what risk means in asset management conversation. Normally it means things like safety, environmental impact, and it tends to mean kind of those negative things that could happen that we just need to make sure we don't screw up, and we don't have a negative impact on, so I think that's where the disconnect comes. You know, I think, I'm not sure, that the term risk serves the asset management community well, because it has different meanings in different contexts.” (OTH2)

There were a variety of approaches or decision tools used for prioritisation, including the admission they were not used as intended:

“We do have an asset management plan, although it's a question of how that's really like filters down to the people who make all the decisions .. it seems that sometimes, it's very sort of, 'umm it's kind of lick your finger in sorting out what are the top priorities and how much money have we got to be able to do this and what comes up and stuff like that.”(OTH6)

Alignment is one of the key fundamentals of asset management, and often, in practice, there is a lack of understanding of the true impact of asset needs, risks and funding constraints.

“Asset management is about a 3-way balance. In addition to the needs of the assets, how much risk we're willing to take on and how much money we have. “But fundamentally, the model is set up for this is how much money we have, not, how much money we should have. For me, that's a fundamental gap as you've got people running around saying, oh, we've got a low-risk appetite for certain assets, but they

(decision makers) never fund for it. So, there is a disconnect that ends up as arguments between the asset manager and finance department. Where it should actually be a 3-way conversation going, not just, “well if you don't give me the money, I can't do these things”. Therefore, the Risk Department needs to adjust all of our risk appetites, and our decision makers need to accept all that. You don't get to make grandiose statements about how we run stuff and then not back it up with the funding.”(LCE3)

The alignment to the wider ecosystem in terms of the supply chain also affects the assurance of the availability of market capability:

“Funding needs to be predictable because you can't just suddenly turn on a whole lot of funding in year one or two and then turn it off in year three because the whole supply chain needs time to gear up, whether it be materials, staff capability, equipment, consenting, quarries, materials, you know, rocks, you name it, that whole system is quite slow. So that's why I said the medium to long term need and trying to get that as robust, stable and predictable as possible. It is the secret to ‘getting it right’ as political knee jerks on price, political knee jerks on funding availability, just stabs the market. When the market gets stabbed, people leave and when you try to turn it back on e.g., you now need to maintain all these buildings, there's no roofing people left as you have closed all your roofing contracts. People needs to live and put food on their tables. So, understanding the ecosystem, the complex system which we operate is a really important part of it. So that serves as a medium to long-term understanding of the asset needs and determination of the revenue.” (LCE3)

Similar to the above, prioritisation is often risk-centric and often relates to the ranking of the criticality of impact and consequences of risks that are dependent on the risk tolerance of the organisation and the linkages between different risks:

“So, one of the big elements from us from an external auditing perspective was how does the university link risk and it doesn't just mean the health and safety risk, it's the reputational risk, it's the financial risk, it's the security risk, it's the ICT infrastructure risk. It's sort of more of an overarching.... So, I guess the key things that we look at are What is the long-term plan for the university? So, Where does the university see itself? What are the projected student numbers that we're looking to get? What are the impacts that are happening in the economy?” (OTH6)

Compliance is an essential consideration for many organisations with health and safety concerns for internal staff and external customers and ranked as ‘Must Do’, ‘Should Do’ and ‘Could Do’ in terms of criticality ranking:

“We need to keep these houses ticking over and the risk factor is based on our risk appetite. A lot of the appetite as agreed by our Board and a Risk and Assurance committee starts at that compliance level. So, we have three phases to our risk appetite. ‘What we must do’, ‘What we should do’, and ‘What we could do’. So again, it's making sure language is consistent across the organization. MUST DO is compliance led stuff, health and safety led stuff. SHOULD DO is all based on our Levels of Service. We should always try to achieve our Levels of Service. What we COULD DO are added benefits, other things that we could do to add value across the portfolio.”(LCE1)

With funding constraints, levels of service often relate to functionality requirements with aesthetics regarded as “nice-to-haves”:

“... they've got a prioritisation framework that, for instance, puts health and safety right at the top. So, if there's critical renewals, for instance, that will impact health and safety of anybody using that asset, then that kind of gets a number one priority. .. it kind of goes from your critical renewals to maintain service. So, it goes health and safety, levels of service impact, growth impact, etc. And then kind of gets to the nice-

to-haves. So, what are the things that you know, at the lowest end of the priority means that an asset might look tired but will still be safe to use and it'll probably still deliver a service that's not significantly different. And probably a good example of that is, community hall or a playground where you could sweat it. It'll look a little bit old and need a bit of a refresh, but as long as, from a health and safety perspective, it's usable. It'll probably keep getting used by the community.”(LG6)

Other categorisation and ranking of projects at a micro level relates to timing and partial completion are described below:

“Prioritization ... is embedded in our IDM - investment decision making framework..., that's used to inform our investment proposals. ... then you go down to the different programs or programmed maintenance, ... so we invest each year to make sure that's been used at a local board level with DTiMMS, a forecasting tool and availability of precisely funding and stuff. So, it is a tool and we invested heavily to make sure that it's as robust as a modelling can be, and that helps the local partners deliver their programs in a fairly consistent way. The question is, that was put on my table a few weeks ago, as do we fund the whole thing and say, right will. Yeah, you'll do the whole lot, and we'll pay for the whole model and get a standard model and based on our priority considerations, or do you let the local region play with their own buckets to work out where they want to put their money.”(CG3)

Some organizations adopt a centralised approach to prioritisation and allocation of resources at different levels:

“But often times as well, those improvements, tens of millions of dollars. So, I separated them into the different categories, you can then sort of objectively ranked them. And one of the ways we go about doing that as we would use some metrics to sort of look at the cost and the risk profile and how many different triggers they met and give them an arbitrary rank of prioritisation and then moved to have challenge

decisions. We would draw a line and say we've got \$10 million to spend on opex, this is where the line is, and we go through them. The ones at the top all will quickly jump over them if it's true those events are on the same page they need to attend to. Then you get to the ones that are just above and just below the line and you sort of go 'Right, do we agree that these ones here need to happen then? That's when you got finite resource, you know, finite budget and finite labour and even consultants and contractors we're tied to. So start looking and get if we have to choose one or the other then we try to have a company-wide approach and having people not worry about protecting their own patch but considering what is the best for a company with one it's projects goes ahead of the other, so that those who are ways in which we would balance but just looking at those that would bring in risk and cost, you got performance. And like efficiency improvements how we get more for less on the way through. And so, we try to consider all of those things. That becomes quite a broad process, but at the end of it, it's really quite robust and defensible and most people are involved with the outcome.'”(LCE2)

All but one organisation noted prioritisation criteria were not used:

“Criticality is one of the prioritisation criteria, it should be it, but it's not. We don't really have anything at the moment. So basically, if you're good at selling your project, you can get it through.”(LG2)

And when it does, it is not consistently applied:

“We do in a very immature type of a way, so we're sort of at the very grassroots of being able to establish a prioritization matrix. So yes, we do have a multiplier as such, there is a formula used with that we put together that takes into consideration things like the risk, or the space or the critical or the importance of the space, the risk of the asset, how important is the building it sits in and what condition it's in as well is obviously a factor for that. So again, we're sort of in that, we have the framework of that established, but we have yet to sort of roll that out across all of our assets and

be able to produce an accurate report on it with regards to that actually being something meaningful and tangible that somebody can look at and therefore, then make decisions off.”(OTH6)

The principle of *value for money* when procuring goods or services does not necessarily mean selecting the lowest price but rather the best possible outcome for the total cost of ownership (or whole-of-life cost⁷¹) using the most appropriate procurement method for determining the risk and value of the procurement, and not necessarily by using a competitive tender (OAG, 2008).

“For decision making we consider its fit-for-purpose. We have a target score that we measure to the target and the target is not the same for everything. It’s a combination of who measures it and moderated and the targets were set initially with the business and the various regional division. Same questions but just at different levels.”(CG1)

The NZ Treasury’s preferred method for assessing VfM is through cost-benefit analysis measured using Benefit-Cost Ratios (BCRs), but it has been known to cause conflict or not in line with how appraisals are done with government policy drivers such as the Living Standards Framework that plays a significant part for the prioritisation of public services (Treasury, 2021b). This notion was also evident in this study as participants defined VfM for different asset types and areas of investments across organisations. For example, as noted below:

“The next question is ‘how much money do we need to run the assets’ which implies short-term focused on today’s costs and spend. I don’t think we truly understand what

⁷¹ Whole-of-life costs (WOLC) means the present value of total cash costs of an investment over its life cycle, calculated using the WOLC guidance and the relevant Public Sector Discount Rate that should be used as a metric for assigning decision rights over particular investments taking into the considerations of the downstream economic costs as well as the initial economic costs of the investment proposal (CO, 2019)

it should be costing us today because not every single fault on the road network is sitting in the computer system. You can't analyse what is missing. If you look at 100,000 kilometres of the road network in New Zealand, we do not have all the safety barriers in the system that need replacing at some point. Have we actually got the whole picture as roads are not replaced by length but square meters. Adding a half meter to a few 100 kilometers of road makes a big difference in terms of what material we need and the cost of running those assets. Getting the revenue right is a big issue for a lot of people. I get the power sector is regulated, so it's slightly different, but in general, public infrastructure has issues.”(LCE3)

Interesting after the interviews, a performance audit on how Government made infrastructure investment decisions found that *“Ministers did not have enough information to be sure that decisions supported value for money”* and made three recommendations: regular reporting on progress that enable the public to form a view whether the investments are delivering value, issuance of a Treasury guidance on expedited decision making, adequate investment criteria and appropriate documentation of decision-making processes and to seek regular feedback to ensure ‘fit-for-purpose’, and consider the Investment Management System include minimum requirements and guidance for setting up and running contestable funding processes (OAG, 2023).

4.3.4 SYNOPSIS

There were similarities and differences between quasi-public (for-profit and not-for-profit objectives) and public organisations. The similarities are that all participants were entrusted with a bundle of assets and accountable for ensuring high-value uses of these assets in a relatively dynamic environment where organisation value derived from assets can change rapidly. From a strategic perspective, as discussed in [section 2.2.4](#), managers

need to consider internal capacity and capability for sustained success, which they have control over to a certain extent, as well as the external world views of stakeholders (e.g., willingness to pay) of what constitutes value for money which they may have some control or none at all. At the operational level, their success is finding a less costly way to achieve objectives and outcomes and minimise risks that often cannot be eliminated entirely (e.g., climate change). At this level of abstraction, the challenges identified by the research participants is about the same. However, once we drop down a level of abstraction and look more closely at the economic and political conditions under which individuals manage the assets, things begin to look quite different, as discussed in this section.

It was interesting to note that in some cases, prioritisation criteria did not always align with how value was defined in the same conservation. This highlights the natural tensions between outputs and outcomes expected by different stakeholders. Improving better social or environmental outcomes comes with a cost as well as great financial risks for the organisation or asset owners. The balance of risk, cost and performance is easier said than done as deciding on the desired value required has to be considered from an output view and an outcome view. For example, an ideal asset created could be sustainable and resilient, support social equity, and generate long-term financial value for the organisation at the least possible costs with minimal risks to the asset owner and society. However, it can be assumed that the implication of the competing needs and claims of different categories of stakeholders will result in the priority given to no particular group using a systematic basis established by these organisations through the policy settings and mandatory tools used.

In general, every organisation has established and applied some form of a prioritisation framework for defining and determining an asset's value and importance at the asset's strategic, tactical and operational levels, but often dependent on the funding availability. When applying the framework, the organisation has considered its context in terms of internal or external issues and objectives that are aligned with the discussions of value for the customer and value for the organisation. However, at times, there was a perceived overlap of the two scenarios as respondents argued that customer value realisation, such as having a reliable asset information system, would be impossible without ensuring value for the organisation. Stakeholders' requirements, risks and opportunities are the common considerations used to define and determine the value that it aims to prioritise and criteria to apply that include the potential impact of the decisions, the urgency or lead time required for executing the decision and the capabilities available to the organisation.

4.4 THEME 3 – SOCIAL AND CULTURAL FACTORS

4.4.1 INTRODUCTION

RQ3: What are the critical cultural/social factors for the successful development and implementation of an asset management system?

The research question RQ3 aims to ascertain how social and cultural considerations (if any) are related to the value perceptions (RQ1), prioritisation considerations (RQ2) and the relevance to the enablers employed (RQ4).

Infrastructure systems are complex technical systems interconnected with numerous sub-systems and collectively engineered by an equally complex social system comprised of

many players bounded by roles, responsibilities and accountabilities that processes and contracts may formally or informally guide. To describe asset management culture in the UK/European context, ISO (2022b) defines organisation culture as *'the belief and behaviour that determines how people and management interact and handles transactions outside the organisation.'*

Schein (1965) model suggested that artefacts, values and basic assumptions at different levels are the basis for an organisation's hard and soft skills. His research supported the thinking of other theorists (Katz and Kahn, 1978, Buelens et al., 2002, Kast and Rosenzweig, 1972) that were based on the systems theory developed by Von Bertalanffy (1950); who established the interdependence between sub-systems (goals, structure, management, technology and psycho-sociology) and their complex interactions at different levels between individuals and groups within the organisation, and with other organisations and the environment as in an open system (French and Bell, 1995).

While there are many definitions and theories of organisational culture, there is a common understanding among theorists and practitioners that organisation culture affects work practices, including commitment and engagement of employees (Lok and Crawford, 2004), organisational effectiveness (Denison and Mishra, 1995) and success of asset management systems in organisations (Zuashkiani et al., 2011, Kuprenas et al., 2000, Brunetto et al., 2014). Similarly, Woodhouse (2003) suggests significant issues with contemporary asset management practices are not caused by technical capabilities but rather centred around human factors that require a paradigm shift in the sophisticated requirements of skills and abilities of employees.

The paradigm shifts through improving the competencies of management and staff could only be achieved with a good understanding of an appropriate organisational culture. Cultural attributes can relate to and be affected by governance and managerial style, vision and strategic direction, organisational climate of employee relationships and working environment, stakeholders' expectations, etc. However, asset management research is predominantly focused on technology, methods and systems for managing assets (Hipkin, 2001, Hodkiewicz and Pascual, 2006, Trevelyan and Tilli, 2007, Albert, 2002) and has the tendency to overlook the importance of internal and external stakeholders or people play as a critical element in implementing an effective asset management system which this research intends to address.

Social and cultural factors were often interchangeably used in the interviews, which reflects the perceptions that both are similar, interrelated, and interdependent. Gündoğan (2021) argues that the idea that '*social*' is first produced and later manifests into '*culture*' is incorrect as they are separate (different) simultaneous processes. He argues that social space always starts within specific cultural spaces but tends to produce new ones through time. This notion is of particular significance in this study as it explores the context for an effective asset management system under the constructs of a '*built*' or '*created*' environment for asset management through the mastery of effective processes for control, productivity (efficiency) and effectiveness over time. In other words, this research intends to answer the question of '*how*' with specific forms, ways and means through which the question of '*what*' is responded to.

Organisational climate and organisational culture are two conceptually distinct but overlapping constructs that the participants interchangeably used. Unlike organisational culture, which evolved from anthropology and sociology disciplines for over eighty years, organisational climate emerged from the gestalt psychology of Lewin (see Lewin et al., 1939) based on the study of people's reactions (social and behavioural attitudes) to leadership practices. Organisational climate research for more than fifty years focused mainly on capturing people's experiences at work using various methods regarding how policies and practices may affect behaviours (Schneider et al., 2011, Schneider and Barbera, 2014). According to Hartnell et al. (2011), climate is merely temporary attitudes or perceptions subject to regular change, while culture is more enduring over time. However, Denison and Mishra (1995) argue that culture and climate only differ on their theoretical foundations, as the person and the environment are not separable based on '*interactionist*' and '*social construction*' frameworks. In this '*structuralist*' view, according to Payne et al. (1971), individuals create the climate through interacting with the structures of the organisation (culture), where culture engendered by the organisation becomes relatively stable over time (SCHEIN, 2003, Schein, 1965, Geertz, 1973).

Similarly, Ostroff et al. (2003) observed that while culture and climate exhibit shared meanings and understandings of the organisational context, organisational culture literature tries to develop taxonomies that reflect holistic culture while organisational climate literature generally focuses on specific dimensions of climate. In that sense, climate can be considered as a shared perception about the entire manifest characteristic (culture) of an organisation.

Riley (1983) notes that structures are both the medium (rules and resources) and outcomes (the application) of interaction and cannot be independent of the social practices created. Interestingly, as observed, responses from participants did not always fit nicely with what would be academically or theoretically considered social, cultural or climate factors, including personal values and beliefs both existing and deemed absent in the organisation by the respondent for effective asset management. Shelton et al. (2011) argue that organisational culture is a function of internal and external factors. External context of the New Zealand public sector includes inflationary pressures, climate change commitments, hydrogeological disruptions, historical underinvestment in critical infrastructure, intergovernmental relations and political influences. Internal context relates to the maturity of management systems, organisational behaviour and culture, stakeholders' satisfaction and perceptions, competencies and capabilities within the organisation value chain. With similar veins, Parker and Bradley (2000), in their studies of six organisations in the Australian public sector based on the '*Competing Values*' framework, identified four major types of culture depicted in [Figure 4-9](#).

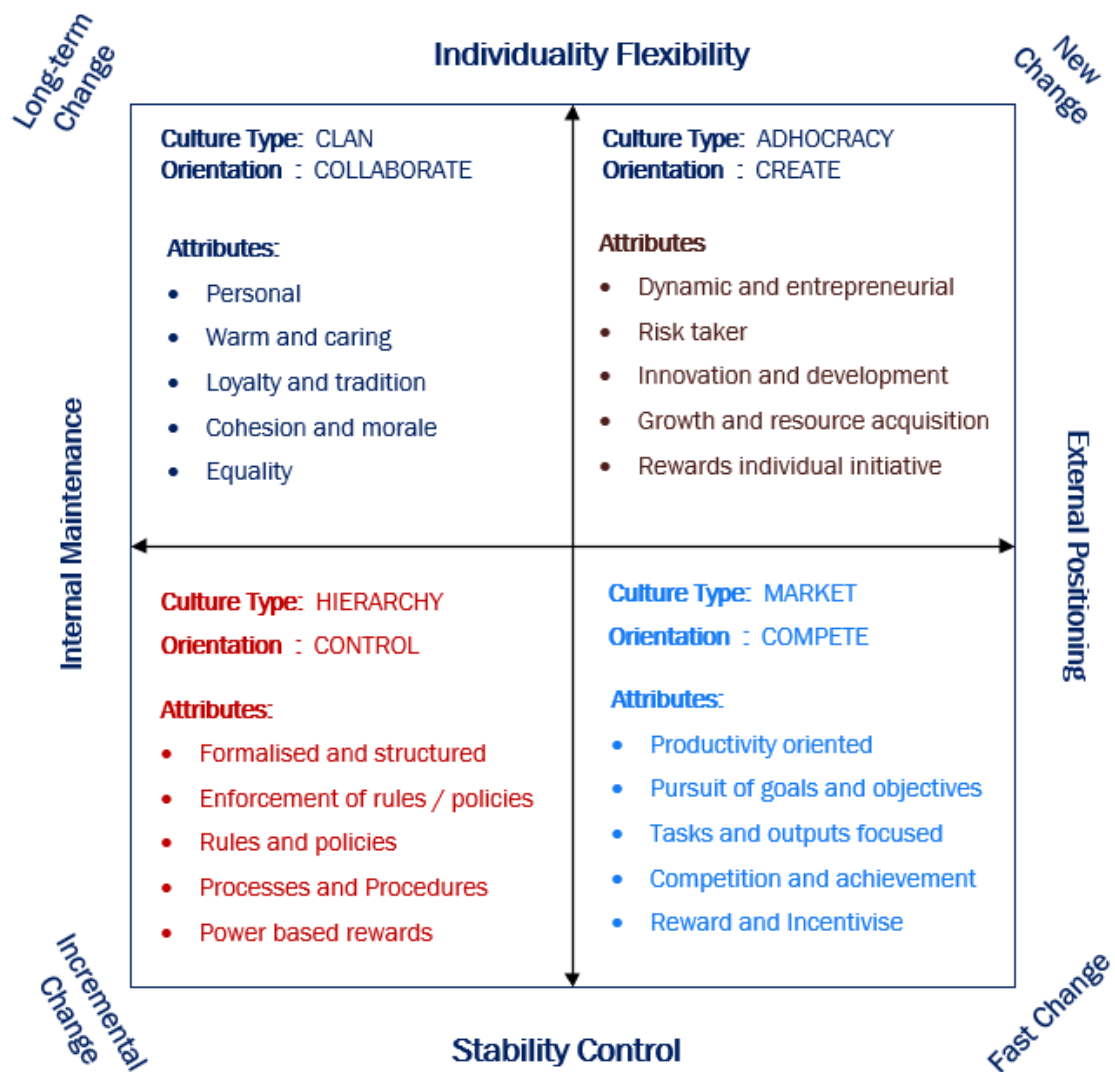


Figure 4-9 Competing Value Framework (adapted from Zammuto and Krakower (1991) and Parker & Bradley (1991))

Interestingly, the varied responses of the participants could easily fit within the four quadrants in one guise, or another based on the different constraints of the organisation and individual circumstances (authority, experiences, education and training), although it was not the intention of this study. It was observed some participants tended to focus more on influences within the organisation, while others preferred the discourse of the external environment within the wider public sector, such as the Treaty of Waitangi obligations,

political influences, regulatory constraints and the public service sector perceptions by society.

As expected, the participants in this research, as experts in their respective asset management disciplines, were cognisant of the complexity of the social/cultural aspects and presented a much greater degree of understanding of the multiple and complicated elements within their organisation context that is often difficult to capture comprehensively the full knowledge and meaning of their responses. In some responses, social and cultural factors were included in answers to all three research questions that highlighted the importance of these elements for value optimisation and effectiveness of an asset management system. Hence, this section will attempt to organise complexity into profoundly simple terms of value and application to the research objectives. The following will describe the sub-foundation or key social/cultural elements upon which the asset management systems are built and managed by the research participants.

Figure 4-10 adapted from Johnson (2010) model for creating an asset management culture. It illustrates an overview of the discourse on what and how social / culture factors relate to the other research questions based on references framed by assumptions and values of the organisation that defined the participants' selected asset management strategies.

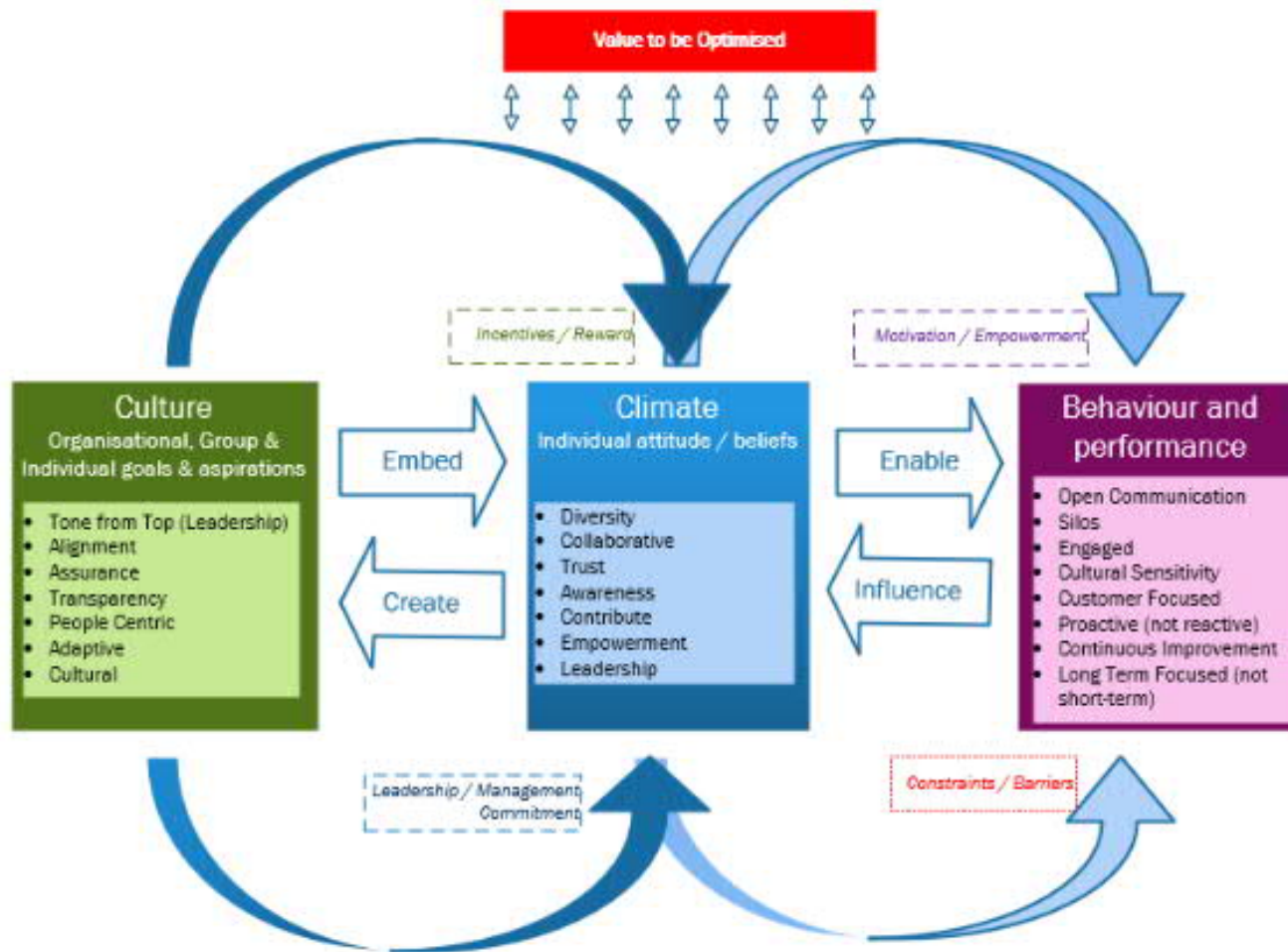


Figure 4-10 Relationship of Social and Cultural Factors with Performance (adapted from Johnson, 2010)

For research question 3, the axial codes and selective codes (categories) were created from several hundred open codes identified as key considerations of critical social/cultural factors to consider for successful implementation of an asset management system as provided in [Appendix G](#). The three core categories of ‘*Societal-Political Legitimacy*’, ‘*Organisation Culture*’ and ‘*Organisation Climate*’ are based on several axial codes that appear in ‘*culture*’ or ‘*climate*’ separately or both in a different context characterised by properties derived from situational circumstances provided by the participants. The following sections will present some of the key considerations grounded on the data collected and coding processes described in [Chapter 3](#).

4.4.2 SOCIETAL-POLITICAL LEGITIMACY

Latham and Sue-Chan (2014) posit that the transmission of culture is not top-down or linear, as social cognitive theory states that behaviour is influenced by thoughts and feelings by an individual. These thoughts, feelings and actions affect actions taken in the environment in which the person works characterised by its (value-laden) elements of culture and climate created by individuals (Bandura, 1986). Extending this notion to *public choice theory*⁷², Boston (1996) describes society as:

⁷² According to McLean (1986), Public Choice theory is focused on:

- the problem of aggregating individual preferences
 - studies of formal social choice and spatial theory of voting
 - individuals as rational actors (voters, politicians, bureaucrats, lobbyists, etc.) and how they behave in different settings with different incentive structures
- analysis of collective action problems that produces sub-optimal societal outcomes as a result of the pursuit of individual interests

“In short, human beings are not merely economic beings, but also political, cultural, and moral beings who inhabit an economic system that is profoundly influenced by, and in a sense depended upon, the attitudes, habits, beliefs, aspirations, ideals, and ethical standards of its members.” (p. 30)

The central tenet of the *public choice* approach, according to Buchanan (1978), is that all human behaviour is dominated by self-interest as individuals, by their very nature, are rational utility maximisers, which implies that as private businesses seek to maximise profits, politicians seek to maximise votes and public sector officials seek to maximise resources at the expense of societal well-being or the common good, not guided by fundamental ethical precepts. This phenomenon is often regarded by public choice theorists as a rationale for a relatively conservative political agendas of minimising state control or maximising autonomy as much as possible. While *agency theory*, similar to public choice theory, assumes individuals are self-interested utility maximisers, it is focused on ensuring the appropriate information is available to enable optimal principal-agent contractual relationships, including the best form of motivation through rewards and sanctions (Rees, 1984). The term ‘*contract*’ includes both a formal and explicit, legally binding agreement and an implicit, obligational or relational agreement through mutual trust and cooperation. The concepts and assumptions discussed above support what this research termed as *societal-political legitimacy* that determines how a public sector organisation optimises value from the asset management decisions made and the performance expectations by citizens and society. The value optimised would correspond with the financial commitment (willingness to pay), and the legitimacy and support provided to organisations to achieve the agreed outcomes. An example below reflects several views of the political influences on the public sector.

"I've got a little bit of involvement with xxx, which you would be aware of their 30-year plan that got released last year or they've adopted plan got released last year. The language in it is a little bit concerning. As I said at the beginning of the conversation that this government in particular and you know, it's not a new concept, but there is a greater propensity to centralise and some of the commentary that's made as, that organisations such as xxx have not managed their assets well for many years and look, the reality is there's probably some fact and truth in that, because that's what we're dealing with at the moment. But centralisation of the day-to-day decision-making and operations is not the answer. Putting in place protocols, frameworks, policies, guidelines in terms of how public funds should be used in managing its built infrastructure is necessary and will help us. And it needs to be audited and you know that is occurring through the monitoring agency. But to actually sort of have decisions made around whether we build a building or don't build a building and how that sits with our master planning, I think, is fraught with danger."
(OTH4)

"I've already commented I do believe there should be more focused from TEC being good performance from the university estates across all the universities. That does not mean that TEC should take over all of the estates in New Zealand and start managing them centrally. I think that would be an absolute disaster. I think when central government attempts to manage things, it doesn't do it very well to be honest. I think providing the rules and the guidelines and doing a bit of monitoring and enforcing, absolutely that's appropriate, that's the standard Governance-Executive model. The executive decision has to lie with the university." (OTH3)

4.4.3 ORGANISATION CULTURE

Organisational or corporate culture is difficult to define and generally accepted as intangible, representing values, shared meanings, assumptions or beliefs about its challenges, problems, practices, and goals. (Igo and Skitmore, 2006). Culture is a reflection

of the various organisational depths of belief systems (Chowdhury, 1992) and what people believe to be the *'best thing'* to do in a given circumstance, often called *'best practices'* (Hofstede et al., 1991). These perceptions have been shown to be influenced by the behaviour of leaders among followers (Block, 2003). Buch and Wetzel (2001) suggested that whilst often there are prominent, visible and audible manifestations of culture, artefacts and espoused values in most organisations, not all attributes can be directly observed and instead must be inferred from the interactions with actors themselves, which is an intention of this research. Maanen and Barley (1985) provide a concise view of organisational culture comprising four attributes: ecological context, differential interactions, collective understandings, and reproductive and adaptive capacity. The first two are structural requisites, the third are dependent on the rules, rituals and values created to respond to unique issues facing the organisation by strong leadership (e.g., champions) or written policies or motivational tactics employed, and the last imply that cultures cannot be fixed as circumstances and personnel changes.

The comments from participants support previous research on *competing values* framework (e.g., Igo and Skitmore, 2006, Quinn and Rohrbaugh, 1981, Morais and Graça, 2013, Brunetto et al., 2014, Hartnell et al., 2011) of *'internal vs external orientation'*, *'control vs flexibility'*, and *'traditional bureaucracy vs autonomy'*. In most cases, as expected, these public organisations revealed a standard set of characteristics, such as structured hierarchies, rational rules and procedures for decision-making constrained by political authorities and activities. Their objectives, structures and processes through *'Letters of Expectations'*, *'Statements of Intent'*, and *'Statements of Performance Expectations'*, often defined by the government (cabinet papers), central controlling

(monitoring) agencies, regulations and legislation are often subjected to the conflicting demands of society, specific communities and interest groups.

The New Zealand Public Service Commission - Te Kawa Mataaho established the *Papa Pounamu* work programme that defines cultural competence as recognising one's own worldview and understanding and valuing the cultural and social norms reflected in the diverse public service sector in addition to supporting the Crown in its relationship with Māori under Tiriti o Waitangi (Treaty of Waitangi). In addition to the Māori-Crown relationship, all the organisations have noted broader cultural competence and obligations on their websites that broadly include, but are not limited to, ethnicity, nationality, age, gender, sexual orientation, disability, religious or faith affiliation, etc. One respondent noted the relevance of social and cultural considerations for asset management:

“For social and cultural considerations, there’s several angles, and I guess two sides of the same coin. There’s the understanding and awareness of the people who are managing the assets, the organization and the staff, and the other, how the assets contribute to community outcomes in a positive or negative way. ...this understanding of what is in the kind of the understanding of the community, I do think that if decision makers and staff are representative of the community or at least have a good understanding of the community and all their kind of social and cultural diversity, then they will make decisions that had a better understanding of the impacts that the assets will have on those communities. So, I think that’s quite a key external facing, cultural, societal kind of consideration, Yes, it’s community, but you’re going to understand the impact if you understand the community. I think that the treaty itself isn’t necessarily cited.... I think there should be engagement with the community and understanding what and where should things be done with the assets, where the community wants to get their balance between cost and asset performance. And often, the community engagement has come up with surprising answers. They would

rather have a cheaper power but less service or they're happy to accept more outages, if I can get more cost-effective power because I have no money because of poverty. So, it's more about understanding the needs of the different community groups, which I think is a reflection of the Treaty principles.”(OTH2)

Another externally focused perspective identified the different implications of the various strategic and operational levels of consideration.

“When it comes to cultural, I think where we are, in terms of our own journey, we're probably, I think, as an organization, we more, do things at a project level rather than, you know, a higher-level strategic management process. So, I don't think, it's not visible to me that, we, as part of an asset management policy, we might talk about Treaty of Waitangi and our obligations, and Māori outcomes but to your earlier point, that's not a category that we use in terms of prioritization. So, it does it have the same, we talk about level of service is one thing, which you could argue incorporate some of that but not it's not deliberate, if that's the word I'm looking for. And I think the critical stuff that is getting stronger and where there's a lot of focus is in terms of managing and looking after our natural resources, our land, our water, our, you know those are the things that are actually I suppose through climate change as well, and sustainability, but is really important to Māori is around protecting our natural resources. And so, there is quite a leaning to that, but whether, I suppose, I can't really say whether I think that's happened because of the focus on Climate Change rather than the focus on Māori Outcomes and what we're trying to achieve.”(LG6)

BSI (2014) established that applying a management system for managing assets must include ensuring the appropriate awareness of stakeholders under the organisation's control, which might consist of staff, contractors, internal or external providers and suppliers. To establish this culture, a unified vision and intention from top management is

needed to ensure an understanding of the relevant asset management policy, asset management plan and asset management objectives, as one participant noted:

"I've seen it in an organization where the organization lives and breathes it and just does it, you have, so, it's baked in right away from the top all the way down to; it's very easy to just become part of that is expected, to become part of that."(OTH1)

Sinclair (1991) describes a 'cultural-control' model where, in an ideal organisation, culture is strong, unifying, inclusive, pervasive and widely shared by all within the organisation. In other words, it is felt not only at the superficial level that determines behaviour but also consistent across and entrenched in organisational subsystems (Schein, 1990). Most responses took into account the asset fundamentals of value creation, alignment, leadership and assurance (ISO, 2014) and promoted the principles of good asset management practices:

"Culture will only change from the top. So, when you're not as an asset manager necessarily, the one in charge of a business unit, its profit earning operational business units, you need to start with the people at the top of the food chain. The best place to start is establish a policy. Get everyone on board that this is the right thing to do, and you will have different perspectives on them but ultimately it is a belief issue, people will send you away, did a cost-benefit analysis of why should we have this policy? What's it going to do? What's it cost? Benefit analysis? And if you're dealing with that at an executive level, it's we're not actually talking about cost of associated with establishing a policy because you can change that as you go through. It's actually, "Is this where we want to go as an organization or not?" And if you have that sort of conversations, I've just been having with you now, there's actually about the customer. For example, you might ask about the SAMP: Is it bad? I have sustainability of our business and that's what this document is actually talking about. If you don't believe that then, okay. So, you've got to start with the asset management

policy, but it's got to be a policy with teeth. And that means you need to have, very often, people focus on the one page but that's a statement for the public perspective. But in your asset management policy, you need another bit which actually talks about roles and responsibilities. And I know generally people think of that as being in the asset management system framework and right, but very often you got to establish your policy before you've developed your asset management system framework."
(CG6)

Whilst the culture control approach remains enthusiastically encouraged in many organisations, some have argued that the model is unsuitable for public sector organisations, as Martin and Siehl (1983) raise the question: *At what point does culture become propaganda and training becomes indoctrination?* Similarly, Fitzgerald (1988) observed that overzealous control of corporate culture is morally questionable and likely to jeopardise the ethical robustness of the organisation in the longer term, as one participant noted:

"I've seen organizations attempt to get that sort of leadership team, asset management focus leadership teams up and running but without a clear policy in terms of what the role of the executives and what you're actually trying to achieve. They have been rudderless and eventually they peter out." (CG6)

However, proponents of a subcultural approach believe that good management of culture begins with an understanding of the value differences and terrain of controversies or conflicting views (Gregory, 1983).

"You will always get people that oppose you, but you can't help that. But you want to have as few of them as possible and have more people on board and promoting what they have done; help them see the transition through to a future state and how they

adapt to their day-to-day job that enforces strategic objectives for the company. That's really essential that they that they can get ..ah, ok, we're not do this, we're gonna have, it's gonna make more money, people are gonna be safer. ...it creates a more fulfilling work environment as well as getting a more heavily engaged workforce, better outcomes, better quality outcomes, social outcomes. All that leads to correct culture around ownership, you then get to see better outcomes for your assets that will last longer, they'll report failures and observations of damage sooner, so you'll actually mitigate a lot of your problems before they become big issues causing downtime and breakdowns.”(LCE2)

From a systems perspective, based on the cultural control model and participative-authoritative dimension, a participant noted:

“I think that the first one is that it is a system and an understanding that it is a system and complex systems like asset management. A system has a large number of subsystems, and those subsystems are owned by different places, as they should be across the organization. And each one of those subsystems might have independent people being accountable for the delivery of those subsystems, but the overall system owner needs to be across all of those subsystems and ensuring that the dependencies and interrelationships and that there are controls on the performance of those subsystems to make the overall system work. Which then brings to play the cultural and people challenges and social challenges. Because often, in a large organization people are very focused on their one little subsystem box and no matter how much you try and invest in your organizational maturity, not everyone operating in all the subsystems can ever appreciate the whole system and what you're trying to achieve and how it all interrelates to one another. So, you need a very strong centre around that, so what I would say are now is that asset management as a system, just like any system, is a mix of technology and IT as an enabler, it is a mix of training and education upskilling at all levels in the organization from leadership right down to your cold face rangers that maintain stuff through to cultural acceptance of your vision and objectives, what the system is trying to do.” (CG7)

Martins and Terblanche (2003) argue that poorly developed organisational cultures can have a detrimental impact on organisational effectiveness and can be managed to stimulate creativity and innovation.⁷³.

"... some of the barriers that would get in the way of an asset management system are deeply, deeply cultural. So, I always say in a thing like an asset management system, that 20% of your effort is in the technology and 80% is in the people. And that's where it gets hard because there's nothing more difficult than people. If I could drive an asset management system through to success purely based on IT and technology and standards, all of that hard rather than the soft stuff, then this would be done everywhere in all organizations, to a much better way than it is at the moment in New Zealand and in the world. The issue is culture, people and change, and leadership. So, to that end, in an asset management system, there is three things. There's the system which is that technological system which we need to land. There is leadership and I'm not just talking from just the Minister, SLT down to, you know, a manager at a site. There is integrated leadership that needs to be upskilled and informed, and told what good looks like, and have them lead it and own it, and then there is a whole bunch of symbols and other things that that need to go with that."
(CG7)

There is a concern in the current control environment that attaining the long-term goals of the organisation (collective) depends on more than the *direction-alignment-commitment* framework as the context of a public organisation (technologies, social changes, historical

⁷³ Creativity and innovation are often used interchangeably when regarded as a thought process and intellectual activity used to generate new insights or solutions to problems (Arad et al, 1997). Martins (2003) defined innovation as the implementation of a new and possibly problem-solving idea, practice or material artefact (e.g. a product).

outcomes) has a significant bearing on longer-term outcomes requires flexibility and adaptability as noted below:

“So, in the same way that finance has managed to get their attention, asset management should too. And finance, probably should take a bit more of a backseat. Because at the end of the day. It's the arbitrary decisions of finance saying let's defer there or that, let's take 5% off all the budgets, those sorts of crazy decisions, which basically means you're going to start cutting corners and when you start cutting corners, you start going blind on things. And that's when people start to get hurt and things start to fall down. And that is the concern I've got is where they go with a 5% across-the-board drop in budget and then they don't adjust their risk appetite statements, and they don't take tell you what and just assume that we can suddenly do stuff. Using an analogy, you know you can't replace a car tire for \$10. You need \$40 and if you give me \$10 to replace a car tyre, you can't sit there and say, oh, that's your fault, you've done a bad job. Oh, I'm sorry. Attire cost \$40. You didn't give me \$40. I asked for \$40. You gave me less. I did the best I could with the money you gave me. The challenge with that is, I don't think the communication is adequate where there is no feedback loop to come back and say, oh, the consequences are due to the fact of giving me \$10 to replace the tire. The key consideration for me is that 'engaged ownership' of the decision makers. And that leadership, that decision makers can bring in terms of informing the conversation.”(LCE3)

Several participants also place distributional equity and due process of doing the 'right thing.' from the Treaty of Waitangi perspectives:

“... from a Treaty perspective, we're on a real power sharing, equity driven Kaupapa at the moment ...that's quite how we have to be, I think, moving forward, is to be completely open around who derive the benefits, who actually gets the value from our service.”(LCE1)

“there is also the overlay of the Treaty of Waitangi and about partnering with the Iwi. It's not just about a community with some stakeholders. we've got this other layer here in New Zealand. So particularly, when we talk about Heritage and Cultural buildings, we've got to bring them on board as well.”(OTH1)

“The equity question we'll get answered by who benefits or who potentially can benefit, and then how the narrative is done.”(CG5)

Central and local governments have a stewardship role in ensuring future generations do not pay for poor decisions of the past. In other words, they have an ethical responsibility to protect the interest of the next generation of citizens, though it is evident many organisations in the study appear to not follow good practices of ‘futureproofing’ assets as several respondents noted:

“We also have to give a lot of consideration to long term serviceability as well. That probably links in more to the system in terms of is it going to meet our needs not just today but is it going to continue to meet our needs in the future.”(OTH6)

4.4.4 ORGANISATION CLIMATE

Theories of social influence, such as *social learning theory* (Bandura, 1986), *social exchange theory* (Kieserling, 2019), and *social information processing theory* (Salancik and Pfeffer, 1978), posit how individuals look for cues of appropriate ways to behave in their environment. The social exchange between organisations, organisations with individuals, among individuals provides a shared understanding of what constitutes appropriate behaviour for ‘*organisations like us*’ and for ‘*us in particular*’ and provides a coherent and predictive collective behaviour within organisations over time that leads to an organisation identity. According to Albert et al. (1985), organisation identity will exhibit the

characteristics of *“central, enduring, and distinct”* where core elements (not peripheral) endure over time (not ephemeral) and consist of a set of core features that characterise the organisation as either similar or different with others. For organisational identity to make sense, according to Alvesson and Willmott (2012) *“organisational members must broadly agree that that the organization has certain distinctive features, that it differs from others in certain respects over time, and that its distinctive features characterize the organization in different situations and across various themes, such as decisions, actions, and policies”*(p.22).

The performance issues surrounding the asset management profession can be affected by the consulting firms engaged, professional societies, forums and academia (education), which can have a significant impact at a personal level that could alter a manager’s sense of self and accountability. The change to a *‘strategic identity’* could transform the profession from passive administrators to self-disciplining strategists (Clark, 2004). According to Whittington et al. (2003), strategy can be considered a profession like law, medicine or engineering occupational groups with collective identities and connections that go far beyond particular organisations or sectors. At a national level, Barry and Elmes (2017) assert a strategy discourse can influence public policy by supporting the national competitiveness of New Zealand, referring to several strategic writings (e.g., McKenna, 2006)

ISO (2014a) identified leadership as a key fundamental (pillar) underpinning the standards and later repeatedly identified leadership as a key support process of an asset management system. As a fundamental, it is about a widely shared set of expectations

about what it means to be a leader (but not necessarily the) that encourages beliefs, perceptions, and behaviours to achieve their fullest potential as leaders (Day et al., 2014). There is a shift in considering leaders as stewards of culture and climate to active change agents of the psychosocial environment (felt and perceived) where the mandate changes for the better as stewards. Hernandez (2012) defined stewardship as *“the extent to which an individual willingly subjugates his or her personal interests to act in protection of others’ long-term welfare”* as interpreted by a participant:

“For the social factors, there’s a classic saying: The culture will eat strategy for breakfast. So, you can sit there and say what we’re going to do, we’re going to be the greatest asset managers in the world, we’re going to do all this amazing stuff. The key decision makers are absolutely across what this is, and they are directly doing their jobs as the custodians or the decision-making custodians of the assets. I’ve seen it work a number of different ways, but generally, the people that get those roles as the decision makers really don’t understand infrastructure. So, investment is required to upskill them to broaden their understanding of what’s actually going on, they might not want to hear it, and they might not have time for it, but fundamentally, that is absolutely essential. I can have the best asset management team in the world, but if you start going up the food chain to the decision makers and they’re not engaged and they don’t get it and don’t handle them right, it is pointless. . But at the end of the day, if the culture of the business isn’t firmly established and reinforced to deliver that it’ll never happen. And fundamentally, that comes down to me, leadership.” (LCE3)

Smircich (1983) argued that fashioning and reinforcing values and beliefs through socialisation, role modelling and rituals is considered a critical yet misunderstood responsibility of senior managers. This notion is supported by Sinclair (1991), who established that creating and maintaining a solid culture requires clear steps, commencing

with the development of a corporate philosophy or mission, widely shared by those right at the top to be successful as one participant commented:

“Internally, as I say that the success of any other systems relative to the culture, and the leadership that you've got, So if it's not brought in from a highest possible level, it's not really going to go anywhere in my opinion and that's why here, I really don't want to invest my time and energy doing a lot of stuff downstream until the strategy and the policy or at least the policy is signed off by someone higher in the organisation, and then you have the mandate to say, right, we need to do something.”(CG3)

ISO (2014) stipulated 'alignment' as another fundamental for asset management (clause 2.4.2) and 'commitment' (clause 2.5.3.3) as a key support process also implies the concept of leadership does not just involve the shared goals of leaders and followers but one that follows the *direction-alignment-commitment* ontological framework of leadership that provides direction to achieve consensus and agreement, alignment as a collective and commitment or willingness to subsume to the collective interest and benefit (Drath et al., 2008). From a 'whole system' perspective, it is argued that leadership is not about an individual but can happen in teams, communities and whole organizations in interactions and exchanges among people.

It was evident that most of the asset management practitioners have considered the application of management techniques that had previously been reserved for private profit-making organisations through strategic management, collaboration, effective communication, good change management processes and recognition that the human factor, in particular, leadership is pivotal to success as one participant note:

“For social factors consideration, you got leadership, culture, collaboration that is absolutely collaborative. You cannot have asset management when some people were not included or when they are in opposition then there are opposed to because they need to be on board. And so, as a word I'd use here is ownership. If people are really engaged and then taking ownership, they won't walk past things, they won't take shortcuts and trying to cut corners, they'll have this mentality that 'I want us to be as good as it can be. I'm looking after the long-term benefit of the plant. And so having that mindset will change how they engage with what's in front of them, the quality of job, they'll do, the number of incidents in their report or breakdowns they will notify you of.”(LCE3)

Another respondent noted:

I think that culture and people is the critical factor in landing asset management, particularly in a whole-of-country situation like this department. It is so much easier and I've been here and done it when you're sitting in a xxx Regional Council like Otago or Hawkes Bay, managing assets with everyone in the same office with you, you're dealing with them every day, it's a smaller scale, smaller number of people, smaller number of assets, with co-located people, it's so much easier to run it than a fully dispersed nationwide, 45 different offices, all with their own culture and personal views and biases, and a leadership team that that needs rapid upskilling in this area.”(CG7)

Scholes et al. (2002) argue that decision processes are significantly influenced by frames of reference drawn by management and governance built up over time from experiences which he coined the term 'cultural web' made up of six key elements: stories, rituals and

routines, symbols, power structures, organisational structures and control systems⁷⁴. Kouzes and Mico (1979) suggested in their domain theory that public organisations are likely to be composed of subcultures of policy or professional groups and that active management of a cultural scenario maximises the contribution of subcultures within the constraints of the organisation. This notion, when applied in the professional-multicultural model, assumes that cultural diversity produces synergies and a greater potential for innovation (Adler and Gundersen, 2001) where an increase in group performance is possible when social psychological mechanisms are activated (Roberge and Van Dick, 2010) as one respondent noted.

“Another key aspect of social considerations is diversity. I'm lucky to work with a team where I was initially the only engineer. We had an Economics major, Maths major, a Bachelor of Commerce and some with Science degrees. We also had people with no formal qualification. It was my first excellent experience of diversity of thought, and how different people looked at the same thing but also more importantly, which made a massive difference was the diversity of communication style... and so having a team with the confidence to speak and communicate and tell the story to different audience is important. They need to take people on the journey and having the luxury of the different ways of being able to tell it that suits an audience or the particular decision-makers around the table so that they could hear it in the language that they understood, and they hear it in a way that they got empathy. For example, there are

⁷⁴ Brief description of the elements of the cultural web (Scholes, 2020):

- Stories – Past events and personalities shared within the organisation and the wider ecosystem of the industry that describes core values and behaviours
- Rituals and routines – Behaviours and actions of people that reinforce how activities are conducted such as promotion, training, disciplinary or performance evaluation
- Symbols – Symbolic representations of the organisation such as branding, logos, working environment, common language and terminology used that portray the nature of the organisation
- Power Structures – Groupings within the organisation most associated with core assumptions and beliefs that are deemed most important (that may not necessarily link to value) and have the greatest amount of influence on decisions, operations, and strategic direction
- Organisational Structures – Formal structures that defines functions and processes that translate and action the organisational goals and vision. The organisation chart may be supported by unwritten lines of power and influence that indicate the value of contributions
- Control Systems – Measurement and reward systems that helps focus and provide direction on what is important for the organisation

times where some people look at me and say "I don't trust him, he stands there in a tie and a suit, and I don't trust him or like the way I speak. We like someone with a more informal style that can put people at ease and so the same message can be consumed a different way. So that for me, the biggest things are leadership, culture and diversity. That from my experience, other things that jump out the most."(LCE3)

Considine (1990) observed that public sector activities and functions formed part of a broader government strategy of economic management, social development and environmental sustainability and, therefore, were affected by prevailing political ideologies and not performed in a manner that the delivery of goods and services determined by market influences. At an individual level, Perry (1996) established that employees from the public sector might have values and motives that are different from the private sector, and hence, there are limits to attempts to align organisational culture in the public sector with the 'ideal model' of effectiveness and efficiency that the private sector organisations aim for to attain shareholder value (Perry and Rainey, 1988) as one of the respondents noted:

"In my experience, people do asset management by stealth, that is, the people responsible don't do all the documentation around it. It is different for me at present as I am the creator of the AM system. It is important to understand that you are part of a bigger system in terms of looking after long-life public infrastructure so that the asset management system exists, whatever that means. It should be either documented or instilled in the culture; so that people understand their roles and responsibilities within that system, and the behaviours and the cultures that are expected of an asset management system and it is continuously refined . Too often, it exists in a team but doesn't exist across an organisation . It's reliable and trusted. It's engaged across the various teams. IT management system has to work across the company, and in the changing context of the company."(LCE3)

Asset management as a term became popular in the late 1980s and early 1990s with the evolution of maintenance to management of physical assets that integrated engineering, financial and planning decisions for better outcomes. Until then, maintenance or managing assets was only focused on functionality and reliability (Burns, 2018). Chris and Michael (2019) noted asset management is still in danger of being mistaken for a branch of engineering. The term was a natural progression and aimed to galvanise new bodies of knowledge as the thinking at a system or portfolio level was wholeheartedly embraced by governments (including New Zealand) and large asset-intensive organisations. However, a few respondents noted that current practice and thinking do not entirely align with the intention of the ISO 55x standards.

"...other organizations even though there might be pursuing ISO 55001 don't see themselves as an asset management organization. I think it's, that's really the responsibility of the small team over here; the rest of us do other stuff and this certification thing is just a bit of a thing for that team or just a bit of a kind of a red tape thing. So I think you organizational culture is a big thing if people see themselves as asset managers, as a management company, and they understand how that contributes to community outcomes or external stakeholder outcomes. That makes a big difference for implementing your good practice, and structures."(OTH2)

As a result of privatisation and the New Public Management (NPM), the establishment of asset management frameworks (policies, standards) and asset management plans have become a backbone of demonstrating good governance to regulators (Vaughan, 2019), although a few respondents caution against this notion:

"Like all government agencies that goes in waves, depending on the passion of the staff that are around, we're currently probably starting to ride another wave of

enthusiasm to drive this. So, asset management is not new as roading has been around since time began. The science hasn't hugely changed, materials haven't hugely changed, it is a little bit of reinventing the wheel to a degree. But we're now, we are starting down the path again, of defining policies, asset management strategies, lifecycle management plans and establishing again, the framework to enable the delivery of those, that's what we're trying to achieve, our objectives. So, we're probably, I would say mature, but in it's in infancy."(CG3)

However, Chris and Michael (2019) noted asset management has now become one name of many things, and once tongue twisters begin to appear in the lexicon, it will cease to be useful, as one respondent noted:

"And the word asset management is probably not as relevant in our organization as something like a value chain or a delivery model or something. It is effectively a business process and is trying to establish that understanding that it is just a process that we're trying to deliver here. I think the word asset management, because people don't understand it, they don't want to engage in it. So, the language should be more appropriate, something they could relate to, then it will have more buy-in. So, whatever the process is the underlying aspects are asset management but getting that definition as 'what I'm trying to get right now'. And so, we've had, for example we have a need to do an asset management strategy, or a SAMP as they are called, to put a direction to our infrastructure, so we're not so reactive. However, the person that was in charge of delivering that didn't understand asset management. And so decided it's nothing to do with asset management and has gone down another path. All right, right now, it's coming back to the direction of saying, 'well, yes, you can have that, but it's still an asset that you're trying to manage', however, you word it." (CG3)

Though the current climate could be set to reinvent itself, new names emerge organically (Lloyd et al., 2019). Instead of a new term, Burns (2018) suggests the new revolution in asset management will be the era of *'infrastructure decision-making'* in the *'digital future'*,

incorporating climate change (Rayner, 2010) and sustainability (ISO 2022a). At a micro-level, language has been identified as a barrier to implementing asset management principles, as noted below:

There's a real language barrier where a concept is not known. A lot of people will switch off as they'll go back to their comfort zone. And so, yeah, it's about turning it into a language which is probably even more simple and then it demystifies it. So, getting that language right is a real challenge for each organization probably has its own language build into it. So, that's part of what I'm trying to do now is find that that language that people understand from a higher level. So, your Chief Executive will understand, your General Manager will understand a business process. At that level, what does asset management do. It's not really the best way to say asset management because a lot of organizations when they're starting this journey, won't really understand that, every time you change your management levels, they may or may not understand what asset management is. So, creating more timeless meaning it's probably what I'm looking at. right, right.”(CG3)

According to Vaughan (2019), it is imperative that asset management moves from being a ‘silo’ to becoming a ‘core business’ activity, and instead of a language for the technical expert, asset management practitioners need to learn a new language, the language of business as one respondent noted:

“Our investor or the Ministry have a higher level of direction that they must try and achieve, and we're only one of the aspects of delivering that. They go in waves like any organisation of understanding what asset management is. In general, they have a slightly perceived lower level of asset management knowledge, because it's not one of their core functions. And they have a function to identify whether the investment goes, and make sure the investment goes in the right way and done the right thing, as opposed to purely having an asset management team, because they don't

specifically manage an asset, they don't get involved in the day-to-day of an asset, they get involved at the high-level investment directions and outcomes. So, it tends not to be a concept, well embedded, and so, it goes in waves. And some parts of the world, it's a balanced carrot-and-stick, where asset management gets embedded, it is regulated. So, once it's written down on paper, it's something that must be done, then people will understand it because they have to. And you can see that local government here in New Zealand, it's regulated, it's in their system, in their ranks, they must have had asset management, so people are tuned to it and understand it. So that historically has come along faster than other parts of the Public Service.”(CG3)

One participant stressed the importance of conveying that effective asset management is about working with a common purpose, emphasising inter-dependence, co-dependence and collaboration:

“Simple principles that we're in this together, I'm not doing this to you, we're doing it together, so I'm trying to see set you up to success but my success is dependent on you doing good work management and completing the work order fully, not just doing it and not caring about updating the data because if you don't update the data, guess what, I'm going to give you the same plan to do next year because they didn't get updated, and it's in the same condition as it was when I had this year's one. But the fact that is your continuous improvement lead as well so you can see it inherently in that feedback. So, I use a diagram that communicates that quite clearly and I find that resonates very, very well within the business at all levels, the exec level down to the guys actually, doing the work in the field ... ”(CG6)

4.4.5 SYNOPSIS

It is deduced that the participants' asset management experiences are a function of a complex set of stimuli that integrates experiences with perceptions to form a meaningful pattern of effective asset management systems. From the responses, culture and climate

are reciprocally related and could be combined to expand and enrich our understanding of critical constructs of effective and efficient asset management systems. As noted by the respondents, climate and culture exist as multilevel phenomena in an organisation (i.e., strategic and operational). At a strategic level, the different *'enabling environment'* of the public sector under which the organisation operates creates the *'systems of stimuli'* for organisational culture and climate. This phenomenon could easily change over time, influenced by political, technological and other internal and external factors that could have multiple foci for governance, management and staff. Leadership was a common factor across all levels and is central to culture, climate formation, and top-down and bottom-up maintenance. Socialisation and training were standard methods to instil new behaviours, the foundations of core values and beliefs for the organisation and the individual. The reciprocal causation thinking that culture determines how organisations and asset management systems can evolve could just as well reverse the process as organisations take some control over time over the lifecycle but change the climate through appropriate working practices, structure changes, leadership practices and other aspects.

When an organisation adopts asset management, there are clear implications for *what* people do and *how* they work together – ISO 55x stresses the holistic nature of asset management systems and the need to break through traditional boundaries (ISO, 2018, ISO, 2014b, ISO, 2014a, ISO, 2019). But, conversely, essential implications also arise from the diverse types of people working in asset management – for the way teams are structured and for policies and processes governing recruitment, development and retention. It is easy to lose sight of this amidst all the work involved in adopting asset management principles. There are opportunities, too, to rationalise roles and

responsibilities and ensure the right people are in place to discharge them such as the 'asset management champion' as suggested by several participants. A person with a sense of belonging feels part of the organization and is committed to it and to its objectives, which they make their own, and this not only increases their performance but also contributes to creating a better working environment and is a sign of an excellent organizational culture. That people come to asset management from diverse backgrounds is both a source of strength for asset management teams and a weakness. It is a strength because they bring different experiences, perspectives, attitudes and beliefs about what is possible, networks and relationships, methodologies, tools and success criteria. These will make promoting and driving asset management strategies easier across traditional boundaries. It is a weakness because it makes establishing effective asset management teams harder. Hence, culture was also identified as an enabler to be discussed in the following sections.

4.5 THEME 4 – ENABLERS

4.5.1 INTRODUCTION

RQ4 - What are the enabling structures and processes for an effective and efficient asset management system?

The research question RQ4 is to understand the enablers for realising value optimally (through prioritisation) and creating the appropriate environment (culture/climate) for asset management. The resource-based view of a strategic focus discussed in [section 2.2.4](#) suggests that firms' resources drive value creation via the development of competitive advantage (Hitt et al., 2011), and that possessing valuable and rare resources provides the

basis for value creation (Barney, 1991). Traditional infrastructure resources that support an organisation system can include the assets being managed, the natural and built spaces, information and communication technology and other intangible assets such as people, intellectual capability, information, knowledge and culture. Technology can also be viewed as an activity that forms or changes culture to help combine the resources to create value for the organisation. Castanias and Helfat (2001) argue that "*the skills of top management combined with other firm assets and capabilities jointly have the potential to generate rent*" (p.665). Merely possessing such resources does not guarantee value creation (Barney and Arian, 2005, Priem and Butler, 2001). To realize value creation, firms must continuously accumulate, combine, and exploit resources (Sirmon et al., 2007). Hence, strategy can be viewed as a '*continuing search for rent*' (Bowman and Ambrosini, 2010), where rent is defined as '*return in excess of a resource owner's opportunity costs*'. (Rowley et al., 2013).

Similarly, ISO (2022b) noted that the overall performance of an asset management system is dependent on the successful integration of competent people into the organisation well supported by enablers, and advocates the importance of identifying and developing the appropriate knowledge, skills, behaviour of people with the necessary competence to integrate into the organisation to create a work environment consistent and aligned to strategies and values through a strategically based process approach (*Figure 4-11*). Enablers of asset management can be regarded as activities that need to be carried out early in the asset management process as critical success factors (Ngwira and Manase, 2016).

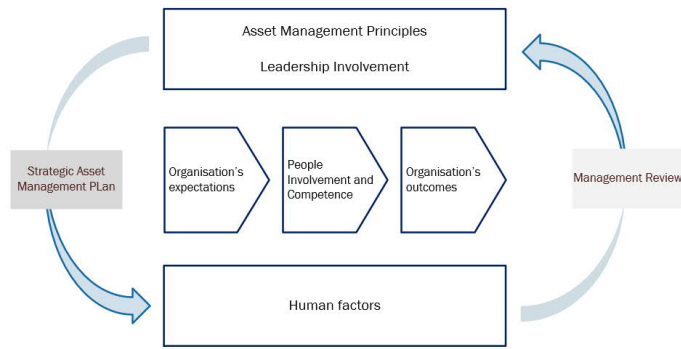


Figure 4-11 Leadership and Human Factors in the AM Processes (ISO, 2022b)

The categories, axial codes and selective codes were created from several hundred open codes based on comments from participants of enablers that were considered important and supported their earlier views of the three research questions (RQ 1,2 &3). Their views expressed are provided in further detail in [Appendix H](#). The relationships between value optimisation, asset management policy and the SAMP are depicted in [Figure 4-12](#).

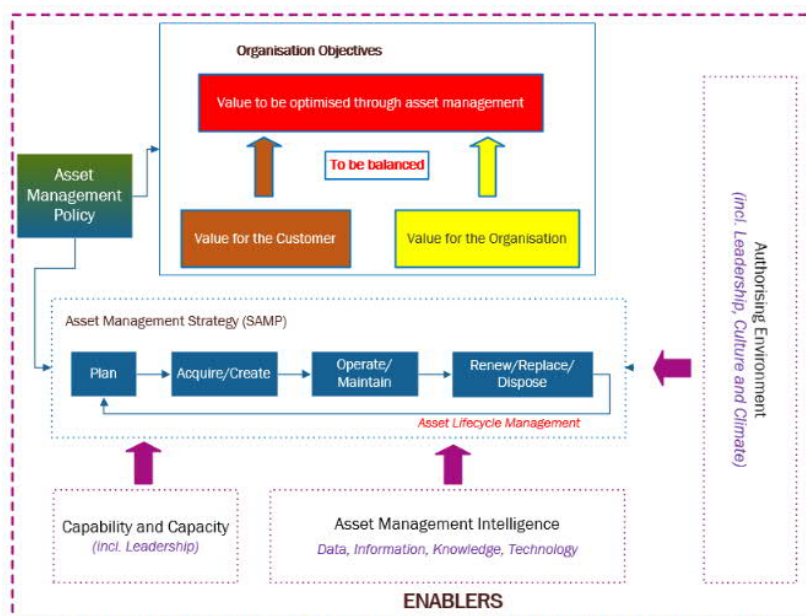


Figure 4-12 Relationship between value optimisation and asset management (source: authors)

The two categories of enablers that emerged from the coding process are '*Capability and Capacity*' and '*Asset Management Intelligence*'. Both categories tend to overlap in the responses collected, but for the purposes of this study, they have been separated into relevant sub-categories. For '*Capacity and Capability*', the sub-categories are '*Structure and Practice*', '*Leadership and Culture*', '*Change Management*' and '*Continuous Improvement*').

Together, the sub-categories of '*Data, Information, Knowledge*', and '*Technology*', are categorised as '*Asset Management Intelligence*'. Each of these categories is based on a wide range of tangible (e.g., technology) and intangible (e.g., intellectual property, learnings) resources as discussed from the *resource-based view* or as input and output components of the *systems view*. The following sections will present some key conceptual discussions and results of the coding processes described in [Chapter 3](#).

4.5.2 CAPACITY AND CAPABILITY

4.5.2.1 *Structure and Practice*

Jones and White (2008) noted that the organisational management theory and the associated practices concerning human factors play a critical role or are considered essential enablers for effective asset management. The theories underpinning these human factors support the four fundamentals of ISO 55x of '*Value*', '*Leadership*', '*Alignment*' and '*Assurance*' that guide organisational activities such as strategic management, change management, motivational management, value management, stakeholder management, leadership capabilities, etc. Viewed from a systems perspective, Ang et al. (2015) argue that many constructs of internal organisation value can be

determined by value management (BS EN 12973:2020, ASNZS 4183:1994).⁷⁵, *value engineering* (EN 16096) ⁷⁶, *value stream management* (ISO 22468:2020).⁷⁷ However, in contrast, Woodhouse (2010) noted the recognition and acceptance that asset management is not primarily a technical subject and that getting the human factors right is even more important than the tools, processes, and technologies as enablers for a successful asset management system. This view is shared by a few respondents as an example below:

“Let's say all that standards, ISO 55000, technical standards, other benchmarking, it's all good stuff. And if it will go really to a top-level asset management system, yes that's all need to be in place. If we go back to structure. I would say asset management capabilities must be internal. Because to build good asset management strategy, you need people who understand the business not asset management only because you can bring hundreds of consultants who know how good asset management system looks like, but in a lot of cases they will not be able to tell it for industry or a particular company, that would be hard or next to impossible.”(OTH5)

It was as expected that many responses emphasised the merits of their organisational arrangements, ranging from a centralised asset management function or a separate but well-coordinated specialist asset management teams embedded within other departments in the same or different locations in New Zealand and also abroad to the allocation of asset

⁷⁵ There two approached to Value Management, Management by Value whereby the concepts of function and value are taken fully into account in management and decision-making; Management of Value, on the other hand is the use of VM tools and methods such as value analysis, Concurrent Engineering, Reengineering, etc.

⁷⁶ Value Engineering as defined by the European Commission Value Management Handbook is the study of solutions based on cost-performance optimisation, the constraints of the programme being taken into account.

⁷⁷ The value stream management (VSM) method is an effective tool for the collection, evaluation and continuous improvement of product and information flows within organizations.

management responsibilities across the organisation centrally directed model as described by a participant:

"I think now we're talking about sort of like an operating model. That is leading me to your asset management system. And look, every organization will make their own choices about an operating model, given their context and issues ... from a departmental perspective, I personally believe and want to retain an operating model that looks like a hub and spoke model ... a centre-led model where the centre develops the systems, the processes, the operating disciplines and then runs things from the centre but relies on people at site which is the hub and spoke to do some but not all of the work at the site within their capabilities and risks and things like that."
(CG7)

Advocates of a centralised function often cited their own experiences of where specific arrangements didn't work. It is usually found that combining operational and strategic planning functions often leads to precedence over day-to-day activities, as noted below:

"... I think in the past we would have, though it wasn't well articulated, but it was definitely, it was decentralized. ... different people had asset manager as part of their title. When we plan a meeting to get them to come along and have them contribute to an asset management plan, to think five years into the future; and then something breaks down, you know, so there whilst they're fighting fires they're never going to have the focus on the future and there's always little things they want to do particularly in reliability program to improve what they there which is correct. ... we've found if you don't have a centralized function, it just won't happen. You need to have a team that are not bogged down by breakdowns, and you know, reliability improvements in the short term. You need have teams that are looking at 5 and 10 years out. You need to have someone who is focused, and then you're need bring those insights into the company. Otherwise, it just won't happen. So, we were absolutely setting up a centralized function." (LCE2)

One respondent noted challenges of reorganisation to enhance asset management capability as experienced in the past:

“People spend far too much time reorganizing organizational structures and while there are certain things that are necessary, a lot of it’s just fiddling with deck chairs while the ship sinks, right? So, let’s agree what we are trying to achieve first, get everyone aligned at a leadership level and agree that this function sits with which and we need them to communicate so people understand that functional design.” (CG6)

Most of the respondents support the argument that critical asset management functions should be sourced in-house with wide variations to how much should be outsourced dependent on the context of the organisation, the size and complexity of the asset portfolio and internal capabilities as noted by a participant:

“We need to mature asset management and grow our business and grow that asset management capability and we need the capacity inside the machine to do that. For me it’s about centralizing that, but then applying it to generate the most value to your company, and I guess the last piece is that the whole in-source - outsource thing. You know, I couldn’t have a team of 200 people. That’s crazy and I don’t think that would work. But likewise, a team of two isn’t going to be enough either to run asset management. A balancing act is required, and the other thing to throw in there is some aspects of asset management which is quite boring, right. Finding the people that love that little niche of asset management and keeping them working for you forever, I think is great. But then you also need to grow them and expand their horizons and give them opportunities to share.” (LCE3)

The matter of having control of some core asset management functions is pivotal for value optimisation as noted below:

“The next thing is and again I've seen this in my career a particularly in regional councils where the oscillated in, say, 3 waters, for instance, just use that example, between doing it in-house and then, you know, where XXX, was that, you know, which was a devolved model out to a consultant is the network, you know, running everything, you know and that sort of thing.. I am, in in terms of outsourced vs insourced, I would never ever outsource asset management as a system in any organization that I could influence and was part of. That is a recipe for disaster, though that doesn't mean to say so you own the system. The organization owns the system and owns all the parts of the system. Now, that doesn't mean to say that in some of the subsystem elements of the overall system, you will employ consultants and contractors to do some of those elements, but they report back into the system from the subsystems, and the data ownership and the IP and everything stays with the organization. So, they're delivering a service, they're not owning the system and delivering it for you. So can I just say, take XXX on asset management, I could never run a fully centralized model. Never right. I am always going to need all of those rangers and that resource at place to do stuff for me. So that takes my definition to a centre-led rather than a centralized and my definition a centralized model is you don't need anybody dispersed at site. But it's not in your line that you are doing everything in your line from the centre and that could never work with the type of assets and their geographical distribution that xxx has.” (CG7)

Interestingly, the same participant echoed the issue of shortage of expertise in the country and suggest a different way of utilising such as resource:

“And then of course you got the other sort of aspects of asset management where you've got a foremost expert, a super technical expert on something. For example, a classic one is someone that like drinking water quality or something like that, drinking water chemistry. We would all love to have a drinking water, super chemist in our companies, but they're pretty rare, and so your ability to developed or promote them and keep them engaged and excited about your business is quite small. So, you're probably better outsourcing that role. Such that everybody in the wider system

benefits from their expertise and you can tap into it with your data. So, for me, there's an expertise piece you should probably outsource. "(LCE3)

Several participants noted consistency delivered by an expert would provide stabilisation to a system similar to the discussion of "asset management champions":

"There's definitely a piece that needs to be inside the machine to help stabilize the machine and give the machine consistency in the AMS consistency and stuff like that. And then, there's the other thing where you've kind of got the need for additional arms and legs, and that could be on an ongoing basis or through peaks and troughs through different cycles. At the end of the day, I don't think there's any right or wrong answer, but I would imagine the righter answer is a balance of internal and external skillsets, leadership and capability of the decision makers. Then I guess the role of the asset management system inside the organization is to best support those decision makers." (LCE3)

Proponents of a more integrated approach view asset management as a function that the whole organisation could be part of, and all staff has a role to play within the asset management system:

"Yes, and that's the trouble calling a group an asset management because I think we need to get better at asset management, well, yes, let the asset management Group over here do it. Doesn't work, because we're all part of asset management. When there's some functions are sitting sort of outside like customer service and all that sort of stuff, shift customer-facing, telephone support systems of, and HR functions and all that sort of thing, the necessary business functions that sit around, but at the core of an asset heavy organization, you need good asset management because this is what's delivering your service. Yes, your people. So, you need to make the right sort of people, customer service, etc. Ultimately, your assets are delivering the service and when the assets failed, you won't be delivering the service. So, when a manager

comes to me and says, 'these bloody assets causing me real problems which I can't deliver on the go'. 'That's okay, we can take it out of service'. We resolve the problem by getting rid of the bloody asset. But that's not the answer isn't it. For disposal of assets, sometimes delivery a service doesn't have a value proposition anymore because you know really want to consult very widely on that before you try to take that.'" (CG6)

Whittington (2007) suggests a framework for considering strategy as a social practice that includes the '4Ps' – '*praxis*', '*practices*', '*practitioners*' and '*profession*'. In general terms, '*praxis*' refers to strategy-making or the activities of strategy (e.g., planning, compelling storytelling, decision-making). '*Practices*' refer to the routines, procedures and tools used by the '*practitioners*' (both internal and external to the organisation) that are often aligned to their '*professions*' irrespective of what roles they play in the asset management system and the profession or recognition of a distinctive set of expertise not easily duplicated. Hence, some participants support a broader ecosystem/industry-wide approach in addition to an internally focused capability perspective:

"In terms of centralisation and decentralisation, I guess, there's two layers. There is the sector, industry wide view, which is kind of an asset system in a broader sense. And then there's, you know, what an organization can outsource and keep in-house. And I guess it will kind of related, I think, the SAMP provides quite a good sort of vehicle for providing that cross-industry coordination. How they kind of get sort of delegated or federated to some organizations, that would provide some kind of cohesive view of the goals and measures and where people fit into it, or the different organization in industry for them. With the Infrastructure Commission, it's pretty interesting, I think, if you want to kind of draw out the key concepts of theirs and say wouldn't it be good to coordinate across the industry. I mean, things that you can benefit from coordination to remove inefficiencies like the outage that we talked

about before and this little thing would be to how you prioritize scarce resources in a consistent way because we can't do everything we might be behind the 8 ball, but we want to foster focus in a coordinated way still leaves a fair bit of autonomy for the individual bodies, yeah?"(OTH2)

4.5.2.2 Leadership and Culture

According to ISO 55x, leadership involvement could include clearly defined roles, responsibilities and authorities; ensuring that employees are aware, competent, and empowered; and regular consultation with employees and stakeholders regarding asset management (ISO, 2014b, ISO, 2014a). Leadership⁷⁸ is crucial in developing an asset management culture that moves from a departmental or functional view to an integrated asset management-centred approach (Edwards, 2010). However, Ngwira and Manase (2016) argue that not all management functions require leadership even though leadership is intrinsic to competence (Morden, 1997), which aligns with the view that the tasks of controlling and coordinating can be systemised and automated (Mullins, 2013).

Similar to the responses for RO3, participants echoed commitment and support from governance and senior management as an enabler multiple times during the interviews. Leadership, as a critical determinant of the realization of value, is defined as *"the process of determining a possible future state that does not exist"* (ISO, 2022c) and should be exercised at all levels within the organisation (ISO, 2018). However, one participant noted:

"I think challenge for asset managers is the advocacy that we have to do. And you've got to be a brave person and put your case quite forcefully if you've got those opportunities. So, part of any framework, I think, is the need to educate your group

⁷⁸ To achieve the aspects of leadership referred within ISO 5500x, the following attributes should be demonstrated by a leader: vision, passion, communication, commitment to others, team building, decision-making and openness (ISO, 2022c):

and some of it can be at a very simple level. So, starting simple as the way to go, but you've got the asset manager has got to have a big degree of advocacy and educated ability to educate those around them. I think that has to be the framework. It's just the thing about any system is that people, people join organizations, they leave organizations, they retire. So, you've got to be able to take new people in, educate them very much speed, you know, train them from scratch, maybe with a new youngster into the sector, you know, and train them up. So, the frameworks got to be sustainable. Yeah, and so you've got to have that little bit of advocacy, education, training built into it, so that it doesn't just run out, if two or three people leave, it doesn't just tail off." (OTH1)

Martin (2001) noted that, in reality, no organisation can sustain a single integrated and unified culture as they evolve and grow with differentiated subcultures that may be fragmented if not correctly led. Aldrich et al. (2020) argued that organisations become differentiated and specialised as they grow. Without strong organisational leadership, complex and chaotic situations can arise where cultural manifestations occur due to divergent interpretations and transitory organisational identity. On the same vein, a participant shared his recent experience of the importance of leading from the top:

"In reality, people do asset management, it is completely people-centric and if your organization hasn't established the cultural people to lead asset management from the highest possible level and they understand the concepts and the value it can provide through the people on the ground that are actually delivering the service, then you're always on the backfoot. And as an organization that's where we're up to now. We're trying to establish that awareness across the organization, very much in our infancy of establishing that awareness, so that means getting our chief executive to buy into the concept of, can we manage \$65 billion, and we have a policy for it, so she as that general manager will have to get the head around this aspect. That's part of my role and my big managers role is to try and bring the awareness of what we're

trying to do because we have, like a lot of organizations, we've grown considerably, we are quite a large organization now and the risk is you can silo what is effectively, the life cycle chain of delivery. And each of those little silos do this, but they don't really understand their wider picture of how many delivers asset management."
(CG3)

Even with the use of consultants and with multiple sponsorships, leadership involves making sure all stakeholders in the asset management system remain motivated:

"Asset management is top-down and bottom-up. At same time you gotta work in both directions and look, it's not easy, you've got its perfect and ugly, and you have the ups and downs options ...downs and one of my comments would be is, an asset manager has been incredibly resilient person because you'll have your good days and then really shockers. So that's work management standard project to them, that I'm responsible for, because I've engaged a consultant to work within but not go across this control, I'm the one sponsor, the other sponsors are the GM for that particular part of the business. Their role is to drive down and make sure that everyone in their swim lane or silo understands that this is important, he understands its important."
(CG6)

4.5.2.3 Change Management

The common thread of discussions in the previous two sections centred on enablers, which was about the antecedents leading to changing the asset management culture and climate through formal structures, prescribed practices, and leadership that enable value optimisation. Change management was identified as an essential skillset by several participants that implies enhancing asset management capability discipline, as one respondent noted:

"... So that's now a huge change process in the business. So, I use best-of-breed system which says you shall do it this way, this way, and this way, and this way. That's good, but I've got to bring all the people on board that are going to have to use it this way. So that's a Business Change project rather than an IT project to stand it up but it's actually, now I'm going to spend probably a quarter of my money just gauging the business, actually formally document these processes and get people on board and trained and accepting, have a go live date and all that sort of stuff that goes with it. They actually make the change and that's actually one of the easiest ways to change the businesses, off the back of a big IT project. But if you don't see change as part of it, you'll. We have best-of-breed system; we are not changing that at all. I'm developing it the harder way. We want to use the system's better because we haven't been using them to their full capability. So basically, we've got an investment there, that we aren't leveraging the way it should be. We can get better value out of Maximo and GIS." (CG6)

Another respondent noted how the organisation recognises the importance of change management as part of leadership capabilities.

"At xxx, it's top down. As a leader, I was very early put onto a training course, Prosci training course. So that was only last year that they started to roll this out at the end of 2020. But all leaders, senior leaders, executive leaders, were put through this Prosci course so they become familiar with the language, the models and frameworks. Couple of years ago, maybe it wasn't so prominent. If I think back to xxx, there was no change management though they were so over it but wasn't aware of it. In fact, when we spoke about engineering change management the space where I was in, it was about technical changes and physical changes on site. So, when I came here thinking about change management, initially my mindset was around physical changes to plant, but since learned actually, you know, there's still a thing, but change management in itself is more around people change. So that's how it's handled here, top down. When you think about the ADKAR model, you want to think about getting almost all of your individuals moving together and as one individual

transitions in their understanding or something in their awareness, then others are more likely to also transition. So, you can't just sit there from the top, sometimes, it does require sort of a more targeted of attention to get there. But I haven't seen anything that was initiated from the bottom up if you refer to hierarchy layers so there might be stuff that's targeted at the guys on the ground level currently but not initiated from them.” (LCE2)

Based on the principles of leadership, adaptability, and assurance, competence needs should be determined at planned intervals to respond to changes in the internal and external context (ISO, 2022c). It is often expected that organisations foster a culture of support for continuous learning for individuals and the organisation as a whole focused on a constant search for improving the quality of outcomes and outputs, as discussed in the next section.

4.5.2.4 Continuous Improvement

Top-down strategic planning processes must interact with bottom-up work management processes to ensure plans can be validated and continuously improved. What holds this together and makes asset management vision a reality is the combination of requirements, assessment and development processes used to ensure that people and teams throughout the organisation and, if necessary, in its supply chain are competent and motivated to make the necessary contributions. Some of the organisations studied are subjected to mandatory monitoring by the regulator for asset management maturity and have mixed views of the effectiveness of the assessment, as one participant noted:

“Asset management maturity can be, are really valuable for generating improvement initiatives and understanding your strengths and weaknesses, I think the two main

obstacles to it, is kind of; one, 'what I was saying before around people not seeing the organisation as an asset management organization'. If people kind of buy-in to that, understanding the role of asset management; how it is important in achieving the outcomes or trying to achieve for external stakeholders then those maturity assessments are much more potent, and the actions are much more observed and acted on. I think the second obstacle is kind of the external views, that regulator view they want maturity assessments. But of course, everyone wants to perform well against the regulator, and a lot of these asset management organizations are regulated. (OTH2)

Even for the ISO 55001 certification, that's kind of more of a bit external attention on the outcomes. It doesn't necessarily drive useful outputs from this maturity assessments. But it can do it still. I think if you take two kinds of risks aside, I think the maturity statements are really powerful for helping people understand that you know the foundations that must be in place. Hopefully also, if it's linked to performance outcomes, you can kind of draw a link between the two. And the maturity is about of insight into kind of root cause to things we may not be able to, or it may be hard to understand if you just look at performance measure, which often lead us to apply band aid, just fix, the fix of the kind of end result. Whereas the maturity assessment helps understand the root causes. I agree that I think it is a lag thing, like saying performance is good today but we can see there's an issue looming in 10 years with significant risk potentially. But yeah. maturity assessment digs even deeper and say, you know, well, our process is, you know, part of the problem here." (OTH2)

Another participant noted the merits of conducting an external review:

The point is, personally, there's benefit for me having someone with a fresh set of eyes that know the business, come on a regular basis and help me, from their experience and what they're seeing around the world, to get better and better and better. For example, I remember producing an asset management plan a few assignments ago. I thought it was the best asset management plan one would ever

produce. We were all absolutely over the moon about it until an independent auditor, through maturity assessment, said 'you've completely missed your national lifelines responsibilities'. So, you know, so again for the for the next one, I got better and better. So, for me you must measure your maturity. You must measure that journey because, ultimately, if you don't measure it, you don't value it. And if you don't value it, there's no way in hell you're ever managing it. So, isn't this called asset management? So, for me that's why that's really, really important. And the other thing is I think is that those audits or those maturity assessments should be on an annual basis. That way you do not get to hide between years and also to the natural churn of staff. However, staff turnover doesn't impact your business quite so much because you've always got the next review coming along as opposed to three years later, staff might have turned over a couple times by then. The auditor turns up and the person's brand new, before you know it, it helps with the continuity business improvement. So, for me, in terms of any maturities, doing the basics are really important" (LCE3)

Another benefit is the independence of external reviewers, which is beneficial in a highly politicised environment:

"First and foremost is to have feedback loops or continuous improvement processes in place. I've done it in other places, if you're to measure maturity you get it done externally, you get it done regularly because it's very easy for political decision makers to be swayed by what's going on. And it's also very easy for them to mistrust their own staff. For whatever reason, it just happens. It's one of those things where I've had it explained to me, in a couple of different ways and it definitely works. However, if the external party is going to tell the decision-maker of you, what would stop you from getting that independent expert on the side to say"and here is what we will say now about this". So, they could say everything's fine or they're going to say something else." (LCE3)

With regards to benchmarking to a standard, several participants noted that it was not necessary to get accreditation, as stated below:

"For the use of quality management standards, Baldrige, ISO 9001 and ISO 55000, my answer is yes, but I'll qualify that answer. Those systems give you the absolute discipline that you should be measuring yourself against, and if you can't measure yourself successfully in terms of what those systems are trying to retain, and you can't, you know, benchmark successfully against them, then you're probably not achieving what you want to out of your asset management system. But I do make the differentiation between what I've just said and actually going through the full process of being accredited. Well, when I said when I said benchmarking before, I didn't mean benchmarking between organizations. I meant looking at your asset management system and benchmarking against what ISO 55000 requires. So, my hypothesis is this. You could actually be doing everything that ISO 55000 requires without having the accreditation and the independent audit, that's telling you that, but you may choose to go that extra step of getting accredited with the independent auditing to give you that independent assurance. (CG7)

However, with regards to the use of benchmarking, some views lay caution to the comparing with other organisations as noted:

Similarly, when you're talking about benchmarks and metrics, how can you compare or make an evaluation that somebody using a heritage building like the Wellington train station is comparable to somebody. How they use a building that was designed and built three or four years ago, you know, the GFA to UFA ratios will be completely different. The xxx facility will have much bigger open spaces. It will have much, less efficient floor plate versus a modern designed building, that would probably have a sort of 70%, plus GFA / UFA ratio, will be very well designed and effective. So, all of these details undermine too much rigidity in a benchmarking system. Now, it's not to say you can't have it. And I think you should have something, but then, I think the

point is that the institutions need to be improving against their own benchmarks, not necessarily comparing with other universities. I think that's a harder thing to do and would need a lot more care to do it in a reasonable way." (OTH3)

4.5.3 ASSET MANAGEMENT INTELLIGENCE

4.5.3.1 Data, Information and Knowledge

Responses in the interviews tended to use the terms '*data*', '*information*' and '*knowledge*' interchangeably, which is not entirely accurate according to knowledge management theorists. *Knowledge* is derived from meaningful information that is created from raw data that can be defined as '*objective facts*' describing an event without any judgment, perspective or context (Huseman and Goodman, 1998). *Data* becomes information when meaning is added and organised to be used for some purpose (Bender and Fish, 2000, Prusak and Davenport, 1998, Wiig, 1994). Information or structured data is only useful when knowledge can be applied as *wisdom* (Piovano et al., 2014, Sarah and Haslett, 2003) or as *expertise* (Bender and Fish, 2000) illustrated in [Figure 4-13](#)

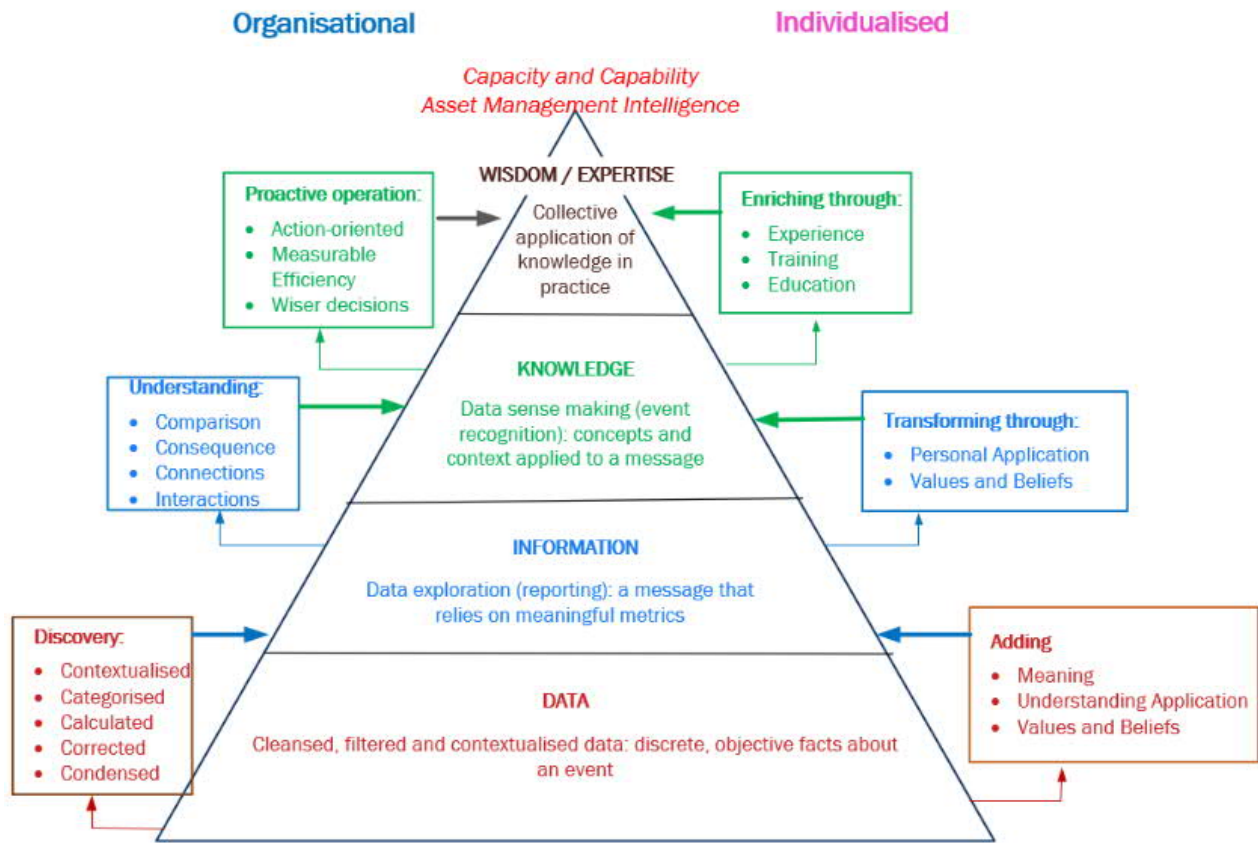


Figure 4-13 Data, Information, Knowledge and Wisdom (adapted from Bender & Fish, 2000)

ISO (2014a) stipulates *'assurance'* as one of the key fundamentals of asset management that requires evidence-based decisions leading to appropriate action that optimises value for the organisation. Most respondents recognised asset data and information as integral parts of asset management that permeate every facet of managing and utilising assets. For Crown Entities, the FABRIC framework⁷⁹ is used for assessing performance information based on the following dimensions: *'Focused'*, *'Appropriate'*, *'Balanced'*, *'Integrated'*, and *'Cost-Effective'*. The majority of participants from the Crown Entities are in the process of upgrading or acquiring new asset information technologies to better use the current data or for collecting new information and implementing new digitisation tools. For the local authorities, technological upgrades were required for the 3 Waters strategy.

Data assets⁸⁰ are vital enablers for most asset management activities, including decision-making that needs to be of sufficient quality, accuracy and usefulness (ISO 2022c). ISO (2019) suggest that the successful implementation of asset management systems requires vertical and horizontal alignment⁸¹ of financial and non-financial functions. Vertical alignment is achieved when financial and non-financial asset-related directives by top management (top-down) are informed by accurate upward information flows through the

⁷⁹ The Public Service Commission (2023) adapted the FABRIC framework for assessing performance information that should be:

- Focused on entity purpose and functions
- Appropriate and useful
- Balanced – it enriches the overall performance story
- Robust – uses credible and verifiable data that can be used over time
- Integrated (where practicable) into business planning and management processes
- Cost-effective – the benefits of knowing outweigh the cost of finding out.

⁸⁰ Considerations for data assets generally include, data dictionaries, data frequency, data volume and data security. Usefulness of data are determined by the alignment with prevailing data standards, clear guidelines for retention and management of data.

⁸¹ Alignment is defined as the “deliberate arrangement, relationship and mutual understanding of common concerns within a particular activity or among activities”(ISO, 2019).

appropriate levels of the organization (bottom-up). Horizontal alignment relates to financial and non-financial information flows between departments and clarity of organisational roles, responsibilities, and authorities, which becomes more important when asset management activities are outsourced.

However, one respondent noted that there seems to be some confusion between the means and end:

"... unless that's working well, it's garbage-out or garbage-in to my eyes. I get garbage into long-term planning. And over time, no one knows, and after all, no one cares. Because you got people that meant to go out there and inspect the assets every year, right? After a while, people aren't stupid, "I can put whatever I want in here. No one ever sees anything" and then they go, "Why do I need to do this at all?" Even though it says it in the maybe a standard something but "I'm not getting in trouble for it, I've got it all these other fools on my time. Either won't do it or I'll do it on bits of paper, and I put in my drawer, but I won't put it in the CMMS. No one cares and they are quite right. But when you start looking at it, people know you're looking at it, that changes the culture in XXXX, for example, until we actually started doing this and put it, rolled out the new processes. We didn't know there was in one particular region, there was an engineer for the contractor just making up the condition scores in writing. They weren't actually going out and doing any inspections yeah. You've to fight against that as an asset manager, but actually fight for that clear process and discipline to execute. Leader up here will make it happen; you can't do it from the side." (CG6)

The above echoes the view that no matter how intelligent or smart the technology is, it is just a tool and not the solution, as successful implementation relies on people, culture and the human system rather than any artefacts (Pinto and Guerreiro, 2019). Many provided examples of their current state of being 'data-rich' but 'information poor', citing legacy

data inherited that could not be used effectively for decision-making. It was evident from the responses there is a shift towards data-driven approaches and modelling of asset renewals and maintenance needs, although data transformation poses similar changes associated with technological change and resistance, as one respondent noted:

"... more importantly, shows how operational teams are dependent on the longer-term planning horizon, in terms of technical planning, the asset management plan, the forward works plan and how what they do in terms of information provision. But when they do their maintenance, they update the condition data in their asset information system, don't they, because actually, we use all of that back here and we use for lifecycle modelling and decision-making purposes. So, garbage-in, garbage-out. So, if you feed me garbage, unfortunately I'll give you garbage, but I don't want to do that because I want to set you up for success as an operational business." (CG6)

Organisations must recognise that critical asset data and information are required for evidence-based decision-making and to foster a forward-thinking culture that is receptive and engaged for a transformational journey with a key message, as in an example provided below.

"Simple principles that we're in this together, I'm not doing this to you, we're doing it together, so I'm trying to see set you up to success but my success is dependent on you doing good work management and completing the work order fully, not just doing it and not caring about updating the data because if you don't update the data, guess what, I'm going to give you the same plan to do next year because they didn't get updated, and it's in the same condition as it was when I had this year's one. But the fact that is your continuous improvement lead as well so you can see it inherently in that feedback. So, I use a diagram that communicates that quite clearly and I find that resonates very, very well within the business at all levels, the exec level down to the guys actually, doing the work in the field. And it's a bit different to the AM Council

which has a very conceptual model that is too complicated and very engineering as well.” (CG6)

ISO (2022a) notes that knowledge management⁸² is a key support function of an asset management system that should include *‘processes for retaining existing knowledge, acquiring new, utilizing available knowledge, and handling outdated and invalid knowledge and ensure knowledge is readily accessible at the time of decision-making’*. As in other sectors, organisations operating in the built environment must address the problem of integrating knowledge contributions from multiple specialty areas in the entire value stream, which is comprised of suppliers, customers, partners, and even regulators. Barclay and Murray (1997) consider knowledge management as a business activity that treats knowledge as an explicit concern across all levels of the organisation and makes a direct connection between the organisation’s tacit [individual know-how] and explicit [recorded] intellectual assets. For O’dell and Grayson (1998), knowledge management is the *“conscious strategy of getting the right knowledge to the right people at the right time and helping people share and put information into action in ways that strive to improve organisational performance.”* The currency of these interactions and communication can be data, information and specialised knowledge across boundaries created artificially or organically that will provide a competitive advantage if managed effectively (Carlile and Rebentisch, 2003).

⁸² Knowledge management (KM) can be defined as “a framework for designing an organization’s goals, structures, and processes so that the organization can use what it knows to create value for its customers and community” (Dalkir, 2013)

Recognising knowledge as *'intellectual capital'*, the *knowledge management model* of Bukowitz and Williams (2000) outlines how organisations generate, maintain and expand their knowledge base to strategically create value. Their model considers all types of knowledge, including information databases, technological infrastructure, organisation intelligence, functional know-how and individual skills, etc. However, at a fundamental level, Nonaka (1991) posits that only individuals and not organisations can create knowledge. He noted that the theory of organisation has long been dominated by a paradigm that conceptualises the organization as a system that *'processes information'*, *'creates knowledge'* and *'solves problems'* through its people. The organisation's purpose is to support or provide a context for individuals to create knowledge (Nonaka, 2005, Nonaka et al., 2018, Nonaka and Takeuchi, 2007).

It can be argued that knowledge itself cannot be managed as the emphasis should be on changing entire organisational cultures and strategies that value *'learning and sharing'* (e.g. Tsoukas, 1996, Polanyi, 1980, Winter, 1998, Nohria and Eccles, 2000). This notion is supported by a comment about the reluctance to change related to power:

"In my view, people do not always want to use it because it's taking power away. Its means control, I think we're going through the cultural shift in a moment. Let's say this when we had a lot of manual processes, and we had a people who had the control and power to make decisions ... old way was on a gut feel. Well informed gut feel, so it's a sort of based on experience, blah blah blah, but it still comes to the gut feel."
(OTH5)

However, Gold et al. (2001) also observed that formal and centralised structures often inhibit knowledge transfer processes. Several researchers have suggested better

communication can be achieved through open spaces (Kim and Lee, 2006) and encouraging collaboration through informal meetings and group workshops (Liebowitz and Megbolugbe, 2003, Yang and Chen, 2007). Several researchers also posit creating the right environment mentioned above brings about the essential attributes of good relationships and trust among individuals as antecedents for successful knowledge transfers (e.g., Cheng et al., 2008, Constant et al., 1996, Zakaria et al., 2004, Das and Teng, 1998, Kramer, 1999, Lucas, 2005, Wu et al., 2009, Argote et al., 2000, Levin and Cross, 2004, Politis, 2003, Gruenfeld et al., 1996). Interestingly several respondents suggested finding ‘champions’ as a key success factor regardless of what job titles the person holds as noted:

“...you've actually got to find those champions within an organization that like asset management work. But then when you have those champions, you need salespeople as well that are able to reach out vertically and horizontally. I think the tone from the top is actually critical. So having the support from the governors and having the support from the executive leadership team for the need for good asset management planning and then through that commission, establishing a really cohesive team across the organization so that people understand the value of the asset management because it is more than looking after the asset it's actually about your financial, long term financial planning, it's about, protecting your assets currently, but it's also setting up the community to be successful into the future.. And so, with that, it's setting up the community to be successful for the future, it's more than counting the stones and the reseal, it's actually thinking about the negative impact for example of a transport system, dealing with the environmental issues, dealing with the financial issues we talked about, it's about minimising the impact of your neighbours. So, there's so many things that we need to think about when it comes to asset management planning and so with that it's about being able to tell a story, it's about been able to walk in their shoes of those people that are involved in asset planning, or are the reactors to responders to, or the decision makers; and being able to

communicate that to them in a really simple way so that they actually understand.”(CG4)

4.5.3.2 Technology

As one participant noted the obsession with thinking technology will resolve many of the asset management challenges:

“A lot of organizations get stuck on: “Our new information system will solve my problem, it won’t. It never will. You need to start with process because what is an information system? it’s ultimately a form of automation. What are you automating? What’s your process? So, you ask any IT person, this is what striking, business analyst tends to sit in the IT part of the business, they shouldn’t, they should start from a business process management group, which is actually business orientated, they map the processes. Because every time we run an IT project, guess what, they get a BA to map business processes, but if you actually maintained your business processes, they wouldn’t need to do that because to say, well actually, this is a current state and this is what we want to do to update it. Can we implement that using a piece of technology? The only time IT staff can drive things, and this is a legitimate reason, is it actually comes with good process.” (CG6)

As observed by one participant, some organisations tend to acquire new technology that does not necessarily add value:

“We’re too busy doing bespoke solutions, or we need to do it our own way. I think that’s a huge issue. I think a lot of what we do could be a cookie cutter. And therefore, the real value-add is in the innovation space and in the continuous improvement space, not in the development of methodology for counting population at terminals turning it into a demand model. That’s ridiculous. You know, there’s so many core aspects of asset management that should be standardized, or should be based on a standard formula, standard methodology, standard guide, whatever you want to call

it with standard training. Because that's not the value-add part, the value where there is innovation and the strategic long-term view." (LCE3)

With regards to digitisation and the use of BIM, a few participants doubted that the technology would deliver the benefits it claims at the moment:

"We are we are going down the BIM path for the three projects XXX projects. I think there are certain aspects to BIM in terms of, you know, design conflicts, design clash, you know, that sort of checking is great, there's definitely an efficiency there, whether or not, we see the full benefits of being as they are stated in the theoretical context being realized. I have my doubts. When I ask the questions, have you developed, you know, a big asset data set, as you've gone through that is going to be at the end of the project simply migrated straight into Maximo in a seamless manner, I get some very concerned looks and I'm not sure it's going to happen. There is such a vast amount of work that needs to be done in the background in terms of all of that asset data, maintenance requirements, warranty document, etc, in addition to the structural and the services and everything else that goes on and I just, I think where I think we've gotten the benefit in terms of through the construction project, but I'm not convinced we're going to see the benefit delivered in terms of the post project completion; going into the maintenance and the transition into the asset management system and we are plugging that very hard at the moment. With our project managers and our contractors to say project isn't finished, you know, once practical completion or handover is achieved. We still need this other stuff to come across in the right format. So it'll be interesting to see. I'll be honest with you, still get a sense that all of the layers within the, you know, the suite of consultants, engineers, contractors, subcontractors and clients everyone's learning about BIM and how to make it work effectively. I don't think we're very mature in the BIM field at the moment generally as an industry." (OTH3)

ISO (2022b) notes that personnel, in addition to the knowledge and awareness of their roles and expectations within the asset management system, should be equipped with the

right tools, including access to training to reach their full potential. An organisation is expected to determine the necessary competence of person(s) working under its control to fulfil specific responsibilities and be provided with the right tools⁸³ to ensure value is realised through the expected performance of the assets, asset management and asset management system. It should look for opportunities to take advantage of specific existing competence in the design of work-related functions, processes and systems by considering all organisational processes, functions, and levels. Most respondents described what systems they used, their capabilities and limitations. Examples as follows:

"... we use Maximo as a tool, ... we capture all the asset details that you would expect condition, functionality, fitness-for-purpose, criticality, risk, as well as, installation date, make, model, all that sort of stuff. There are maintenance regimes programmed against each of those asset types and classes. It all gets automated through to work orders, goes out to contractors, or internal staff. All the normal things you'd expect."
(OTH3)

"... PULSE, which is formerly BEIMS, so a couple of other xxx that use it ... asset assessment and condition that's done by contractors, provide an updated condition assessment and replacement cost information to us across all assets in the portfolio for which they manage. We track the condition profiling and risk profiling and things like it tells."(OTH3)

"We have our maintenance management system, which is an on-premises system which we own and we are looking in the next year or so to transition away from that one and upgrade because it's 10 years old and we'll probably move through a cloud based system as a service kind of their software or software service, package and

⁸³ Building information modelling (BIM) approaches are increasingly being used to ensure asset data and information is shared between different organizations in a controlled way and that the information is not lost between key stages in the life cycle of assets (e.g. between projects for creating/modifying an asset and its subsequent operation and maintenance by different service providers).

process in management as a software there. So that'll be exciting because we move away from simply management of maintenance to then bring in, you know, failure modes and risk assessment, and asset health condition assessments, scenario modelling, remaining life projections, all those things I'm really excited to bring in."
(LCE2)

4.5.4 SYNOPSIS

As noted in [section 2.2.4](#), the literature highlights strategic asset management as a source of competitive and sustainable advantages for regulated or open market environments. The fundamentals of ensuring strategies across all levels of decision-making are interconnected and focused on balancing cost, risk and performance of the asset portfolio, which considers the external challenges, political tensions and financial constraints. ISO (2019) noted that processes, leadership and governance are critical enablers for aligning data, information, knowledge and capabilities among different levels of an organisation. It is suggested that processes within an organisation should use common technology and focus on the end-to-end need rather than being governed by function.

It was evident that most of the asset management practitioners for research question 4 have considered the application of strategic management techniques that had previously been reserved for private profit-making organisations, such as change management, market adaptability, resilience, collaboration (internal and external), effective communication, good change management processes and recognition that the human factor, in particular, leadership is pivotal to success. These views supported the discourse from both the strategic management and systems thinking perspectives, the resources required to undertake asset management that contribute to organisational capacity and

capability that typically include people skills and competencies, information technologies, effective and efficient business processes for planning and control activities. Although awareness and communication were key factors brought up by some participants in [section 4.4](#) as key social and cultural factors, others considered them key enablers ([section 4.5.5.2](#)) as well.

“But if you want to change some of the inputs you need, or you’re going to change some of the outputs, talk to the people that you’re connected to before you do it, don’t do it unilaterally because that way won’t work. Because if you get lower than that, you end up doing the procedural space. You start with what you do today. Don’t try to develop something that they don’t do, and that was one of the problems we had is that, there was a heap of documentation that was produced off the back of the IIMM guideline, all theoretical, business didn’t understand it, business didn’t want to engage with it, business hasn’t used it, it was a waste of time, waste of effort. I just threw it away. We start with what the business does today, for example, working on work management with the guys in the regions at all levels, financing how we all connect, but mainly the regional guys because they’re the ones who can be impacted, the production managers, the asset engineers, build engineers, etc. We all workshop, workshopping them to pull out what are the procedures used today? And some of them are in their head, that’s fine. But we’re actually going to develop a Work Management Standard. That actually has these high-level processes involved and when you have to deal with your CMMS, but all the other things that they do as well in terms of connecting, in terms of scheduling. So, tools are one thing, but it’s actually the process. The processes are very important and I’m spending a bit of time on that at the moment documenting for the organisation. This is not to tell people how they should do things, there’s arrows and swim lanes, it’s about how do they connect as an overall system. You’re responsible for your efficiency around process, so continuously improve that as these.”(CG6)

Chapter 5

DISCUSSION OF FINDINGS

5.1 INTRODUCTION

The purpose of this chapter is to discuss the findings and selected theoretical frameworks in the context of the research aim and objectives. The main concern for value optimisation that emerged was the need for a balanced realisation of value (core category) for public infrastructure. The main concern was resolved through the presence of identified patterns of behaviour of stakeholders, systems and environment (sub-core categories) and relevant value enablers. While the unit of analysis of the primary data was from interviews at the individual level, secondary data from government and organisation publications provided by participants or referenced in the interviews (e.g., Parliamentary papers, Ministerial Letter Annual Reports, Strategic Documents and SAMPs) were used to provide a fuller context of the substantive area that could not be elaborated due to the time constraints during the interviews. This approach helped raise the level of understanding as to what was happening in the substantive area such as inherent barriers or tensions, ease of execution of policies or provide the rationale for not performing or doing an action that seems logical or sensible. These findings were later compared to theoretical frameworks that either support or challenge the underlying theories noted throughout the thesis alongside results from the validation process summarised in this chapter.

Table 5-1 provides the list of primary concerns (core category) and concepts (sub-categories) that emerged from the data collection and analysis that involved theory integration and shaping

of data through constant comparative analysis of coded transcripts (Glaser, 1998) within each case (e.g. organisation, sector group) and between cases. Multiple open codes and subsequent codes were applied to the data with the aim of discovering “the emergent fit of all ideas so that everything fits somewhere with parsimony and scope and with no relevant concepts emitted” (Holton and Walsh, 2016) to derive sub-categories and ultimately the core category.

Table 5-1 Outline of Core and Sub-Core Categories

LEVEL OF CONCEPTION	CONCEPT
Core Category	Balanced Optimal Value
Sub-core category	Balanced Performance
<i>Property of Balance Performance</i>	<i>Stakeholders’ Value</i> (section 4.2.2.1)
<i>Property of Balance Performance</i>	<i>Systems Value</i> (section 4.2.2.2)
Sub-core category	Balanced Value for Money
<i>Property of Balanced Value for Money</i>	<i>Whole-of-Life Value</i> (section 4.2.3.1)
<i>Property of Balanced Value for Money</i>	<i>Risk-Cost-Performance</i> (section 4.2.3.2)
Sub-core category	Balanced Prioritisation
<i>Property of Balanced Prioritisation</i>	<i>Outcome Focused</i> (section 4.3.2)
<i>Property of Balanced Prioritisation</i>	<i>Output Focused</i> (section 4.3.3)
Sub-core category	Enabling Environment
<i>Property of Enabling Environment</i>	<i>Societal-Political Legitimacy</i> (section 4.4.2)
<i>Property of Enabling Environment</i>	<i>Organisation Culture</i> (section 4.4.3)
<i>Property of Enabling Environment</i>	<i>Organisation Climate</i> (section 4.4.4)
Sub-core category	Enablers for Optimisation
<i>Property of Enabler</i>	<i>Capacity and Capability</i> (section 4.5.2)
<i>Property of Enabler</i>	<i>Asset Management Intelligence</i> (section 4.5.3)

The theoretical integration between core and sub-core categories follows the Systems approach depicted in [Figure 5-1](#) that led to the proposed conceptual framework for value optimisation in the built environment which we term as the Balanced Optimised Value Framework (BOV). BOV further elaborated in [section 5.2.5](#) recognises people as the ‘*value creators*’ that require an appropriate authorising environment (external) as well as an enabling environment (internal). Value is created or realised when the benefits being produced exceed the costs of producing these benefits. Identifying the required benefits that match stakeholders’ expectations in the first place is a key challenge of value optimisation. There also needs to be a balanced focus on outputs (short term) and outcomes (long term), as well as a balanced delivery of stakeholders’ expectations.

Massa et al. (2017) assert that a business model should have three essential characteristics: (i) a mutual understanding of cognitive/linguistic schemas describing its purpose, (ii) formal representations and descriptions of key components and (iii) a focus on specific attributes that enable superior performance. From a simplistic view, Mitchell and Coles (2003) concluded that a model is simply the combined elements of ‘*who*’, ‘*what*’, ‘*when*’, ‘*why*’, ‘*where*’, ‘*how*’, and ‘*how much*’ is involved in providing services/products to customers or end-users. Supporting this notion, ISO 55001 certification incorporated the social-material perspectives (Orlikowski and Scott, 2008) in their requirements, i.e., (i) the material dimension of reality based on document and artefact evidence, (ii) social dimensions such as practices and interactions that

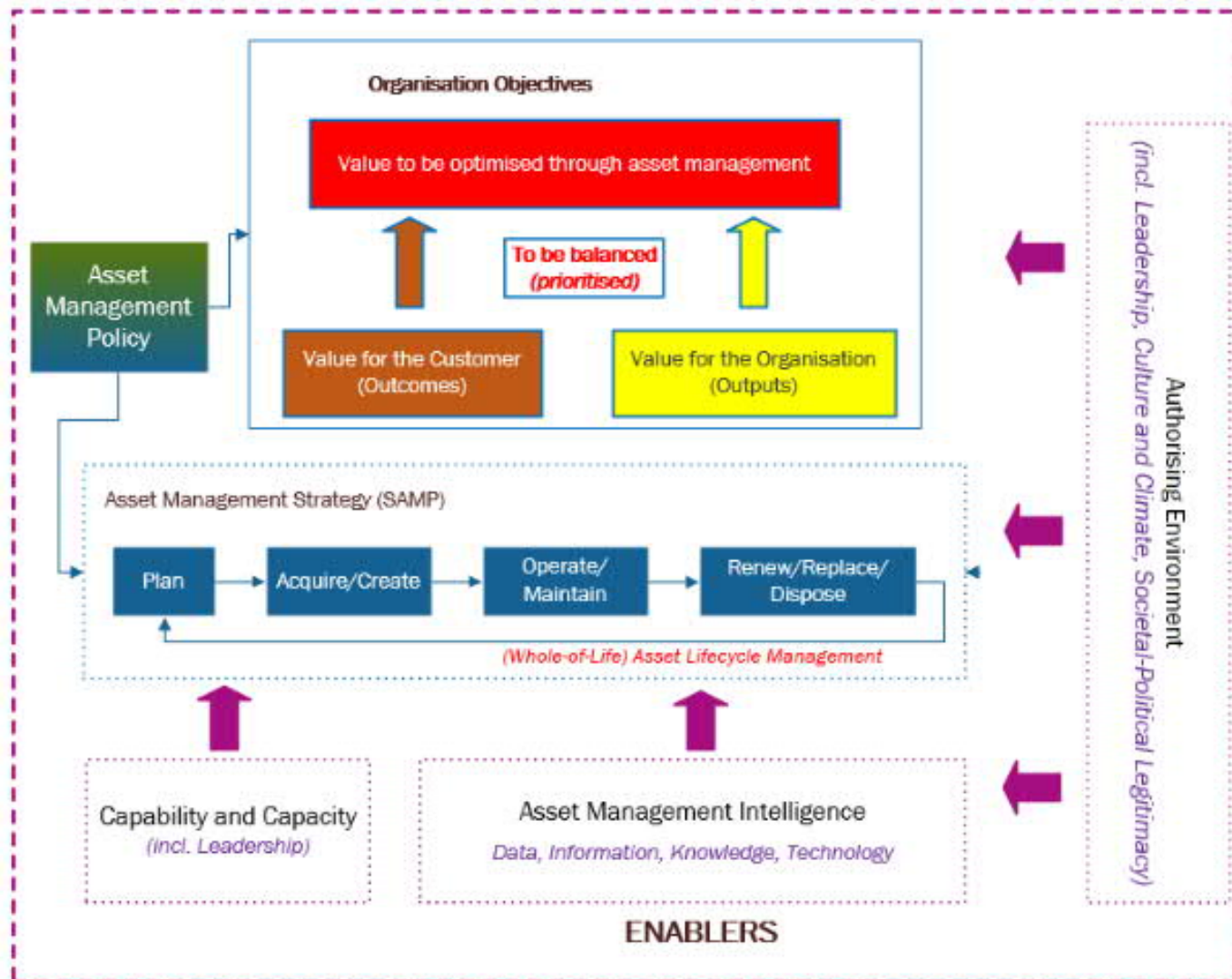


Figure 5-1 Theoretical Integration of Core and Sub-Core Categories (source: Authors)

take place according to the artefacts, and (iii) broader organisational financial and non-financial performance indicators (IEC, 2016). Hence, BOV grounded in theory and practice is intended to assist leaders/managers and organisations in optimising value as it explains and guides optimal decision-making. BOV as a framework can be regarded as a cognitive model (Demil and Lecocq, 2015) used by the participants to describe activities and processes (Baden-Fuller and Morgan, 2010) or to describe taxonomies and typologies of how to create and capture value (Zott et al., 2011).

This thesis has attempted to address the philosophical concepts of *simplicity* and *complexity*, where the former is often associated with naivety, lack of understanding, unawareness, and ignorance and the latter is characterised as elaborate, detailed, cognisant of multiple and complicated elements of any systems that are constructed or exist naturally involving relationships, behaviours and different contexts. The challenge is to develop a framework where simplicity lies at the heart of complexity and where a complicated phenomenon can be presented and explained thoroughly in simple terms for practical applications. The following sections provide the background and explanation for what BOV is (through the research aim), how it was developed (through research objectives and research questions) and how it can be applied (through induction and validation) as informed or grounded by empirical indicators uncovered throughout the research processes.

5.2 ACHIEVING THE RESEARCH AIM AND OBJECTIVES

5.2.1 OVERVIEW

The conceptual framework presented in this chapter was prompted by the research rationale and motivation, initial literature reviews and research findings that supported the view that an effective and efficient asset management system (AMS) is an enormous, complex endeavour both for leaders and organisations. Even with the published ISO 55x asset management standards, an AMS extends beyond the boundaries of a closed system towards an open socio-technical system that includes factors that appear to be beyond the control and influence of any person or organisation. As noted in section [2.2.3.5](#), co-creation of value appears to be a common perception for sustaining value by the research participants that requires a multi-faceted, multi-dimensional view of value through proactive stakeholder engagement, collaboration and relationship management as part of the optimisation processes. The BOV described in [section 5.3](#) is intended to enable managers/leaders to see through the barriers, tensions, and competing values of public-sector organisation, and to capitalise on the potential that others do not see. The framework will help leaders/managers in organisations better define the structure of the value to be optimised by identifying the core elements of the framework with a focus on rethinking the traditional notion of value (e.g., stakeholder value, service or asset value) and the specific approach and tools to enable sustainable change. In other words, what is proposed in the following sections is designed to help leaders/managers broaden their thinking and enhance their capability to value optimisation using methods that have succeeded in other organisations and to help them learn from better practices.

5.2.2 (RO1) CAUSE-EFFECT RELATIONS – VALUE AND DECISIONS

For the research objective (RO1): *'To identify critical properties, e.g., the pattern of cause-effect relations that link value creation/capture activities with asset management decision making in the built environment'*, the thesis observed that there are several dimensions of critical properties that link value creation or capture activities with asset management decision making in the built environment as summarised below.

In a traditional sense, organisations create value when the products/services produce benefits for customers that are significantly more than production costs. As discussed in sections [4.2](#) and [4.3](#), public sector organisations must focus on outputs and outcomes that often involve hard-to-measure soft factors that emphasise human concerns, environmental sustainability, and societal well-being, as well as economic and financial measures. This focus creates a phenomenon where time delays in project execution can separate the cause-and-effect relationship. As a result, direct cost is no longer a single determinant; indirect (opportunity) costs should also be considered to determine whether value has been created in different times and spaces. Opportunity cost and risk avoidance/mitigation are also key considerations of value determination for critical assets (e.g., lifelines infrastructure) or social outcomes for corrections, education and health facilities, where success is not measured entirely in single-minded financial or other quantitative terms and where success may take a long period for benefits to be realised. The research has observed that the relationship between organisational culture, congruence of value with cost, and risk considerations sometimes contradicts the decisions that are subjected to internal and external political influences and are not based on logical, evidence-based decision-making. This phenomenon is what the thesis refers to as the *authorising environment* of a public sector organisation. This environment defines the social

license to operate or exist; the thesis refers to this category as the *societal-political legitimacy* category.

Lawrence and Nohria (2001) observed that all organised human (organisation) activity has a structure regardless of how randomly or dispersed it seems. Aligning to externally focused value creation efforts are the internal individual and organisation culture and climate, together with competencies that support and enable value creation and optimisation such as leadership, dynamic capabilities, and change management (highlighted in sections [4.4](#) and [4.5](#)). This alignment helps staff think differently, clarify purpose, integrate and align practices, and provide assurance to create the appropriate environment for value optimisation effectively. The challenge for managers is to uncover the underlying cause-and-effect relationships within an organisation such as leadership, culture, and climate. Such relationships influence learning, motivation, innovation, and decision-making. In this context, the research has observed that leadership, culture/climate, and asset management intelligence underpin both authorising and enabling environments. It is interesting to note from the responses that some organisations are perceived to be more effective if they (as leaders) maintain internal processes well. In contrast, others were considered adequate when positioned appropriately with customers and the community through stakeholder engagement and management. Regardless of whether internally or externally focused, the challenge for asset management is to make optimised decisions or to be able to influence (without authority) correctly balanced decisions of whether to meet stakeholders' expectations at all costs, having preferential treatment with one group at the expense of another, or to operate within an acceptable risk tolerance. In other words, the challenge is to decide trade-offs between an outcome or an output, or to trade off potential outcomes (that are longer-term focus) with outputs (that are often short to medium-term

focus), as discussed in [section 4.3](#). Framed by the appropriate organisation and climate, value is optimised when there is a balance between outputs and outcomes (authorising environment) with inputs (e.g., capacity and capability), and when it is adequately supported by asset management intelligence (enabling environment) as depicted in [Figure 5-1](#).

5.2.3 (RO2) RELEVANT THEORETICAL FRAMEWORKS

For the research objective (RO2): *'To identify relevant theoretical frameworks that support the conceptual business model for optimising organisation value through the successful development and implementation of an effective asset management system'*, the framework proposed in [section 5.5](#) is supported by several organisational and management theoretical frameworks discussed throughout the thesis and will not be repeated. It is beyond the scope of this study to delve into each theory in greater detail, hence, a selection is emphasised in this section.

The ISO 55x asset management standards are based on the *Systems Theory* that regards organisations as socio-technical systems. To be effective, human activities are structured and integrated around technologies, processes, and systems in a harmonious manner. In other words, in an imperfectly organised asset management system, even when every part performs well relative to its objectives and performance targets, the value of the overall system is not guaranteed to be optimal. This research has determined that while technologies significantly affect inputs and outputs, the social aspect determines the success of the technology, and capabilities introduced. While the ISO standards have provided some formalisation of relationships between the technical and psycho-social subsystems in the built environment (Green, 1999), this thesis asserts that linkages are by no means complete, bypassing any formal

structures in place, (where relationships and interactions occur between subsystems in an organisation), as well as the broader ecosystem beyond the traditional boundaries of an asset management system.

The responses gathered in this thesis align with a common thread of these theories that point towards the view that strong organisational cultures facilitate consistent internal behaviours through agreed norms and values, collaboration, coordination, and control within an organisation. This enables goal alignment and assurance to instil trust and legitimacy maximises performance and optimise value. According to *Identity Theory* (Baumeister, 2010, Brewer, 1991) often cited in organisational scholarship, there is some latitude in an individual's subjective understanding of his or her social space and associated expectations or sense-making. Schein (2010) refers to this phenomenon as "*cultural assumptions*", similar to "*institutionalised social forms*" described by Pólos et al. (2002) and "*shared cognitive framework*" (Weick, 2021) These are deemed to guide organisational functions, business/operating environment interpretations, strategies/objectives setting and how resources are acquired and distributed (Bartel et al., 2007, Whetten, 2006).

It is noted that strong values and practices do not guarantee optimised value because many uncontrollable factors affect sustainable high performance at the individual, group, or organisational level, such as conditions and influences of the economic and political environment for public sector organisations. Hence, to be adaptable and sustainable, organisations need to take advantage of emerging technologies and methods while encouraging self-management, to develop an effective performance/feedback-oriented system, while promoting a culture of positive engagement to meet changing conditions.

Performance management methods are often shaped by the traditional theories of motivation such as Maslow's *Hierarchy of Needs* (Maslow, 1998, Maslow, 1958), Herzberg's *Motivation/Hygiene Theory* (Herzberg, 2008, Herzberg, 1986), Vroom's *Expectancy Theory* (Vroom, 1964, Vroom, 2000) that describe and explain the relationships between behaviour and outcomes and between management and leadership. In other words, any asset management systems can play the role of the contributor to, or the reflection of, or the determinator of both organisational culture and climate at the same or different points in time.

Complexity Theory can be seen as a device for explaining unexpected and inherently unpredictable outcomes and for encouraging managers to cultivate and foster an environment that facilitates creativity and emergence to optimise value through stakeholder involvement and empowerment. Organisation theories (Tsoukas and Knudsen, 2005) posit that managers/leaders must understand that there is no '*one size fits all*' when establishing an asset management system. As alluded to by most responses, the success of any implementation of ISO standards depends on the nature of the business, leadership philosophy, individual capabilities, operating capacities and organisational learning as a whole. In other words, organisations benefit from some activities that are highly structured, predictable and repetitive with a focus on efficiency and productivity (e.g., technical engineering activities). Also beneficial are activities that require flexibility and adaptability to enable generative innovations to solve complex problems for delivering quality outcomes (e.g., increase literacy, patient wellbeing). This notion may explain the low uptake of the ISO 55001 certification among participants with the exception of one who had completed the second re-certification and another who is in the process of becoming accredited

Schneider and Barbera (2014) argue that managing performance (optimising value) is a function of the organisational context where the economic, social, political and technological conditions of the time are embedded in cultural practices and values. Capturing most of the above discourse in the core and secondary dimensions under the *Competing Values Framework* (Quinn and Rohrbaugh, 1981), several responses involved in the validation process concur with the framework that posits that managers/leaders need to comprehensively diagnose and manage the interrelationships, congruences, contradictions, and tensions, as well as harmony to better navigate current complex and changing environments for value optimisation. A multi-perspective consideration is required for a holistic approach by managers to perceive an event or phenomenon from different angles and to consider additional variables for decision-making to understand better both the short- and long-term consequence/impact of a decision. This ensures appropriate representation of other points of view, including reconciliation of individual, communal and societal interests.

5.2.4 (RO3) LIFECYCLE MANAGEMENT DECISIONS AND BENEFITS

Regarding research objective (RO3): *'To establish the linkages of both tangible and intangible benefits embedded within asset lifecycle management decisions'*, the thesis argues that the linkages are subjected to constant change affected by time and subject evolving environmental variables as in all living systems. Based on an abstract functional model of ISO 15288 (ISO, 2015), every system represents: *'the conceptualisation of its need, realisation of that need, utilisation, evolution and disposal'*. While the ISO 55x standard does not prescribe to any specific asset lifecycle model, ISO (2019) defined the seven asset management lifecycle phases as: (i) requirement definitions, (ii) asset planning, (iii) asset creation, (iv) operation and maintenance (v) asset monitoring (vi) renewal/rehabilitation, and (vii) disposal (end of life). The alternate

view based on the cyclical nature of managing the built environment, Madritsch and Ebinger (2011) describe lifecycle management as consisting of six phases: (i) strategic planning, (ii) capital planning, (iii) design, (iv) construction, (v) commissioning/services, (vi) maintenance and operations. Bourke et al. (2005) identified six “*cradle to grave*” phases of infrastructure and building assets as (i) inception, (ii) feasibility appraisals, (iii) plan/design, (iv) construct/handover, (v) operate/maintain (vi) decommission/renewal.

Asset management principles, if adequately implemented, will influence the value creation (after benefits minus costs) of all aspects of the asset lifecycle (ISO, 2018). Conforming to ISO 55x considerations of both tangible and intangible value for asset management (ISO, 2014a) implies that direct and indirect benefits are considered in a similar vein to the value concepts identified in this study. Based on the common perceptions of the multi-level definitions of value derived from the strategic, tactical and operational activities of an organisation; and in relation to an asset, asset system or the organisation as a whole; and integrating with the discussions in this thesis, [Figure 5-2](#) below depicts how the purpose and benefits of an asset is embedded with its lifecycle.

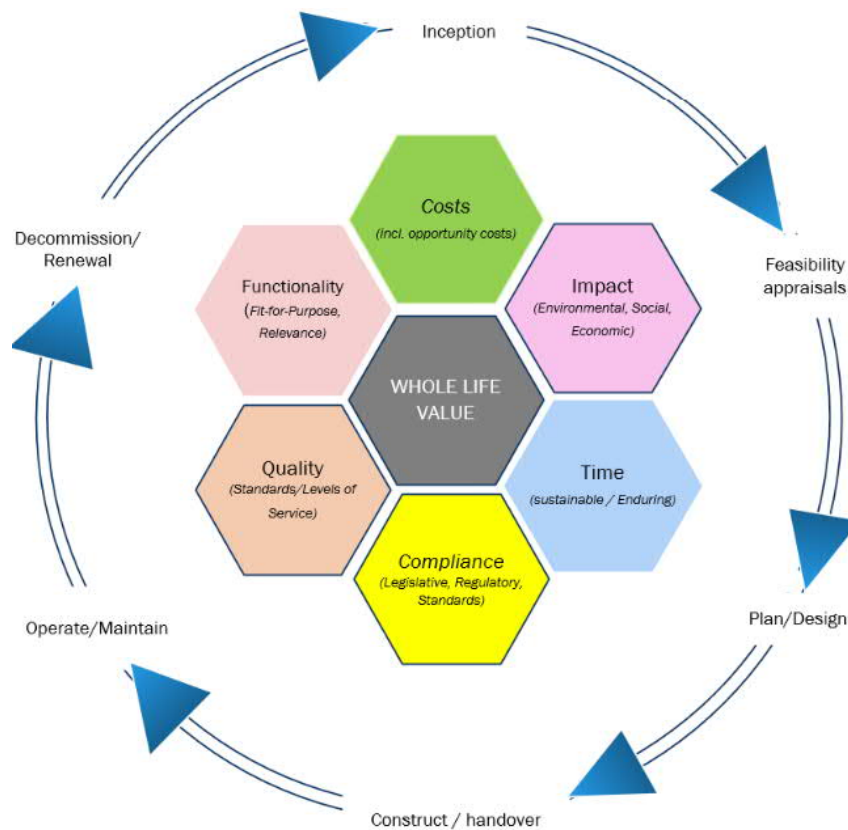


Figure 5-2 - Whole Life Value (Adapted from Bourke et al 2005)

It is noted that a change of use, function or repurposing of an asset during the asset lifecycle can create new (or more value) in some cases, such as converting a heritage building into a tourist attraction. In the public sector, the construction or acquisition of a new asset often has strong political support regardless of the value gained compared to the preservation or maintenance of an existing asset that usually does not get any media or public attention. In the case of appointed or elected central and local government representatives whose terms of office are three years, their ability to focus on future consequences often limits their ability to realise long-term benefits, leading to inaction or incorrect decisions. From the interviews, there were also occurrences where value was destroyed due to prolonged deferred maintenance, leading to early asset failure, irreversible asset deterioration and increased maintenance costs.

From a *whole-of-life* perspective, it is essential that long-term or intergenerational benefits are considered throughout the assumed asset lifecycle. By its very nature, value, benefits (including disbenefits), costs and risks change over time along with stakeholders' expectations, as discussed in [section 2.2.4](#). The challenge for asset management systems is the ability to adapt to changes to optimise value in a sustainable manner. GFMAM (2021) describes adaptability as *"having the ability to sense and respond to changes in the organisation's context and stakeholders' expectations and refinement of decision-making tools for industries faster than the rate and magnitude of changes over time"* (p. 15). This ability requires an organisation to be proactive and not reactive to adverse situations that enable systems changes, and to align to different conditions (Woods, 2015, Woods and Hollnagel, 2017). The dynamic challenges highlighted in [section 1.2](#), such as inadequate funding, ageing infrastructure, climate change adaptation, and short-term political focus, require organisations and managers to understand the potential consequences (impact) better and, more importantly, how to respond when the risks become a reality or issues (Weick and Sutcliffe, 2001, Vogus et al., 2014).

In the interviews, asset resilience at the strategic, tactical and operational levels was identified as one of the value drivers for the built environment due to the higher frequency of natural hazards (flooding, rising sea levels) and man-made disasters (asset failure). The key challenge for many organisations in this study is determining the risk tolerance or the acceptable thresholds (time, capacity) for an asset system to regain or retain a regular functional system after an event as a proxy for the quantification of risk as equivalent to value as one participant noted the difficulty in the quantification of risk, the cost of risk control or the consequences such as financial losses to the organisation. These benefits of asset resilience are considered intangible. The indirect benefits of creating agile asset systems and increasing agility of the

people who manage these systems are often difficult to quantify or justify. Although recent events (e.g., Cyclone Gabrielle in 2023) have provided empirical evidence, the benefits outweigh the costs several times over previously assumed in the business case to install flood protection devices at the expense of providing more popular community amenities. This decision eventually prevented a city from facing a substantial economic loss and the associated social disruptions compared to its neighbouring township that encountered a systemic failure of the electrical power supply systems, as noted by a participant:

“The challenge is you need to move to some form of eventually, to some form of quantified view of risk. So, they've been able to achieve that in the electricity sector. It's much more difficult and roading and rail. So, for example, with an asset we know roughly how the assets degrade over time given the environment. So, you come up with an asset health indices and then correlated to a probability of failure curve. Now it's an average of your averages. It's really stochastic. The world is stochastic, but what you do is, try to take a pseudo deterministic perspective to give yourself a failure curve, probably take it, you know, the criticality. So, the criticality covers all of those dimensions are mentioned before, safety, environment, cost, performance. And most organizations already have risk matrices where those different dimensions are aligned, and you can put a dollar figure to those. And, as I said before, this is not a full answer because it's the little, put your legal perspective, your safety perspective. Be clear when it comes to safety. But if I know what my consequences and I know what my probability is, I can work out my annualized value of risk for that particular asset. So, in terms of its potential failure, I know that it might cost me \$250 annually or two hundred fifty thousand dollars per year. Then could we apply for opportunity costs as well as, yes, and in fact you do if you want to put in a new service you'll actually say well what is the value that the same will actually deliver to the end consumer, so it's just this other side of the same quote.”(CG6)

The research findings noted that the *'fit-for-purpose'* criteria (an intangible benefit), when integrated with sustained value creation or realisation, could benefit from the clarity of purpose

expressed as a balance of measurable outcomes and impacts (tangible benefits) that could include quantifications of risks and costs, and different categorisations of value (refer sections [4.2.2](#) and [4.3.3](#)). Achieving this balance may imply that optimised organisation value is not consistent with the meaning of value as defined in the asset management standards, such as the balance of cost, risk and asset performance. The required trade-offs within systems to optimise value may extend beyond needs of the asset/s or asset management system, the organisational system and possibly the eco-system made up of several public sector organisations delivering the similar outputs and outcomes to society (e.g., social wellbeing, community resilience) that involve both asset and non-asset solutions (e.g. change of behaviour).

5.2.5 (RO4) BALANCED OPTIMISED VALUE FRAMEWORK

5.2.5.1 PREAMBLE

Regarding research objective (RO4): *To evaluate the key attributes of a business model that enables all stakeholders in the sector to improve their capability and capacity for value optimisation when managing public assets*, the Balanced Optimised Value Framework (BOV) proposed in the thesis resulted from the synthesis of selected literature review, qualitative evidence and integration of the ISO 55x asset management standards (including principles and practices related to a value-based systems approach and a strategic focus for maximising value). Also noted in the thesis is the argument of Beckett and Dalrymple (2019) that a suitable business model is based on five crucial elements of context: (i) business establishment and goals, (ii) business opportunities and stakeholders, (iii) dynamic capabilities, (iv) organisational structure and activity systems, and (v) value architecture.

Following the theoretical discussions in [section 5.2.3](#) and as noted in [section 2.2.4](#), the literature has highlighted that strategic asset management is a source of competitive and sustainable advantages for both regulated and open market environments. The fundamentals of ensuring strategies across all levels of decision-making are interconnected, focused on balancing cost, risk and performance of the asset portfolio to generate value while taking into account the external challenges, political tensions and financial constraints (organisation context).

We noted in our discussions thus far that achieving desired outcomes is a broader goal than just the performance of inputs or outputs of the activity that are based on what is valuable to the organisation and its stakeholders⁸⁴. This research shows a common occurrence of outcomes being compromised (and ways in which this occurs) in the public sector with too much focus on short-term outputs and a financial bias that inhibits the ability to deliver the intended long-term benefits. Hence, there needs to be a different approach to understand better the risks (and benefits), explicitly specified to be measured (or formally assessed), and which considers all potential consequences (intended or unintended) because of the decision made. As noted in [section 4.5.2](#), an organisation's asset management capacity and capability must include responsiveness to the organisation's internal and external context. The challenges of poor-performing infrastructure cannot simply be explained away as poor performance or lack of resources. A more holistic and inclusive approach to collaboration between owners, users and service providers of public infrastructure is required. In other words, there needs to be awareness or anticipation of forthcoming changes to the internal context (e.g., acquisition, mergers, restructure) or external context (e.g., politics, regulators, technology, competitors)

⁸⁴ The process of defining and explaining desired outcomes throughout the organisation adds clarity and deeper understanding of the objectives. Coordinating the organisation's activities is an iterative process that requires the capabilities and competences to be considered (ISO, 2022b)

that will enable organisations to take advantage of opportunities or manage risks more effectively by proactively seeking other capabilities and resources.

Most respondents acknowledged that their organisations continually assess their asset strategies and the context in which these strategies are executed to align with the changing needs and expectations of stakeholders, which will influence their business processes that support their objectives. It is important to note that infrastructure assets are long-lived assets; adaptability and resilience would require a long-term approach with appropriate time scales and rates of change to establish and prioritise for realising future benefits. It is fair to say most physical public assets will outlive leadership cycles and even the organisations' existence and will encounter different requirements from the original needs. They may also be faced with shorter functional use as anticipated regardless of its condition or performance, or encounter environmental influences (e.g., climate change) that would not have factored in the original design (useful) life. Hence, a whole-of-life approach is required, especially when value can only be realised when an asset is used effectively and fit for purpose throughout its life cycle. The consideration of total costs and total value (including risks) across the whole of life is consistent with the principles above of looking beyond a short-term perspective as well as from a sustainability perspective.

Responses reiterated the literature and the ISO standards' stance on the need for alignment or line-of-sight between organisational goals (purpose), plans and activities vertically and horizontally across the value chain. This can be achieved through enablers for alignment, such as processes, leadership and governance, supported by adequate asset management policies, strategic asset management plans, valuable data and information, etc. In addition to

highlighting answers to the research questions that related to the processes and practice areas, it was also necessary to transcribe the relationships between different factors and interfaces within an asset management system.

From a resource-based view, we can define value creation as creating or reconfiguring tangible and intangible assets in an organisation to increase economic, environmental, or social returns. Hence, institutionalising an AM system would require creating a structure or framework with key players (stakeholders) identified and understanding their asset management knowledge, including appropriate capability and capacity concerning the environment. Hillman et al. (2004) noted that literature on corporate political behaviour neglects the organisation's specific internal processes and capabilities and focuses on what has been done. On the other hand, the BOV framework and this research have provided insights into what is required to capture opportunities and minimise the adverse effects of ill-informed decisions by identifying the antecedents and conditions for optimising value.

The concept of dynamic capabilities is particularly relevant to the BOV framework as it focuses on the adaptability of the organisations to the short-term characteristics and changing nature of the New Zealand political and external environments, in terms of policy changes, priorities or level of funding provisions as well as the rate of external technological advancement with new tools to capture data and generate useful information for decision-making. Adopting the systems view, environmental influences can also be regarded as resources (not just constraints) that have the potential to serve as a transformational catalyst or facilitative contribution for the realisation of current or future organisation value by being more flexible and adaptable.

5.2.5.2 FOUNDATIONAL DIMENSIONS

As an output of this research, the conceptual framework proposed is intended to help organisations apply the asset management standards with the relevant settings to optimise value with the assets as illustrated in *Figure 5-3*.

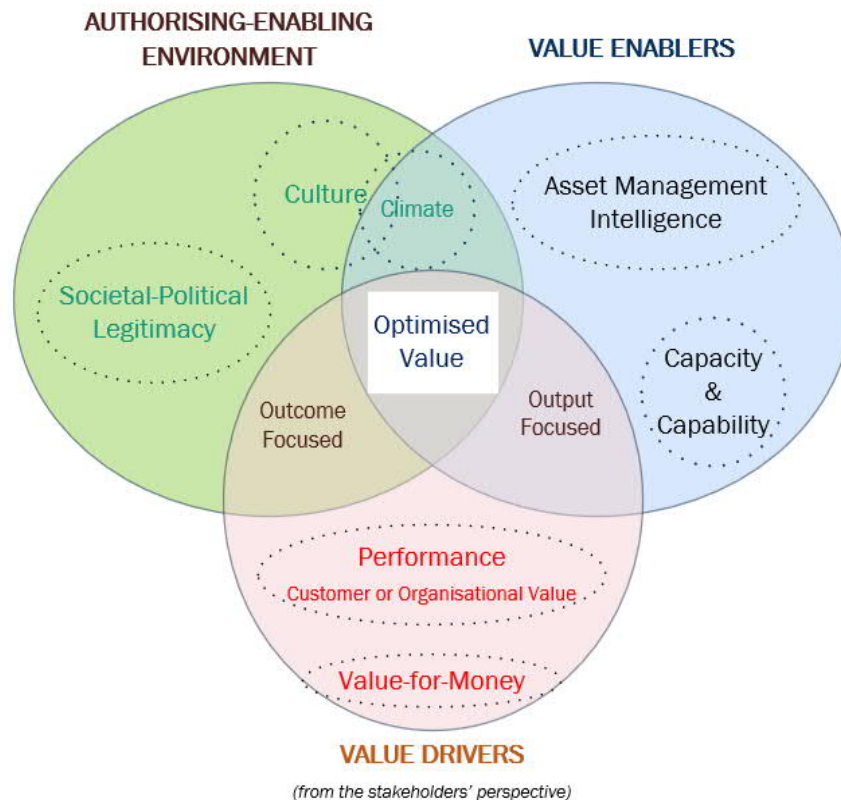


Figure 5-3 - Balanced Optimised Value Framework

The three foundational dimensions for optimised value realisation are (i) *Authorising-Enabling Environment*, (ii) *Value Enablers*, and (iii) *Value Drivers*. The framework is based on the research participants' responses with reference to the strategic nature of the asset management system as described in ISO 55x standards, combined with a focus on the authorising-political environment specific to public sector organisations and the coherence and alignment of their organisation's operational capability and capacity. Interestingly, organisation culture and

climate are considered both conditions for the social license (legitimacy) to provide services for the public and as a critical part of the dimension of *value enablers* to respond to challenges and enable the effectiveness and efficiency of an asset management system. The third dimension of *value drivers* follows the Service-Dominant logic that posits the roles of producers and consumers are not distinct, and that value in the public sector is always co-created jointly and reciprocally in interactions among providers and beneficiaries (authorising-enabling environment) through the integration of resources and application of competences (value enablers).

Application of this framework provides the opportunity to take a holistic perspective and appreciate the complexity of an organisation that may appear chaotic at times but, at the same time, an organised system that can be framed under several theoretical concepts. However, an organised system should not be regarded as mechanical and predictable but is better understood as a complex adaptive system made up of interdependent individuals in a dynamic living world and the need to establish dynamic capabilities. From a systems view, both customer and organisation, as system elements, are closely related and interdependent on each other, as value cannot be delivered without adequate capacity and capability. An effective asset management system also requires all stakeholders to be aware of the environment (e.g., political landscape, market) in which the organisation operates, which the thesis termed as the '*authorising-enabling*' environment that provides the social license or legitimacy to operate, as well as providing the required enablers for optimisation.

An effective manager or leader (including governance) needs to ensure the appropriate enablers (people, processes, tools, culture) are in place as part of the authorising-enabling

environment. In other words, managers and leaders are able to shape the environment and not just react or adapt to it. This is a key difference between this framework and ISO standards. Value is optimised when there is congruence with the environment and supporting enablers and more than simply balancing cost, risk and performance.

The respondents have also identified management of risk or minimisation of potential risks as proxies for value for assets exposed to climate change risks (floods, coastal inundation), geological risks (earthquakes, volcanoes, tsunamis) and other environmental risks (drought, wildfires). Optimisation from this perspective implies that a balanced realisation of expected value (or risks minimised) for different stakeholders is required.

It is also acknowledged that there will be instances where value is not optimised through deliberate leadership or management discretion due to various circumstances, such as when there is a strategic or operational necessity as internal or external resources are unavailable or a long-term objective takes precedence over a short-term goal. Nevertheless, an organisation should always aim for an optimal outcome by creating the appropriate environment with the relevant enablers of information availability and technologies for legitimacy and support. The following sections describe the philosophical and practical considerations based on research findings of the three foundational dimensions of the BOV framework.

5.2.5.3 AUTHORIZING-ENABLING ENVIRONMENT

The ISO 55x standards noted that successful implementation of asset management is a function of the organisation's internal and external contexts subjected to various conditions such as economic, political, social-cultural and technological influences. The authorising-enabling environment for asset management in political jurisdictions often depends on appropriate

policies and regulations, as described in [section 2.3](#) as well as the social and economic conditions at a point in time. However, as noted in sections [4.4](#) and [4.5](#), this environment is dynamic and changes constantly in response to the actions and interactions of its participants within the organisation as well as external stakeholders that can be positively supportive or negatively in opposition creating unwarranted silos and barriers. Non-government participants such as the academia, professional associations and standards bodies can help create, sustain or enhance the asset management culture within an environment by creating '*an identity*' ([section 5.2.3](#)) for effective asset management through organisational learning, knowledge sharing, promoting benefits, innovation and development opportunities for individuals. Interaction with and between stakeholders is crucial and fundamental to creating a sustainable authorising-enabling environment with a clear value definition ([section 2.2.3.2](#)). Bringing asset management expertise, advocacy and professional organisations together (e.g., Āpōpō, IPWEA, FMANZ) to establish a systematic multi-disciplined view can provide a holistic, integrative approach to policy development that could achieve their intended outcomes as New Zealand Infrastructure Commission and NZ Treasury had attempted to achieve and continue to do so as identified in this thesis.

In a highly politicised environment, any relentless pursuit of cost savings or short-term benefits can affect organisational culture and climate, influencing staff and supplier behaviours when a socio-technical systems view is considered. It was evident from the responses that the performance management processes, whether self-driven, systems related, or leader directed, can contribute to organisational development, culture and climate change, including implementing new technologies. Leadership culture or processes have been singled out by most participants to be a key contributing factor for transforming individual perceptions and beliefs

into shared (perceptions) and collective beliefs (culture), as described by Day et al. (2014) as "*reciprocally interrelated but different constructs*". Organisational leaders at various managerial levels can develop policies, practices and procedures and introduce management systems to build intended efficacy to achieve specific outcomes (Bandura, 1986) as discussed below. The challenge is to ensure the presence and alignment of both individual leadership as well as organisation leadership starting from the top.

5.2.5.4 VALUE ENABLERS

Adopting the ISO 55x fundamentals and a strategic focus suggests a methodical approach is required to establish an asset management system that increases the organisation's value. The '*capability and capacity*' enablers are a collective of processes and cannot be delegated to an individual or even a group and should be adopted organisation wide. The '*asset management intelligence*' category inherent within the organisation, and potentially from the stakeholders must be shared and made available to ensure value is optimised. In other words, enablers are also considered influencers that can shape the external environment. It is important to note that the appropriate positioning of enablers would also positively affect the authorising-enabling climate, particularly the effective dissemination of information to prevent any power imbalance.

5.2.5.5 VALUE DRIVERS

Value drivers are considerations that increase the worth of an asset, a system or an organisation. Adopting the ISO 55x value-based approach suggests optimising value begins with clearly defining the purpose of the organisation and the types of value it would like to create for the customer and/or the organisation. The thesis has identified value as defined by the

respondents from their perceptions as a customer of the services offered, and according to those stipulated by their organisations based on its purpose from the different contexts such as economic, social, psychological, asset management, etc. This thesis has attempted to align their views with the ongoing theoretical discussions of what the concept of value means for a public sector entity. Value also represents the means used to achieve the desired outcomes, the social license for the organisation to operate, and its relevance. Public value generally falls into three categories: *outcomes*, *services* and *trust* for most public sector organisations (Kelly et al., 2002). Aligned with the resource-based view and the dynamic capabilities perspectives of the strategic aspect of asset management, the cultural context of a strategy significantly influences stakeholders’ value expectations. This thesis argues that the input-output model of the ISO 55x illustrated in *Figure 2-4* when appropriately integrated and balanced creates optimised value, as depicted in *Figure 5-4*. In other words, the balanced value optimisation approach compared to the balancing of cost, risk and expected performance of outputs (or outcomes) in decision-making create less tensions where trade-offs consider optimised value at the right time and the right price.

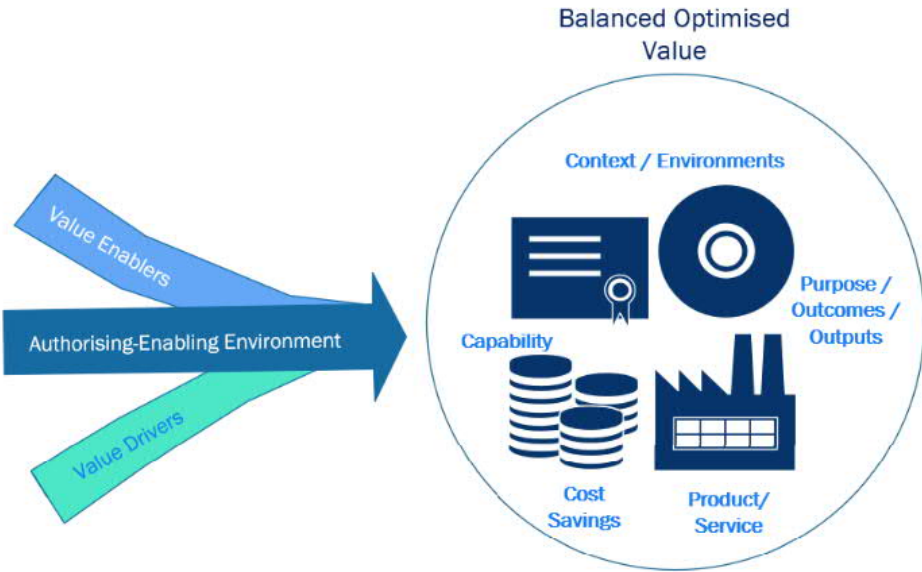


Figure 5-4 Input-output dimensions of the BOV framework

5.3 STUDY VALIDATION AND OTHER CONSIDERATIONS

5.3.1 OVERVIEW

The research topic chosen for this thesis relates to a phenomenon that is considered a lasting part and parcel of the public sector under study and have important implications for the asset management discipline and capability for managing public assets. It was not the intention of the researchers to use limited resources, time and energy to engage in the study of a “*passing*” or “*one-time*” episodes of any government that may be interesting but instead have focused on what is considered as “*worthy*” of in-depth study to enhance the asset management knowledge base that will stand the (relative) test of time. Bridging practice and theory in the thesis is also a key consideration to determine what events are “*worthy*” of study when the context in which the research carried out over 3 years (2020-2023) was faced with uncertainty and constantly challenged by Covid19 restrictions, significant weather events (i.e. Cyclone Gabrielle) and change of governments (i.e. Labour Coalition (2019-2021), Labour (2021-2023), National Coalition (2023-present)).

The issue of reflexivity, validity and reliability was discussed in the previous chapters, this section will highlight the findings as the thesis attempts to generalise (or transfer) research results and proposed framework with a sample of participating organisations and other sectors. It will also highlight key discussions of the thesis that resonates with the release of recent government publications made available after the final draft thesis was completed for review. Finally, an example of the how application of the framework to an existing model on dynamic capabilities is presented as discussed in section 2.2.4.3.

5.3.2 VALIDATION RESULT

Five participants were approached to provide feedback on the conceptual framework proposed in the thesis (see Appendix D). Two interviewed participants (*Central and Local Government*) and three new participants from the sector (*i.e. Health, Education and Social Housing*) provided feedback to the following validation questions in 2024:

- Q1: Is there anything you would like to add to the three key dimensions and 10 elements of the BOV Framework?
- Q2: Would you like to add any other inputs and/or outputs that you think are relevant for the framework to consider?
- Q3: Is the BOV Framework something you could consider applying to your work or your organisation?
- Q4: Based on your experience and expertise, what do you think could be the challenges for implementing the framework in practice?
- Q5: Do you have any other comments or suggestions on the optimisation of value through effective and efficient asset management of NZ public assets?

The five participants were engaged online and in-person for those based in Auckland. Notes and memos were created from the meetings. For privacy reasons, participants requested that the sessions of between 30 minutes to an hour were not recorded. [Table 5-2](#) outlines a summary of the feedback received from the validation.

Table 5-2 - Summary of Feedback in the Validation Exercise

Question	Response
Q1	<ul style="list-style-type: none"> • There needs to be an explicit reference to the organisation strategy • Culture is included in the diagram but could expand to include cultural intelligence and competency • There are probably more than 10 elements I can think of in my organisation but believe it could easily fit in your three dimensions
Q2	<ul style="list-style-type: none"> • Asset management being empowered to take a broad look at all possible actions (ILM based approach) including non-asset – changing the way a process works, rather than changing the physical/IT infrastructure as part of the authorising-enabling environment • Seems logical and aligns with ISO • Funding is a major issue in the sector and not sure if your framework could address that in the short term without significant political intervention
Q3	<ul style="list-style-type: none"> • All five respondents provided positive comments that it can be applied in their organisation • Cultural intelligence could be added to value enablers • The challenge is for your three dimensions to progress at a similar pace which is a big issue I am currently facing. • Establishing the relevant details behind the elements and dimensions is crucial for successful implementation
Q4	<ul style="list-style-type: none"> • Lack of asset management skilled professionals (not just condition-based maintenance experts) who have been trained to see the business, then the asset • Support from the political environment as the proposed require systemic changes • Not sure what can be improved in the current political situation • Lack of asset management expertise, having to use consultants for basic functions • Understanding the likely cost and time to embed the model for small/medium/large organisations (and different types of organisations e.g. government, corporate etc)

Question	Response
	<ul style="list-style-type: none"> Require someone who can evaluate the model once in operation for its effectiveness.
Q5	<ul style="list-style-type: none"> Need to look at the executive level, maybe applying to the ICR asset management maturity framework Asset management should be socialised with others in the sector, e.g. finance, policy analyst etc. Clear definition of value and who decides whether something of value and who is to receive said value It is a very complex topic, great attempt to capture reality and relate to best practices and make it simple to understand There needs to be some separation between governance and management although your integration thinking makes sense in practice

5.3.3 OTHER CONSIDERATIONS

5.3.3.1 GOVERNMENT PUBLICATION

In September 2023, an expression of government policy was issued to all Crown entities by the previous government in a Cabinet Office circular CO (23) 9: *Investment Management and Asset Performance in Departments and Other Entities* (DPMC, 2023) concerning the Investment Management System, the operational requirements for agencies and the roles and expectations of other parties in the system (DPMC, 2023). Strategic Planning and asset management was a new section (p. 4) that coincidentally reinforced the research findings and the discussions in this chapter in particular:

“Agencies’ strategic planning and asset management practices must incorporate consideration of whether, and the extent to which, existing and future assets are resilient to the effects of significant risks (for example, climate change, natural disasters or demographic changes). The level of

resilience required for any given asset is determined by the agency and may vary based on factors including the asset type, location and the criticality of the asset". (para 28)

"Agencies must manage assets to ensure they deliver intended levels and methods of service." (para 30)

"Agencies must demonstrate a level of asset management practice and performance that is appropriate to the scale of assets under their management and the criticality of those assets to the delivery of key public services". (para 32)

"Agencies must maintain asset management plans to inform strategic, tactical, and operational choices." (para 33)

"Agencies must identify their service critical assets and maintain details of the identity, condition, and risk exposure of these assets in the agency's asset register". (para 34)

"Agencies must capture relevant indicators of past and projected asset performance (for example, asset utilisation, condition, and fitness-for-purpose) for service critical assets. Agencies must use these indicators in internal management and decision-making processes". (para 35)

An Asset Management Guidance for Agencies was released by the new government early 2024 that covered the above key points in CO (23) 9 and the five key asset management

principles agencies must apply when managing the current and planned assets under its control: (Treasury, 2023):

- Assets exist to provide value by supporting government objectives
- Agencies act as stewards of public assets on behalf of the government
- Asset management decisions must have regard to the appropriate balance of cost, risk and performance
- Asset management must be integrated with other organisational functions, processes, activities and data
- Asset management decisions must be made using a whole-of-lifecycle approach.

Similarly, the above generally aligns with most of the research findings but lacks the detail and rationale of these principles which this thesis has uncovered and expanded upon as summarised below.

- ***Assets exist to provide value by supporting government services***

The guidance noted under this principle, *“agencies are required to consider asset and non-asset solutions, make asset management decisions (including acquisition and disposal), and measure performance, based on the current and expected contribution the asset makes to the agency’s existing and planned service delivery needs”* (p.6). This thesis noted that such considerations need to factor all the 10 elements in the BOV Framework.

- *Agencies act as stewards of public assets on behalf of the government*

The guidance noted that stewardship requires *“agencies to apply responsible management practices and make decisions consistent with whole-of-government priorities, while considering any impacts on existing and future generations”* including the *approach to collaborative asset management practices with whole-of-government priorities* (p.6). This thesis noted that this notion does not always occur unless there are

mandated and specific requirements that support long-term sustainability (not short-term) and to address any power imbalance and equity.

- *Asset management decisions must have regard to the appropriate balance of cost, risk and performance*

Whilst the principle mirrors the requirements of the ISO 55x standards, this thesis argued that the appropriate balance of the value could be more appropriate when considering whole-of-system approach to prevent silos. In other words, there will instances where whole-of-government (e.g. property), whole of sector (e.g. tertiary education, healthcare, waters reform) requires more than just a whole-of-life costing approach but also future value creation (including risk mitigation) planning and thinking.

- *Asset management decisions must be made using a whole-of-lifecycle approach*

Under this principle, *“asset management decisions must consider a range of potential solutions (both asset and non-asset based) to respond to recognised service needs and assess alternative options, which account for full lifecycle costs, benefits and risks (financial and non-financial)”* (p.7). This thesis asserts that value can be optimised by considering dynamic capabilities that could affect future costs, benefits and risks through, for example, introducing new technologies or initiating significant behavioural changes in the organisation (organisational culture/climate) and of society (societal-political legitimacy).

5.3.3.2 AN EXAMPLE OF ADOPTING THE BOV FRAMEWORK

The point of departure of this chapter is to suggest an alternative to the ISO 55x approach to AM systems processes, inputs and outputs, as illustrated in [Figure 2-4](#) from a strategic perspective where there is a need to look at the bigger picture suggested by the research

participants, incorporating both forward and backward thinking with both short term and long term considerations as in the discussion of *dynamic capabilities* (section 2.4.3). In other words, completing a SAMP, an annual plan, or an AMP is only the beginning and not the end of a continuous asset management implementation process. Aligned with this notion, Tan et al. (2022) suggest the ABCDE guideposts of Haines (2000) could be adapted for establishing an asset management system as an alternative that can respond effectively to the potential impact of competing stakeholders' demand when contending to the traditional mechanistic approaches to managing assets is no longer sufficient (Godau, 2008) as illustrated with *Figure 5-5*

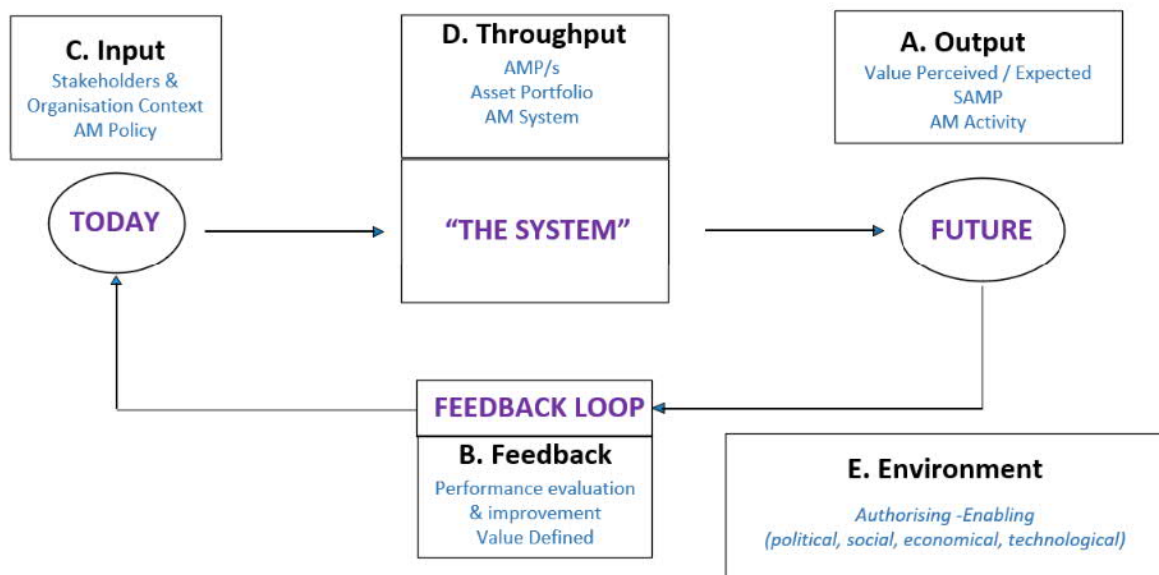


Figure 5-5 AM System elements and processes against ABCDE guideposts (adapted from Haines, 2000)

Using these arguments and integrating with the research findings, *Figure 5-6* depicts the critical attributes of the asset management function based on the topics discussed in this chapter, in particular, the systems approach, dynamic capabilities and value concepts within the BOV framework. Three separate activity groups informed by the authorising-enabling environment enable value to be optimised at different stages of an asset lifecycle: (i) Operating Model Antecedents, Operating Model Selection and Operating Model Implementation. All three activities are interrelated and dependent on each other, depicted by the connectors and processes in blue, further discussed below.

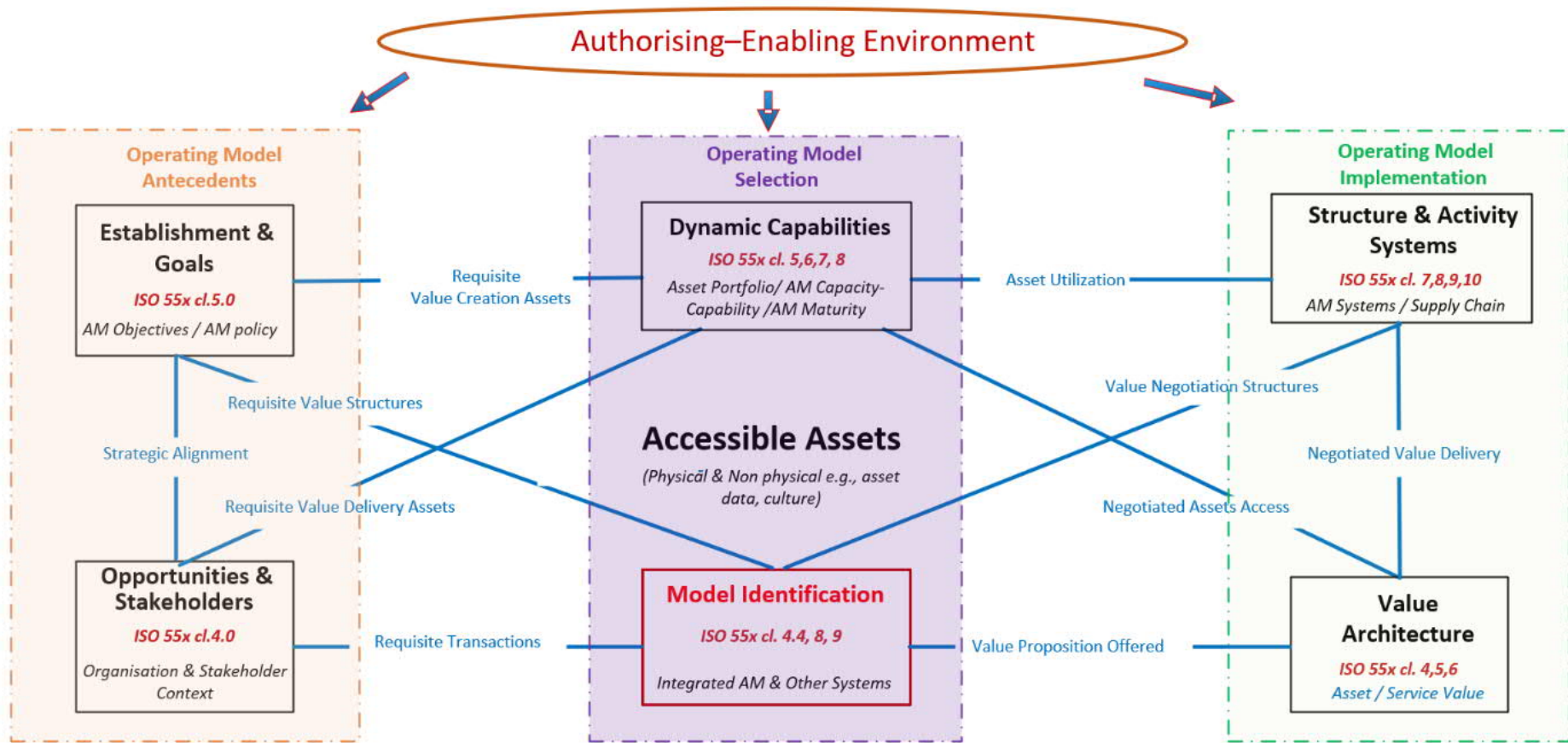


Figure 5-6 Key attributes of a business model based on ISO 55x asset management system elements and BOV framework (adapted from Beckett & Dairymple, 2019)

OPERATING MODEL IMPLEMENTATION

The antecedent of the operating model relates to the societal-political legitimacy factors (e.g., through government policies, interest groups and ratepayers' expectations) that establish the organisation's 'social license' to operate (e.g., for-purpose or for-profit). This license defines the authorising environment, which will have a significant impact on the culture and climate of an organisation, or the enabling environment established by who is employed and developed to lead and deliver expected value and what tools (e.g. information systems, processes) are deployed.

For this activity, the value to be balanced and optimised according to stakeholders' expectations needs to consider the impact of decisions made against the agreed risk tolerance or threshold that can include, in addition to restrictions of cost, risk and performance of the assets, but also the delivery of outcomes in the long term that may not be easily quantified. The research also advocates the co-creation of value with stakeholders, informed by a feedback loop to ensure the joint agreement and acceptance of what value is prioritised or trade-offs to be made. In other words, stakeholders need to be well-informed and have a clear understanding of the organisation's capability and capacity and its environment (e.g., financial, natural, social) in relation to the impact of the assets under management and the service (value propositions) to be delivered through these assets.

OPERATING MODEL SELECTION

The capacity and capability or operating model selection begins with the appropriate leadership and commitment to optimise value through asset management. This commitment

extends beyond supporting an individual or a group of specialists to the entire organisation through effective communication, information and knowledge transfer to ensure the positives and negatives are understood by all stakeholders, internal and external, with a strategic focus, considerations of a systems approach to execute value considerations with the appropriate enablers in-house or outsourced, centralised, decentralised or a combination. The research advocates having an end in mind as illustrated in *Figure 5-4* where the expected output determines the input and the system via a feedback loop.

OPERATING MODEL IMPLEMENTATION

The operating model implementation activity needs to incorporate capacity and capability considerations to establish the value architecture incorporating the asset management system's cultural and social factors. Stakeholders' requirements and concerns are at the core of the system value architecture development. Any introduction of enablers must be managed through a formal change process incorporating behavioural change, transition and organisational learning. From a systems perspective, the AM system design should also consider the cause-effect relations of decisions made and adapt continuously to exhibit resilience and sustainability. Accounting for factors by working backwards from the objectives ties in with the systems and whole-of-life thinking into a larger context of the organisation and its asset management system and places particular emphasis on interrelations between critical elements and the effects of time. An organisation's cultural profile influences the extent of value realisation from the asset strategies deployed. A performance-based, cost-oriented or risk-focused cultural profile will also affect how an organisation develops its capability and capacity. Any culture change must incorporate clear and sensitive communication of the vision or purpose and the strategies that arose from it.

Chapter 6

CONCLUSION

6.1 INTRODUCTION

This final chapter begins with a reflection on the research journey that has now come to an end, having started three years ago when it set out with intentions to discover and address gaps identified in past research and to expand on the existing body of knowledge on the asset management philosophy (or rather its absence) in Aotearoa New Zealand. This is followed by the synthesis and conclusions of the thesis on the proposed conceptual framework of asset management practices in the public sector for optimising value from its physical assets. It will also discuss its relevance to the asset management profession in New Zealand. Finally, it describes the limitations of this research and makes recommendations for future research.

6.2 REFLECTION

Having chosen a topic close to his heart, the researcher could be positioned as an *'insider'* (Kacem and Chaitin, 2006) that had the advantage of recruiting suitable participants with affiliations with the sector through past employment and professional qualifications. With a head start in understanding the topic and empathy with the nuanced reactions of participants during the interviews, it encouraged interviewed participants to share their views more openly with the confidence that the researcher had the relevant knowledge and ability to understand the implied content and was more sensitised to specific dimensions of their responses than they would with an unfamiliar person or limited asset management or sector knowledge. However, as Drake (2010) noted, apart from the abovementioned benefits, insider's position and familiarity carry the risk of ambiguities in separation (boundaries) and

unintentional biases that must be managed carefully. Hence, it was noted the most significant challenge throughout the research process was the need to maintain objective distance and limit the potential influence on the data collected by conducting constant comparative analysis (Neill, 2006), mindfulness of reflexivity at all times, and the need to reflect the voice of the author in the final output (Charmaz and Mitchell, 1996) while acknowledging the data stems from the postpositivist ontology of the grounded theory approach.

The essence of using the case study research and grounded theory methods was their concurrent, iterative and integrative inductive-deductive interplay throughout the different research phases, beginning with a topic of interest (i.e., asset management), a research situation or event (i.e., public sector, ISO 55x) followed by allowing ideas to develop with an open-minded approach (i.e., participants' responses and references to associated theories and literature). Instead of Glaser's model, the research has chosen Strauss's model of theory generation that supports an interpretive stance that continues from the beginning using an *a priori* based on the ISO 55x standards, which the participants are aware of and for many, very familiar with; before proceeding to ground a theoretical concept generated by empirical evidence of the social phenomenon under investigation (Strauss and Corbin, 2015).

Aligning with the views of McGhee et al. (2007), the research acknowledged it is not possible to control what is already known by the researcher and participants when entering the research field, but control can be exercised on what is relevant to be added to that knowledge base through a transparent and well-defined reflexive approach (Strauss and Corbin, 1998) using well-written memos, coded notes, operational notes, mind maps, logical and integrative diagrams of reflection and acknowledgement of pre-existing knowledge and experiences while collecting data, during transcribing and coding of interviews. This approach ensures that

the research adheres to the inductive requirements and the ontological and epistemological underpinnings of the grounded theory methodology.

The initial review of literature in [Chapter 2](#) highlighted a lack of theoretical grounding of the asset management philosophy and little extant knowledge of the research topic. Hence, it was fair to say that the use of *a priori* based on the current ISO 55x standards did not result in the grounded theory being preconceived and framed by concepts imported from the literature or was constrained for effective generation of categories, properties and theoretical coding for establishing a new perspective on an existing issue (Strauss and Corbin, 1998, Glaser et al., 1968). The framework proposed from a socio-technical perspective suggests an integration of other theories and disciplines deemed relevant in practice by the research participants. Considering that the research findings are based on real-life asset management leaders' perceptions, their relevance to the discipline is almost certain to some extent.

Finally, the change of government in October 2023 led to the removal of crucial government documents from some of the organisations websites referenced in the beginning of the study as well as contradicting (or superseding) information provided during the interviews that was used in thesis. A few references to government publications were removed from the final thesis due to significant changes to infrastructure decisions made by the previous government. Interestingly, some of the changes support what was highlighted in the thesis, about the complexity of asset management decisions that are not always subjected to evidence-based criteria, the asset whole-of-life considerations, or the adverse impact to society and population.

From answering the four research questions, the inductively derived BOV framework is provocative and novel. It challenges contemporary views of what is required for an effective and efficient asset management system based on the ISO 55x standards, as discussed below.

6.3 BALANCED OPTIMISED VALUE FRAMEWORK

The realisation of value through asset management has been a long-standing objective of the asset management discipline and its community even before the publication of the ISO standards in 2014 and could be traced back a few decades prior. The initial literature review highlighted how value could be defined in various ways by different stakeholders (e.g., economically, financially, literally, risks, costs, outcomes, outputs) or under other circumstances (e.g., climate change, resilience, disaster recovery, financial constraints) that were empirically supported by the responses from the participants. However, what was not identified in the literature were the mental models associated with managing the complexities of a highly politicised environment of the New Zealand public sector and the non-linear day-to-day reality of ensuring the assets served their purpose of delivering public services and public value.

This research has shown that not only were the factors and interfaces between the asset management system, the wider organisation and the eco-system complex, multi-directional and multi-dimensional, but they were also further complicated by layers characterised by the level of power and influence, which were considered under a broader theme of a political-social dimension. Many of these issues are managed by tools such as a highly sophisticated asset information system with advanced data collection, storage and analytical capabilities. However, with ongoing funding shortfalls and increased complexities of environmental and

social challenges, this research asserts that these tools, on their own, cannot be used as proxies for effective decision-making and discharging responsibilities and accountabilities by governance or management. Similarly, the specialisation of primary functions within an asset management system that supposedly brings about more efficiencies are, in fact, sources of silos. The focus on technical in-house outputs (e.g., costs matching funding) and misconstrued as customer outcomes can be avoided with a *“new philosophy”* that is focused on outward-looking outcomes (not outputs), not limited to just the asset base itself but adopting whole-of-organisation, whole-of-systems thinking and practice perspectives.

The BOV framework theorised for this thesis, and its approach to establishing a business model for asset management offer other means to optimise value from complex infrastructure systems that complement the current ISO 55x requirements. The model supports the reorganization of structures and processes that incorporates capacity and capability improvements. These improvements need to be supported by changes in the people’s mindsets, organisational culture and climate, appropriate technological tools, and relevant knowledge management methods. The availability of data and information is insufficient for conversion to knowledge and wisdom for effective decision-making and value optimisation. It requires, first and foremost, a good understanding of the underlying value of the purpose of the organisation system (whole) and its sub-systems (parts). This thesis argues that asset management is about knowing what can be directed and influenced, not just merely observed, rather than just acknowledging complexity. This notion is comparable to transforming theory into practice and as noted by that Madhavan and Mahoney (2012), *“motivates practitioners to give attention to scholarly evidence”* where the outputs of the research are *“seeded by the real-life problem that is worth solving”* (p.84).

Depending on specific circumstances, value creation or enhancement can be attributed to making the right decisions that balance costs, risks, and benefits. Preparing adequately for present and future challenges in the built environment sector requires concerted efforts within the whole system. The current study has provided a pathway for organisations to enhance leadership and capacity by adopting a holistic, integrated, multi-disciplinary approach to increase the value of the assets in their organisations. The BOV framework will enable better collaboration between stakeholders through further developing a common vocabulary across New Zealand's built environment value chain; it can be used in any benchmarking and performance measurement tools to define an organisation's value and what optimisation looks like. Both would lead to, instead of competing, jointly developing technological solutions by different service providers to lift capacity and capabilities for servicing the sector. Efficiencies can occur through lean thinking, action learning, and minimising support costs such as monitoring, inspection, maintenance and operational disruption by making the right decisions from the beginning at the concept and design phase, well informed by value, compliance or conformance to international standards, and whole-life-value through effective knowledge management.

The research has provided new knowledge to inform public infrastructure investment and procurement policy formulation. Also, potential influences on legislative and regulatory changes will positively impact the sector and benefit society more significantly by ensuring all key players comply or conform to relevant quality standards and adopt international best practices. With a better-informed infrastructure development pipeline, training providers can better tailor their educational and training programmes to ensure adequate capability and capacity of all workforce levels. This research can contribute towards an effective knowledge-

based economy that will attract more private capital to infrastructure projects and overseas investors to Aotearoa New Zealand, due to better clarity of value, stability and transparency across the lifecycle stages. When the entire value chain is better prepared to enable greater returns to investments, it could also catalyse local businesses to provide services in the international market.

6.4 (RO5) LIMITATIONS AND FUTURE RESEARCH

With all the research questions (RQ 1-4) answered and the four research objectives (RO1-RO4) achieved, several limitations remain that inform the last research objective (RO5): *To validate recommendations for future research and development of an asset management knowledge base for managing NZ public physical assets.*

The first limitation is that the research was carried out in a very specific context involving asset management systems in organisations managing public infrastructure assets and could not include all public services due to time constraints, resources available, and disruptions caused by the COVID-19 pandemic. To increase reliability and generalisability of the conclusions presented in this study, or otherwise, refute them or replace for more feasibility and practicability is to include other sectors (e.g. health).

The second limitation concerns the implementation of the framework and business model for long-lived assets with long lead and lag times. Ideally, comparative analysis of different approaches for implementation should cover at least one or two political circles (3-6 years) to enable further validation of models, tools and frameworks tailored for an organisation that is consistent with the thinking of incremental improvements that enable continual re-

evaluation, reset and adaptation are required to create an enabling environment as described in this study.

Thirdly, although the proposed BOV framework is logically and empirically sound, the methods, tools, and approaches do not offer '*a silver bullet*' or a '*one size fits all solution*'. It would be beneficial to evaluate the framework against organisations that focus on facility assets separately from those with infrastructure assets to uproot generic principles underlying the mechanisms used to optimise value within particular organisations, sectors, and for specific asset types.

Considering the above limitations, irrespective of the results of this study, there are considerable opportunities for further research, but not limited to:

- More focus on the '*soft*' topics of culture/climate and social factors (e.g., leadership, knowledge) of the socio-technical aspects of asset management systems within specific organisations over a period of time.
- Ongoing research that adds to the understanding of the interfaces and tensions between value realisation and creation, between internal and external stakeholders, and between the outputs and outcomes expectation within different time horizons.
- Investigate the adaptability of a continually evolving system, taking into consideration the social-political legitimacy factor introduced in this study through dynamic capabilities that address both capacity and capability in terms of financial (e.g., funding) and human resources (e.g. practice).

- Further development of system and sub-system level themes that would enable effective interventions and technical solutions to minimise potential barriers and constraints for value optimisation to enhance the BOV framework.
- Consider how effective and efficient asset management practice can transition beyond just technical or technological outcomes, for example, investigate how society interacts with an asset with fixed expectations (outputs) to a co-creation of value that reflects the outcomes, the needs, beliefs and choices of society, or having an external-oriented strategic view that can continually accommodate and respond dynamically to unforeseen changes and disruptions.

6.5 IMPLICATIONS

In summary, it is acknowledged that this thesis does not suggest that the BOV framework is *'the solution'* for addressing all the challenges of a complex public infrastructure asset system in New Zealand . Instead, it offers a systems-oriented approach and sense-making practical model to address the real-life issues and challenges in the sector with practical solutions that have worked well for those who participated in this study.

The research has contributed to the academic and professional asset management literature from the New Zealand perspective as well as providing new knowledge to inform public infrastructure policy formulation and investment. It has identified that value for the built environment is as much as a political concern as it is a managerial one. The literature review has affirmed value in general is difficult to grasp and define, partly due to the diversity of language, variety of theoretical constructs and the multiplicity of interpretation formed through complex social processes.. The research has shown that value can be considered as

the quantification of the relative importance that different stakeholders place on the changes they experience in their lives or the perception of the benefits to society. Despite the challenges of grasping and defining value of public infrastructure assets, the BOV framework suggests that the concepts of 'shared value' can be incorporated into asset management practices for a better balance of delivering economic, environmental and social outcomes. The 'balancing' approach in the framework extends beyond the current ISO 55x standards and asset management guidance provided by the New Zealand authorities of balancing cost, risk and performance. The framework posits that management and governance should ensure that shared (agreed) value definitions, informed by appropriate value drivers, adequate value enablers are available in a supportive authorising-enabling environment simultaneously (both top-down and bottom-up) for value optimisation.

The findings and outcomes of this research will have potential influences on legislative and regulatory changes that will positively impact the sector with the provision of the right assets that optimise benefits for society. This research can also lead to training providers developing better tailored educational programmes to enable effective asset management capability and capacity for the sector and the discipline in general. The efficiencies can occur through better collaboration and understanding between stakeholders of public infrastructure based a common vocabulary across New Zealand built environment value (both private and public sectors). A consistent view of what optimal value looks like could lead to collaborative development of technological solutions, performance and benchmarking tools that promotes continuous improvements as opposed to only focused on competitive advantage for funding and scarce asset management resources.

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Appendix A – ETHICS APPROVAL



16/11/2021

Dear: Raymond Tan

Re: Low Risk Notification - 4000024756 - Value Optimisation in the Built Environment: Bridging practice and theory in the application of International Asset Management Standards for managing New Zealand public physical assets

Thank you for your notification which you have assessed as Low Risk.

Your project has been recorded in our database for inclusion in the Annual Report of the Massey University Human Ethics Committee.

The low risk notification for this project is valid for a maximum of three years.

If situations subsequently occur which cause you to reconsider your ethical analysis, please contact a Research Ethics Administrator.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course-Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

A reminder to include the following statement on all public documents:

"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named in this document are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you want to raise with someone other than the researcher(s), please contact the Research Ethics Office, email humanethics@massey.ac.nz.

Please note, if a sponsoring organisation, funding authority or a journal in which you wish to publish requires evidence of committee approval (with an approval number), you will have to complete the application form again, answering "yes" to the publication question to provide more information for one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

Yours sincerely

Professor Craig Johnson
Chair, Human Ethics Chairs' Committee and Director (Research Ethics)

Research Ethics Office, Research and Enterprise
Massey University, Private Bag 11 222, Palmerston North, 4442, New Zealand T 06 951 6841; 06 95106840
E humanethics@massey.ac.nz; animalethics@massey.ac.nz; gtc@massey.ac.nz

Appendix B – PARTICIPANT INFORMATION SHEET



COLLEGE
OF SCIENCES

PARTICIPANT INFORMATION SHEET (PIS)

Research Topic

Value Optimisation in the Built Environment:

Bridging practice and theory in the application of International Asset Management Standards for managing New Zealand public physical assets

Introduction

You have been identified as a key player in a three-year research as an asset management professional involved with New Zealand public physical assets (e.g. Property, Infrastructure, Utilities, etc.) This PIS sets out the rationale of the study, what your participation would involve, your rights during the study and what would happen after the study ends.

Aim and Objectives

The proposed research aims to develop a business model that enables optimisation of organisational value through the effective and efficient management of public physical assets with the following objectives summarised below:

- To identify critical properties e.g., pattern of cause-effect relations that link value creation/capture activities with asset management decision making in the built environment.
- To identify relevant theoretical frameworks that support the conceptual business model for optimising organisation value through the successful development and implementation of an effective asset management system.
- To establish the linkages of both tangible and intangible benefits embedded within asset lifecycle management decisions.
- To evaluate the key attributes of a business model that that enables all stakeholders in the sector to improve their capability and capacity for value optimisation when managing public assets.
- To validate recommendations for future research and development of an asset management knowledgebase for managing NZ public physical assets

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Interview Procedures

Research questions will be sent to you prior to the scheduled interview that will take no more than an hour. Discussions in the interview will be recorded (audio file only) and will be transcribed for your approval and consent to be included in the study and the final report as an accurate record of our discussions. Your identity will not be revealed in any records and will be held for the duration of the study. The data collected will be destroyed within 5 years after the completion of this research. Written reports will be prepared based on the analysis of the data and may be published as research findings in various formats.

Participant's Rights

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- decline to answer any particular question; withdraw from the study at any time without providing any reasons
- ask any questions about the study at any time during participation
- ask for the recorder to be turned off at any time during the interview
- provide information on the understanding that your name will not be used unless you give permission to the researcher
- review and comment on the transcript of the interview
- be able to access to a summary of the project findings when it is concluded.

If you agree to take part in this study, please sign the attached Consent Form. You will be given a copy of both the PIS and the Consent Form to keep.

This project has been evaluated by peer review and judged to be low risk. The researcher named in this document are responsible for the ethical conduct of this research (ID 4000024756).

If any queries arise, please contact the investigators:

Raymond Tan

PhD Candidate
School of Built Environment, Massey University
email: rtan1@massey.ac.nz

A/Professor James Rotimi

Academic Dean - Construction
School of Built Environment, Massey University
email: j.rotimi@massey.ac.nz

Thank you for your time and your kind support!

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CONSENT FORM

RESEARCH TOPIC

Value Optimisation in the Built Environment:
Bridging practice and theory in the application of International Asset Management Standards for managing New Zealand public physical assets

You have been provided information on the research and the interview procedures by in the Participant Information Sheet. Signing this form acknowledges your permission to be interviewed.

During the interview you may ask to stop recording to make comments off the record. Results will not be published in any form that allows the identification of individuals or organisations without permission.

You are free to refuse to answer any question and to withdraw your participation at any time without needing to provide any explanation for your decision. In this event, the researcher will destroy all data gathered from any withdrawing participant.

Signature: _____ **Date:** _____

Full Name _____

CONFIDENTIALITY AGREEMENT

I, **Raymond Tan**, agree to keep confidential all information concerning the research. I will not retain or copy any information for any other use other than its main purpose.

Signature: **Date:** _____

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Appendix C – INTERVIEW GUIDE

Interview Guide

¶

¶ → Definitions (ISO-55001): ¶

- → An asset is an item, thing or entity that has potential or actual value to an organization that can be tangible, intangible, financial or non-financial ¶
- → Asset management is the coordinated activity of an organisation to realise value from assets. ¶
- → An asset management system is a set of interrelated or interacting elements of an organisation to direct, coordinate and control AM activities in a consistent manner that effectively manage risk and provide assurance that objectives will be achieved. ¶

¶ → ¶

Background -- Participant ¶

Please provide some information ¶

- → about your time and role with the organisation ¶
- → what asset management means for you in your current role ¶
- → any other background professional background you would like to add ¶

Research Questions (Open Ended) ¶

RQ1: → What are the **key** considerations for **defining value** from the perspectives of internal and external stakeholders of (i) the asset, (ii) the asset management system and (iii) organisation? ¶

RQ2: → What are the **key** considerations for **prioritising** AM strategies and Asset Decisions? (e.g., *Balance of Risk, Cost and Performance -- Value/Benefit*) ¶

RQ3: → What are the **critical cultural** and/or **social factors** (e.g., *leadership, collaboration, Treaty of Waitangi, diversity, demographics, power*) for the successful development and implementation of an asset management system? ¶

RQ4: → What are the **enabling structures** (e.g. *centralised vs decentralised, outsourced vs in-house, automated vs manual*) and **processes** (e.g., *procurement, condition assessment, IT, automation, use of maturity assessments, benchmarks or standards such as Baldrige, ISO 55000, ISO 9001, ISO 44001, etc.*) for an effective and efficient asset management system? ¶

Appendix D – VALIDATION INFORMATION SHEET

VALIDATION INFORMATION SHEET (VIS)

Introduction

Thank you for agreeing to participate as an asset management subject matter expert in the final validation process of my PhD research that aims to develop a business model (framework) for optimising value of public physical assets through effective and efficient asset management.

The validation consists of answering four questions based on two considerations:

- relevance of the research findings for asset management that involved interviews with 24 asset management professionals from 20 New Zealand organisations,
- appropriateness of the proposed Balanced Optimised Value Framework (BOV) and its potential application for your work or organisation.

Background

Foundational Dimensions / Elements

Figure 1 illustrates the ten key elements (factors) of the three foundational dimensions of the Balanced Optimised Value Framework that are often interrelated and interdependent.

Research participants had indicated that in practice, there are three foundational dimensions for optimising value that define the effectiveness of the asset management systems and practices in their organisation.

The dimensions/elements are the results of the synthesis of qualitative evidence (interviews) and integration with the comprehensive review of the ISO 55000 suite of asset management standards, official documents, academic and professional publications available as summarised below.

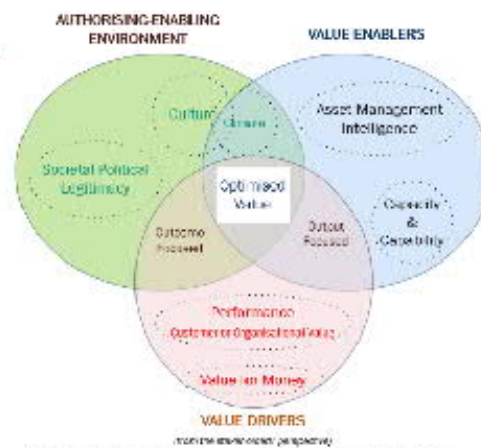


Figure 1 - Foundation Dimensions and Elements of the BOV Framework

- **Authorising-Enabling Environment**
It was recognised that Public Sector organisations are often subjected to social, political, environmental and other influences that are difficult or impossible to control. Even with manageable value drivers and enablers, an organisation needs to have the appropriate asset management culture and climate for decision making
- **Value Drivers**
Value drivers of relate to the perceptions of performance and value-for-money as defined by both internal and external stakeholders that can be in alignment or in conflict from an organisational or a customer perspective
- **Value Enablers**
Value enablers consist of both the tangible (e.g. IT systems, people) and intangible (e.g. culture, climate, intellectual property) resources that define asset management intelligence, capability and capacity for value optimisation.

Balanced Value Optimisation Framework

Congruence of all three dimensions described above will enable value optimisation. The research as illustrated *Figure 2* posits a proactive approach is needed to create the future instead of merely waiting for situations to unfold (e.g. election, natural disasters) or predicting outcomes passively (e.g. climate change, demographics). Value can be optimised (and created) by actively engaging in actions that lead to the most desired outcomes with appropriate resources. In other words, by integrating the three foundational dimensions, asset management professionals can influence their situations or environment, drive positive change, innovate or adapt through intentional and purposeful efforts of embracing technology effectively, creating the right organisation culture, and forward thinking at individual and organisational context.



Figure 2 Input-Output dimensions of the BOV Framework

Validation Questions

- Q1: Is there anything you would like to add to the three key dimensions and ten elements of the BOV Framework?
- Q2: Is the BOV Framework something you could apply to your work or your organisation?
- Q3: Based on your experience and expertise, what do you think are the challenges for implementation of the framework?
- Q4: Do you have any other comments or suggestions for further research for value optimisation through effective and efficient asset management?

Declaration

This study has been evaluated by peer review and judged to be low risk. The researchers named in this document are responsible for the ethical conduct of this research project (ID 4000024756).

Contacts

If any queries arise, please contact:

Raymond Tan

PhD Candidate
School of Built Environment, Massey
University
email: rtan1@massey.ac.nz

Professor James Rotimi

Doctoral Mentor Supervisor
School of Built Environment, Massey
University
email: j.rotimi@massey.ac.nz

Dr Eziaku Rasheed

Senior Lecturer
School of Built Environment,
Massey University
E.O.Rasheed@massey.ac.nz

Thank you for your time and your kind support!

CONSENT FORM

You have been provided information for this research and the validation questions that would form part of the Thesis. Signing this form acknowledges your permission to be involved and meets the University Code of Research Ethics requirements.

Results will not be published in any form that allows the identification of individuals or organisations without your permission.

You are free to refuse to answer any question and to withdraw your participation at any time without needing to provide any explanation for your decision. In this event, the researcher will destroy all data gathered from any withdrawal.

Signature: _____

Date: _____

Full Name _____

CONFIDENTIALITY AGREEMENT

I, Raymond Tan, agree to keep confidential all information concerning the research. I will not retain or copy any information for any other use other than its main purpose.

Signature:

Date: _____

Appendix E – VALUE CONSIDERATION

Category – Performance ¶

... value for our portfolio is about financial value. (CG1) ¶

... value is getting the best bang for the dollar to aid the business doing the work the most effective way. (CG1) ¶

... five key elements of Fit-for-Purpose assets: ... location, branding or expression, building quality, flexibility and functionality. (CG1) ¶

... four expectations of the government: value for money, valuing people, fit-for-purpose, good quality work experience. (CG2) ¶

... we believe that new, modern, fit-for-purpose buildings, set up, appropriately, maintained appropriately, can provide the vehicle for that unified product / public service. (CG2) ¶

... you start rolling it back down into the more technical sort of say, service, we're providing an access, a safe and reliable, efficient access to a system which can then enable your goods or people to travel to where they need to eat, whether that's connecting other networks, or connecting you to major destinations or communities. There are the different levels. (CG3) ¶

... for us as an organization, we got multiple layers and different functions that we deliver (CG3) ¶

I've identified probably three kinds of value, the first one was the ability to generate revenue, second one was internally you need to make sure that you are performing, or the asset management system is performing to its expectations. And then the third is the value from the users' perspective and the indirect benefits that you can provide to other communities and other authorities or organizations that are also interface with, basically our neighbours so to speak outside of our boundaries (CG3) ¶

Health and safety is a big driver because that's part of one of our focuses around our zero program to minimize the risk of health or safety injuries, but that's health and safety from the perspective of the user, as well as health and safety of those that maintain, operate and use our network. (CG3) ¶

The system is more of a delivery function, so to speak, it's an enabler of delivering their life cycle as well as a gateway into managing risk, lifecycle risk, quality, reputation, health and safety type risks. So, all of those aspects will play a value into the system. From an organizational perspective, you rolled it up again, talk about risk of meeting objectives and outcomes and stuff like that. (CG3) ¶

One of the challenges we have in asset management is actually understanding what level of service is. So, if we think of the transport space you've actually got three or four different levels of service frameworks that you could use. If you think of the transport system, obviously customer level services are really important. And so, customer level service when it comes to asset management can be as much as travel time, reliability, can be roughness of the road, how many potholes, things like that, it can be safety. And when we think about asset management, the safety level service could be your road marking, could be your road lighting.

assets, but it could also be coming back to more technical levels of service around skid resistance, about SCRIM. (CG4)¶

So generally, the value proposition from organizations is around 'What is the price that you have to pay for something that you are willing and happy to do so because you feel that you've got something in return in exchange'. So that is for me, that's a value proposition when assets are built in the public sector, so that's why I would focus on. (CG5)¶

The value of assets or infrastructure is around servicing the community... they are usually done to ensure that we have safe, thriving communities... if you are trying to compete as a community, you know a town or a city with others to attract more investment, more people. (CG5)¶

In terms of the value of asset management system, management systems is like a language. And when you speak the same language, you are able to provide consistency. You're able to provide efficiency, you provide, you're able to have a narrative and systems generally allow you to become more efficient because you were repeating transactions and instead of having to make mistakes and learn from it every time. It's like the processes in the system and the documentation have to take account the learnings from others with the ability to keep improving and keep updating the system. And when you have a lot of data, a lot of information. Then again, it becomes impossible to manage that, unless you have a system. (CG5)¶

... an asset management system provides the institutionalization of the approach. Then, if you're a company, people come and people go, and you don't want them to come and bring new approaches every time. You want to provide that consistency over time, so there is value in having a system. There's also value in ensuring that the system is flexible. Then it is not a burden on getting things done just for the sake of, because someone decided that some stage that we're going to do this this way. And people keep doing it that way, so it has value, but it can be an obstacle. It can be a deterrent for people as well. (CG5)¶

So, when it comes to understanding the performance, so what does degraded performance mean to an end consumer? So how do you value that at? So, it's okay to degrade performance and it's quite a real issue in rail. For example, you can apply a temporary speed restriction. So, how do I value that degradation in performance in terms of my calculation of value? And then there's the risks that need to be considered from a societal perspective, multiple dimensions and they include: the risks in terms of safety, risks in terms of environmental impact, risks in terms of direct costs. So, reacting to something, and replacing something that fail invariably is going to be more expensive. Typically, then if you were able to theoretically deal with it before it fails, no one can do that. But the art is to try to get as close to that as possible. (CG6)¶

For internal customers, ultimately, it's about setting the business up for success. So, we have this high-level asset management strategy that has the elements that I talked about, so how do we make that real? So how do we need to establish a criticality framework so that everyone within the business has done as agreement or rough agreement, as to which assets are more critical than others throughout the business. So operational people might say this is a different view to longer-term planning horizon perspective but that shouldn't be too different. It's important that we all are working up the same sort of environment in that regard. So understanding how we go about making an investment decisions is important because otherwise your people operating at the assets on a day-to-day basis feel as though they have to actually do that as well. (CG6)¶

Defining value is a relative term and will depend upon your position in the overall scheme of things, and the perspective that you have from that position. If I talked to a pure engineer and ask them to define value, they will instantly go to life cycle costing, whole-of-life costs, etc. If I talked to a stakeholder or a tenant in a building, they may define value as giving me a bigger office or some other far more subjective, self-interest focus. And so, one of the challenges in a large organization is balancing those various perspectives whilst still fulfilling the core requirements of the organization. (OTH3)¶

Category—Value for Money¶

In terms of lifecycle value, you can roll this into multiple levels. At the highest possible level, the provision of this asset. It enables the economic growth of the country. From a GDP perspective, the road enables the transport, logistics and supply sectors to operate, which is about \$12 billion. Then, as an organization, we are an enabler for the construction industry, which is about another \$6 billion to the GDP. So, there's a high-level value, that our function, our assets provide. And then as you start rolling it back down into the more technical sort of say, service, we're providing an access, a safe and reliable, efficient access to a system which can then enable your goods for people to travel to where they need to eat, whether that's connecting other networks, or connecting you to major destinations or communities. There are the different levels. (CG3)¶

I think, from the internal stakeholders' perspective, the assets are the value, it's providing that service to our performance standards service, but it's also for our organization, an enabler for revenue. So, without the assets, we can't provide service, and we can't generate revenue, so it has a value from that perspective. (CG3)¶

I would emphasize that there has to be a very strong notion around the purpose... you need to know what is the purpose, and how is the value going to be measured. (CG5)¶

the value proposition very much depends on whether it's driven from a public good perspective or whether it's driven from a private good perspective. (CG5)¶

So, whether it's a private sector or public sector, both as an organization, it's quite important for them to ensure that their users, the people that they are serving, see them as value. (CG5)¶

Value to people, most people immediately go to financial value. But value can be non-financial as well. So you know how happiness you get out of something or what your well-being is. There's also value more difficult to define, and it's not, it doesn't have international currency that you can. My value is 3 hearts, but we don't have that. (CG5)¶

... that word value is really important. To come to the point of the first question, and very often people view it, through the lens of this whole, at least, Whole-of-Life, Least-Cost perspective, which is very deficient way of viewing the world. Because value is not just about the cost to the company, but also the risks and the opportunities. And those risk and opportunity costs need to be incorporated in any assessment of value. So, in particular, where you're a social goods organization, in other words, providing a network of some sort, maybe gas electricity, road, rail, then what you're looking at there, is not necessarily the cost to the organization but the economic benefit or the economic cost to the country as a whole, and that's critical because that's what needs to go into social value. (CG6)¶

So, I think that's the term value is, is one that's not fully understood particularly in the risk-cost area because people generally, it's a psychological thing. I find people don't value risk until it occurs in which case it's an event, it's no longer an issue, it's no longer a risk. So, risk accumulates over the years because invariably that risk gets more and more likely to occur, consequence may not change, it could change, but so you've got actually accumulate that risk so that at least telling you the point at which you need to invest because your asset is degrading, so the likelihood of failure is increasing. (CG6)¶

... it's important if one understands that and you have a criticality framework in place and that criticality framework needs to cover all those dimensions that I talked before, in terms of public health, your own workforce safety, your direct costs implications, environmental implications and the implications on performance, which is the economic performance to the customers that you serve. Now, that will get, will give you a sense in terms of how to value the term 'value'. (CG6)¶

the issue that we have in all the public services is the stakeholder that uses assets is not one homogeneous group. In fact, we've got a full continuum from New Zealanders that think that the estate is too big and is over investing and that we shouldn't have assets at XXX... right through to the other end of the spectrum... and you've got everything in between and that's just visitor experience, and then you come to what people attach as value where people say the tax is too much. I don't wanna pay that much. Stop spending money on all of this; right through to "no, no, the XXX and our XXX is the heart of this country's well-being. And the well-being budget from a few years ago where people recreating is a social good from a health perspective and a well-being perspective and everything like that. And we should be investing more on that given the biodiversity and climate crisis and all those sorts of things. (CG7)¶

... xxx is just a vehicle with a mechanism to help us add value to those families' lives. (CG8)¶

Appendix F - PRIORITISATION

Category--Output-Focus¶

One of our core drivers is....space utilization...and where possible co-locate agencies, get efficiencies, efficiency to scale.(CG2)¶

Ultimately, your final investment plan though, will be constrained by available money and that's constrained optimization and the constraint is available funds. The art of a good asset manager is actually to put the case forward to be able to demonstrate the overall value proposition. So, you always have options and that the options are there to designed to have that discussion to fit within the funding constraints. But if we tackle things from a funding constraint perspective initially, and simply think I've only got this amount of money to spend, and I'm just going to spend it on that, then you're missing the boat because you actually haven't gone to the effort of understanding what the value impact to your customers is. So ultimately value is about the end value that you deliver to your customers.(CG6)¶

In other premises, whilst we now do develop a business case of what it is we need to build and how we're going to address our problem. So interesting, you have a seismic management policy or risk management sort of a policy now, because they need, and Wellington have got very different seismic scale. How? How do you cater for? There is that flexibility that area or is one size fit. We have just recently updated our seismic policy, that is, that is taking that into account whether a building is in a seismically low zone or a seismically high zone. That from a risk perspective that does not change the catastrophic outcome of a seismic event in a seismically prone building. So, you know one online risk management, you're looking at the likelihood versus the severity to determine your residual rating. So yes, you're correct in if we would identify building as being seismically prone into need and we would be taking into account. The likelihood of a seismic event in Dunedin to form an occupancy decision. But if a building is deemed virtually the lowest of the low from a new building standard perspective in a higher seismic zone. That that is triggered an occupancy decision that we've made. So, we do take that into account. We do take into account likelihood. So does the NBS calculation. the likelihood or that the likelihood of an event occurring based on the seismicity of that area is built into the calculation. So, it's not, we're not by asking them looking at that again, we're potentially so. For example, if you had two identical buildings, one in Wellington, one in Christchurch. And your response time frame to address the seismicity of that building goes from 7 years to 35 years. But when you're working in a very risk averse environment where your reputation or damaged reputation or damage is substantially more than potential in a private sector.(OTH4)¶

Category--Outcome-Focus¶

Targeted investment is more about making sure that we're investing money where it's going to have the most benefit for the business, it's not about returns.(CG1)¶

Our investor or the Ministry have a higher level of direction that they must try and achieve, and we're only one of the aspects of delivering that.(CG3)¶

When I say maximized value, it's obviously within constraints. It's like any optimization problem. So, and ultimately that cost-risk performance trade-off. So, how do you value risk? How do you value performance? And obviously, how you do value costs because that can have different perspectives as well. Now, for public goods organization, if you looked at the cost element, it's not necessarily to the

organization that is, it's the economic cost to the public or that particular part of the market that it's serving. (CG6)¶

So, Asset Management is the art of being customer focus and delivery in an asset heavy organization. So, it really irks me when people say, "oh you're just an asset manager, just thinking about the assets," which is not. My whole framework is built around value to our customers and ultimately value to our shareholders because it's looking at the value of the customers first and then realizing that we may not have the cash flow available to deliver that which is our shareholders' limitations. So, we need to get the balance between those two; to get the best outcome for both parties. (CG6)¶

And I think for an organization and in particular our size, I think value means that we're able to have really good line of sight in terms of that financial impact, but we also have really good line of sights and decision making around prioritization, which I'm not sure we're quite there yet and maybe it's the nature of our organization in terms of trying to measure social impact, climate impacts as well as you know as a normal kind of user or financial impact which can be a little bit easier. And you know when you go through times like we are now, how do we prioritize the value of a new community multi-use centre that is gonna provide for growth and communities in a social way versus the storm water or the road that needs to be built. And I think that for me is probably the bit where you know, the more we can sophisticate our asset management practice, the more the organization can be better informed in terms of decision making. (LG6)¶

But we also found that there were certain categories that you couldn't so objectively prioritize against the other. So, you had to create buckets on the side, so maybe some safety initiatives would never gonna stick out financially, and it was really hard, cause you don't want to put a value on human life. (LCE2)¶

The fundamental thing about prioritisation is the time horizon and my observation is that the time horizon is short as it is within a political cycle. Councils today have a 30-year strategy and how well is this really addressing the issues. Chances are it is not happening on their watch and as a decision maker, you will be out of a job, possibly within 3 years. So, why do you care about the long-term issues, once you are out of office, you are off-the-hook. That's a disconnect between good long-term decisions. (LCE3)¶

Balancing the political realities of the world we live in and how we are currently structured can be addressed through medium- and long-term focus. If you are looking only at the short-term, it is not asset management. It is basically asset maintenance and reactive work. The fundamental consideration for prioritisation is looking at the medium-to-long-term revenue model. The questions to ask are: How much do we need to run these assets? How big is the asset base in the future? At what age will they be? What are the likely scenarios around future operational context with regards to seismic standards, climate change, sea level rise, demand, energy reliability, etc. If you don't ask those questions, you'll then find yourself the revenue model has disappeared. Take Waka Kotahi, everything was going great until about one year into the 2018 funding plan where there were a few big project blowouts and then they were on the backfoot since. (LCE3)¶

Asset management is about a 3-way balance. In addition to the needs of the assets, how much risk we're willing to take on and how much money we have. But fundamentally, the model is set up for this is how much money we have, not, how much money we should have. For me, that's a fundamental gap as you've got people running around saying, oh, we've got a low-risk appetite for certain assets, but they (decision makers) never fund for it. So, there is a disconnect that ends up as arguments between the asset manager and finance department. Where it should actually be a 3-way conversation going, not just, "well if you don't give me the money, I can't do these things". Therefore, the Risk Department needs to adjust all of our risk appetites, and our decision makers need to accept

all that. You don't get to make grandiose statements about how we run stuff and then not back it up with the funding. (LCE3)¶

Tough one to answer. It depends where the decision makers get their information from. If they are getting the information from the risk department, they will have a particular view. If they get it from the customer services department they will have another view. If they get it from the finance department which most of the decision makers do, their concern will be, can we get enough money to run the business. Asset managers aren't the best communicators, and generally asset managers don't put themselves at the decision maker's table. The biggest challenge for decision makers is making sure that they have the right information at their table. If one reads the Institute of Directors resources, they would argue that those decision makers, all those governors, should possibly be doing more to make sure that they have the complete picture for the decisions they're making. Not just the view of the Risk Department or the Finance department or whatever the latest customer satisfaction survey is saying. (LCE3)¶

In New Zealand, there is no follow-up funding for maintenance and operations. There's no follow-up understanding of how many people we suddenly need to run all of this infrastructure. We can't just rely on the existing number of people and even if we could, they're going to get old and retire. We need to ask, how are we growing the grassroots capability. I was talking to a colleague the other day. They have got a lot of water treatment plants and very few people that know how to run them. And Covid has had a huge impact as they can't check on them regularly as they should. Though the disruption of the pandemic was unexpected, it was always going to happen. We could have embraced technology that enable to run the treatment plant remotely, but we never did that. Now we've got to drive to site and spend all the time driving around in the traffic. What happens if that person gets in a car accident? Basically, the further you look into that. And so basically for me the further you can look into the future and robustly predict your asset needs, the better chance you have of understanding what revenue you need, that gives you more time to program and use scenarios. But you need to have the space to do that and the headroom to do that. And then ultimately that helps you better deploy your resources. (LCE3)¶

Funding needs to be predictable because you can't just suddenly turn on a whole lot of funding in year one or two and then turn it off in year three because the whole supply chain needs time to gear up, whether it be materials, staff capability, equipment, consenting, quarries, materials, you know, rocks, you name it, that whole system is quite slow. So that's why I said the medium to long term need and trying to get that as robust, stable and predictable as possible. It is the secret to 'getting it right' as political knee jerks on price, political knee jerks on funding availability, just stabs the market. When the market gets stabbed, people leave and when you try to turn it back on e.g. you now need to maintain all these buildings, there's no roofing people left as you have closed all your roofing contracts. People needs to live and put food on their tables. So, understanding the ecosystem, the complex system which we operate is a really important part of it. So that serves as a medium to long-term understanding of the asset needs and determination of the revenue. (LCE3)¶

With regards to implementing asset management top-down, it's a combination of all those things you need good data from the ground to present rock solid business cases and arguments that it makes it hard then, through leadership not to accept. Especially for University, if you've got poor data, the first thing they will do is pull it apart, and then you're out. And then it's another six weeks before you have the opportunity to go back in and present again, right? So, you need good data, a good argument for good business case, and then hopefully, you get members of the senior leadership team, who will act without individual portfolio bias. Sure, you can represent the interests of your portfolio, but at the end, in terms of the requirements or the concerns, but you must make a decision that is in the interests of the wider strategic needs of the university. And at times, I'm not sure we always achieve that. (OTH4)¶

So, if I will think about me, I will make different decisions from if I will think about company, have a long-term view. Ah, that's a different strategy, and that's going to business interruption costs, for example, you can use time-based replacement, you can use condition-based replacement, condition monitoring or you can use run-to-failure. I wouldn't say that it's independent. Your long-term or short-term thinking determine what strategy you wanna you wanna use? For example, let's say if you go into a short-term thinking, your run-to-failure will stay the same. Your condition assessments, you can skip it because, why worry about it if you gonna, if you're running on a short term, your condition-base replacement probably will go to run-to-failure strategy for the same reason. You can't guarantee that it's gonna fail till it's failed. So why spend money up front? And time-based replacement again could go to run-to-failure. So that's where short-term thinking taking us, whatever you do, it's always in a short-term more economical not to do it. So everything going to run-to-failure. If you go in about long-term, you start bringing into account, things like resources. For example, let's say, I can replace one asset in a month, and I need two people to do it. So, if I need to replace 12 assets, I need two people over the year to replace them. But if we're going to run-to-failure, we probably need none right now. And then when four assets fail, we need 8 at the same time. But it would be later. probably it wouldn't happen, still the end of financial year. So in this financial year, we can show savings, so again, short-long-term thinking. (OTH4)¶

Appendix G – SOCIAL / CULTURAL FACTORS

The engagement process is long process for the value of that highway. (CG3)¶

... it tends not to be a concept, well embedded, and so, it goes in waves. And some parts of the world, it's a balanced carrot and stick, where asset management gets embedded, it is regulated. So once it's written down on paper, it's something that must be done, then people will understand it because they have to. And you can see that local government here in New Zealand, it's regulated, it's in their system, in their ranks, they must have had asset management, so people are tuned to it and understand it. So that historically has come along faster than other parts of the Public Service. (CG3)¶

For the issue of backlog, and how much backlog investment is real in the eyes of the customer, it only becomes real when something fails or the level of service is eroded to such an extent that, it becomes noticeable to the user. (LG1)¶

The other thing to worth noting is there's confusion in the industry and just generally between the role of infrastructure strategies which are mandated documents and asset management plans which are our best practice documents because they're not mandatory. Nobody has to do an asset management plan if they don't want to. It just shows audit that you're adopting this practice. The infrastructure strategy is mandatory. I think everyone does an asset management plan 'cause they feel obliged to when audit come knocking. But the fact that there were two documents adds to the confusion. (LG1)¶

We spend a lot of effort engaging with iwi and hapu for input in our 30-year infrastructure strategy and that informs our asset management plans. Tuwharetoa, the iwi of Taupo district owns a lot of land and property. What we are doing is with have agreements with Tuwharetoa and Tanui for co-governance with the Turangi community board. Part of the intention is to engage early the development of infrastructure strategy, asset management plan. The current infrastructure strategy and asset management plan is not as strong as we would like. The next iteration I would say will have a strong cultural flavour. As I said in the start, the development of our infrastructure strategy a few years ago, the policy team and Tuwharetoa, there has been quite a lot of engagement but with the community agreements in the future will further strengthen that relation. (LG6)¶

OK, so I think if we relate back to the cultural stuff. Some of that stuff can't be a system, but it's a process maybe, and the way that we consult. So, for instance, through the Mana Whenua forums that we have, and we have different forums. So, we have Kaitiaki Forum, which that's in Environmental Services because that has a different lens to the Mana Whenua forum that we have. I think through those systems of and there's a bit of a drive at the moment. So around seeing how we can make those as effective as possible. So how do we drill in with everything that we do and not trying to overwhelm iwi with multiple questions. How do we get the best engagements in terms of understanding the importance for them, the use of those assets, how they derive value, whether it's through social value or they're able to lease our venues or you know all of those kinds of barriers that they haven't been able to kind of penetrate? How do we get rid of those barriers to help them make the best use of our assets? So, and from a cultural perspective, there's, we've obviously got Te Tiriti etc. and the principles that we have to achieve through that. But there's also looking at diverse communities in terms of the demographics. So, in the South, for instance, you know there's increasing a view around Pacifica becoming a greater part of the population, and so how are we looking at Pacifica? How are we looking

at disabled communities? How are we looking at, you know, all those kinds of different lenses, I suppose to make sure that we're providing assets that are fit for purpose and are the best assets that we can, for the people using them. So those kinds of forums, how we do community engagement, so understanding how we can really leverage community engagement and through forums like that helps us to define the types of assets that we want the use of those assets. (LG6)¶

Internally, so across the group as a talked about the connection across the group to allow proper prioritisation, where investments need to be made. We will look at how can we make them all other join up so that a park actually provides a benefit for the water and stormwater and what is the opportunity for incorporating transport particularly for looking at no change. And if we're gonna do a park here, we create an environment with people can cycle and rather drive. So those things are all come into the consideration in they're not isolated, they're all cross the whole xxx Plan development. There are various strategies we refer to such as the National Urban Development, we have our own strategies around our environment, around the environment, around climate change, around water and water strategy. So those things create the framework in which decisions are made. (LG7)¶

In China, they got stuff done a lot quicker than we did, there no doubt about that. And that's probably because they followed more of the Singapore model than we do. It comes back to that number one concern about that we've gotta to figure out that the political interference. Because resetting a prioritisation depending on their political, there is plenty of improvement for time frame for deliveries and it well it also in time frame for getting projects established. (LG7)¶

For social and cultural considerations, there's several angles, and I guess two sides of the same coin. There's the understanding and awareness of, the people who are managing the assets, that the organization and the staff, and how the assets contribute to community outcomes in a positive or negative way. Then this understanding of what is in the kind of the understanding of the community, I do think that if there is, organisational decision makers and staff are representatives of the community or at least have a good understanding of the community and all their kind of social and cultural diversity, then they will make decisions that had a better understanding of the impacts that the assets will have on those communities. So, I think that's quite a key external facing, cultural, societal kind of consideration, Yes, it's community, but you're going to understand the impact if you understand the community. (OTH2)¶

I think that the treaty itself isn't necessarily cited. Yeah, I haven't really heard it cited, but it's more the grassroots levels, many of the community are Māori, or and many ethnicities, a lot of diversities, able and disabled people and all that stuff. I think there should be engagement with the community and understanding what and where should things be done with the assets, where the community wants to get their balance between cost and asset performance. And often, the community engagement has come up with surprising answers. They would rather have a cheaper power but less service or they're happy to accept more outages, if I can get more cost-effective power because I have no money because of poverty. So, it's more about understanding the needs of the different community groups, which I think is a reflection of the Treaty principles. (OTH2)¶

Yeah, I think that kind of brings some of that stuff in into focus around giving people the chance to make decisions that influence how you manage the assets, that kind of Rangatiratanga, it's kind of governance ship of the community assets and how it affects them and how to fix them. Not so much in the way of signing the Treaty, but more of a kind of at a grassroots way in terms of community engagement. But yeah, I think I think as I still think it is it definitely a gap in terms of if you look at the makeup of the organization and the makeup of the community is quite a big disparity. And so, there's a risk they wouldn't necessarily understand, sort of in a little experience where I, yeah, what the community may expect and require from the assets. (OTH2)¶

These cultural elements things such as the esteem that people get if they get a cellular office or if they get a car park allocated to them. But then what is the flow on effect of that? It means we're using our space less efficiently. It means then, they're more energy intensive to run. It means that we have more cars on campus, more traffic on the roads, more emissions going into the environment. So, there's lots of elements and complexity to developing that overarching strategy. (OTH4) ¶

So, in a lot of cases, you put good asset management systems, and it doesn't change the way how company do the business, so that's cultural. If we will talk about things like Diversity, Treaty of Waitangi and so on, I would probably apply that to configuration of assets, right. So, when you put something in place, let's say, from environmental perspective, you need to maintain river quality from hydro perspective, right, so you will put machine which can manage or maintains the river flow, even probably, that's not the most economical machine, you still want it in place for environmental purposes. Probably you will add some sort of asset configuration to keep Iwi happy because that is going to Treaty of Waitangi. In some cases, diversity is completely different subject and it's going to mostly thinking rather than asset configuration and I would see benefits of that about when we put systems in place. We can get better quality of our systems because we cover wider range of thinking. How people see the world, what they feel, what they do. Do you see what I mean? (OTH5) ¶

ORGANISATION CULTURE ¶

In reality, people do asset management, it is completely people-centric and if your organization hasn't established the cultural people to lead asset management from the highest possible level and they understand the concepts and the value it can provide through the people on the ground that are actually delivering the service, then you're always on the backfoot. (CG3) ¶

Internally, as I say that the success of any other systems relative to the culture, and the leadership that you've got, So if it's not brought in from a highest possible level, it's not really going to go anywhere in my opinion and that's why here, I really don't want to invest my time and energy doing a lot of stuff downstream until the strategy and the policy or at least the policy is signed off by someone higher in the organisation, and then you have the mandate to say, right, we need to do something. (CG3) ¶

But it is, at the end of the day, it's a management system and people just some people despise management system. Start up with the diagram to show how we're interconnected. And then I go one step further. I actually, show the core asset management functions which show that alignment. But more importantly, shows how operational teams are dependent on the longer term planning horizon, in terms of technical planning, the asset management plan, the forward works plan and how what they do in terms of information provision. But when they do their maintenance, they update the condition data in their asset information system, don't they, because actually, we use all of that back here and we use for lifecycle modelling and decision making purposes. So, garbage in, garbage out. So, if you feed me garbage, unfortunately I'll give you garbage, but I don't want to do that because I want to set you up for success as an operational business. (CG6) ¶

So, to do that, we need to focus on that handover process. We need to focus on how you do with management with your CMMS. How do you actually identify work? How do you do you need to plan your work? How do you schedule? How do you resource? How do you then go about executing? How did you close out in terms of general principles and asset? And then a work order isn't completed until the assets, physically accepted by the operational team, and the asset data is accepted by the engineering and the central asset information team. Simple principles that we're in this together, I'm not doing this to you, we're doing it together, so I'm trying to see set you up to success but my success is dependent on you doing good work management and completing the work order fully, not just

doing it and not caring about updating the data because if you don't update the data, guess what, I'm going to give you the same plan to do next year because they didn't get updated, and it's in the same condition as it was when I had this year's one. But the fact that is your continuous improvement lead as well so you can see it inherently in that feedback. So, I use a diagram that communicates that quite clearly and I find that resonates very, very well within the business at all levels, the exec level down to the guys actually, doing the work in the field. And it's a bit different to the AM Council which has a very conceptual model that is too complicated and very engineering as well. (CG6) ¶

A lot of organizations get stuck on: "Our new information system will solve my problem, it won't. It never will. You need to start with process because what is an information system?, it's ultimately a form of automation. What are you automating? What's your process? So, you ask any IT person, this is what striking, BAs tend to sit in the IT part of the business, they shouldn't, they should start from a business process management group, which is actually business orientated, they map the processes. Because every time we run an IT project, guess what, they get a BA to map business processes, but if you actually maintained your business processes, they wouldn't need to do that because to say, well actually, this is a current state and this is what we want to do to update it. Can we implement that using a piece of technology? The only time IT staff can drive things, and this is a legitimate reason, is it actually comes with good process. So that's now a huge change process in the business. So, I use best-of-breed system which says you shall do it this way, this way, and this way, and this way. That's good, but I've got to bring all the people on board that are going to have to use it this way. So that's a Business Change project rather than an IT project to stand it up but it's actually, now I'm going to spend probably a quarter of my money just gauging the business, actually formally document these processes and get people on board and trained and accepting, have a go live date and all that sort of stuff that goes with it. They actually make the change and that's actually one of the easiest ways to change the businesses, off the back of a big IT project. But if you don't see change as part of it, you'll. We have best-of-breed system; we are not changing that at all. I'm developing it the harder way. We want to use the system's better because we haven't been using them to their full capability. So basically, we've got an investment there, that we aren't leveraging the way it should be. We can get better value out of Maximo and GIS. (CG6) ¶

Well, no, I think the centralized and decentralized is a good question you're trying to find out, but it's at the underlying culture. The most important things are that the practitioners are supported by management and the decision makers. So, if you go on the REG website. Well, five years ago, we started out from the data quality project off. So, we actually, followed the business case approach and went back to first principles to identify what the problem was and there are fundamentally a couple of problems that we found. One, decision makers didn't trust the staff, when they turned up with a story and I say we had, we have to teach people to tell it, that story. Here's an elected member turned up at the Council Chambers, totally disagree with the staff because you were speaking to a farmer last night. A farmer friend that has got their own polarized views. So, like the governors need to buy into the strategy, but the asset management plan and the whole asset management planning, are basis of their strategy. And then the other element is that staff are given the resources, and staff's work is valued by management is another issue. Another challenge, staff were given the resources to deliver, resources could be time, could be consultants, it could be whatever, but then once the works done, the decision makers value it and they buy into it, and they talk to it. There's been some beautiful stories where staff have been able to provide evidence around level of service, customers that will be served as level service to the elected members? And you're like the members of board enter and said, I understand that. So, we've talked about culture. I think the other thing when it comes to asset management is, I think you got culture, you've got evidence. So, we've talked about data, but actually we've got it in their data and evidence. And I think the third pillar is leadership. Really, really important for asset management. (CG4) ¶

I think it's about leadership and management, isn't it; it's about culture and embedding; it's about recruiting the right staff; it's about getting the good staff that get the need for really good asset management. Then its leadership and management around embedding the culture and values of good asset management into the staff and organization; and I'd say the organization as a whole as opposed to it just being a small team, and that's always been what's wrong with until recently, or probably a few years ago. It's always been a challenge that asset management was the role of a small team of asset managers that sat in one, you know, in a little box, in a corner of the organization that did asset management, produced an asset management plan every three years with a flurry of a flurry of excitement and reporting. (LG1)¶

And you know the success of an asset management team was often measured by the size of the asset management document that the asset management team produced. It became a document that was in the past, it's been a document that's incomprehensible to the layman, too long to be any use to anyone in an organization, apart from propping up at door, keeping a door opening or propping up a desk. When was the last time you saw an elected member or councillor walk into a council meeting with a copy of the asset management plan under his arm and referring to it when he's making decisions. I would guess most asset managers have never seen that. So, the challenge for asset managers is making the asset management plan accessible and understandable while still keeping the technical content. (LG1)¶

There needs to be some standardisation in terms of performance measures. Then clearly, you've got there. The standard ones which have data completeness, data quality, probably a lot more. There're also some significant financial ratios that relate to finance, asset management would be aware of those, but ultimately, and this is where we come back to asset management is bigger than the small team of asset managers sitting in the corner of a box in an organisation somewhere, doing long undecipherable asset management plans. Ultimately, the successful measure of an asset management system or asset management process, is customer satisfaction if you take the helicopter view of asset management is around, meantime, back to the triangle level of service. What is the Level of Service I'm getting? How much am I paying for it, and What is the risk I'm taking if that's not being done properly? You're never going to get 100% satisfaction 'cause people are pissed off the some of the things like the Rating bills. But the measure of customer satisfaction with each element of the service is the ultimate test of asset management if you are a believer that asset management underpins all activities of Council. (LG1)¶

When it comes to cultural, I think where we are, in terms of our own journey, we're probably, I think as an organization, we more, do things at a project level rather than you know a higher level strategic management process, so I don't think, it's not visible to me that, we, as part of an asset management policy we might talk about Treaty of Waitangi and our obligations and Māori outcomes but to your earlier point, that's not a category that we use in terms of prioritization. So, it does it have the same, we talk about level of service is one thing, which you could argue incorporate some of that but not it's not deliberate if that's the word I'm looking for. And I think the critical stuff that is getting stronger and where there's a lot of focus is in terms of managing and looking after our natural resources, our land, our water, our, you know those are the things that are actually I suppose through climate change as well, and sustainability, but is really important to Māori is around protecting our natural resources. And so, there is quite a leaning to that, but whether, I suppose, I can't really say whether I think that's happened because of the focus on Climate Change rather than the focus on Māori Outcomes and what we're trying to achieve. (LG6)¶

...the idea of diversity as well, then demographics and everything else diversity, that is an opportunity for more ideas, so that's not at all the constraints as long as people listen to each other and even gets the opportunity to share their perspectives, and they are not sort of pushed away. And then diversity

of opinion and thought and experience across any demographic and metric is brilliant because you get different ideas as just all were if it was just me in the room. You want to have this on absolutely, you get a better outcome and all those outcomes able to be accepted by a wider group of people because they represent¶

In relation to the key for ensuring a vertical alignment or even a horizontal alignment with the wider ecosystem as in the case of the xxx, I would go with the open systems view and partly that's to do with being a building as a platform, as it has to support organizations' other strategies. It doesn't just exist to serve itself. So, it would need to respond to the key strategies of its organisations, whatever they are and make sure that it supports those things. And that means we immediately got an open system. But also, if you are considering those cultural aspects again, it automatically is an open thing because you may well have, you know, either the community group or the iwi, or a school or they part of society that's not well served and needs to be, because actually, the asset actually belongs to the Community. I think it's very much a horizontal and open model of being part of the wider ecosystem. And anything that is restricting that is just going to stop the best use of the assets and actually the accountability of the organization to provide to the community. (OTH1)¶

As for barriers in implementation, resistance of diversity of thought, that must be addressed with leadership. I would say in my experience, in a lot of cases, it's going to how we see the world; and it's not only, uh, industry where I work, let's it's pretty much all around we become in very short term. Because good asset management systems, they cover whole lifecycle of the assets and even probably go over and beyond of that, that's a quiet long term. And Long term optimization quite often looks very different from a Short term optimization. (OTH5)¶

And I think the ISO 55000 focuses on structures and processes more than culture. It's probably harder to kind of test the culture in terms of continual improvement culture and evidence through continual improvement initiatives. And I think on the culture side, there's a kind of stuff we're talking about, connecting with communities kind of cultures, I guess. And the other aspect was, I think in terms of seeing themselves as asset managers and having a strong connection with the way we manage our assets, affects our stakeholders and how to fix them, so I think organisations can work with variety of organizations. I guess both when I was at xxx but also more recently, and different organizations see themselves as an organization in different ways. (OTH2)¶

Some at Unison was quite not fully but getting a fairly to a large degree see themselves as an asset management organization and they understand what that role is in the community. Yeah, other organizations even though there might be pursuing ISO 55001 don't see themselves as an asset management organization. I think it's, that's really the responsibility of the small team over here; the rest of us do other stuff and this certification thing is just a bit of a thing for that team or just a bit of a kind of a red tape thing. So, I think you organizational culture is a big thing if people see themselves as asset managers, as an asset management company, and they understand how that contributes to community outcomes or external stakeholder outcomes. That makes a big difference for implementing your good practice, and structures. (OTH2)¶

ORGANISATION CLIMATE¶

And the word asset management is probably not as relevant in our organization as something like a value chain or a delivery model or something. It is effectively a business process and is trying to establish that understanding that it is just a process that we're trying to deliver here. I think the word asset management, because people don't understand it, they don't want to engage in it. So, the language should be more appropriate, something they could relate to, then it will have more buy-in.

So, whatever the process is the underlying aspects are asset management but getting that definition as what I'm trying to get right now. (CG3)¶

There's a real language barrier where a concept is not known. A lot of it will switch off as they'll go back to their comfort zone. And so, yeah, it's about turning it into a language which is probably even more simple and then it demystifies it. So, getting that language right is a real challenge for each organization probably has its own language build into it. So, that's part of what I'm trying to do now is find that that language that people understand from a higher level. So, your Chief Executive will understand, your general manager will understand a business process. At that level, what does asset management do. It's not really the best way to say asset management because a lot of organizations when they're starting this journey, won't really understand that, every time you change your management levels, they may or may not understand what asset management is. So, creating more timeless meaning it's probably what I'm looking at. right, right. (CG3)¶

And so, we've had, for example we have a need to do an asset management strategy, or a SAMP as they are called, to put a direction to our infrastructure, so we're not so reactive. However, the person that was in charge of delivering that didn't understand asset management. And so decided it's nothing to do with asset management and has gone down another path. All right, right. Now, it's coming back to the direction of saying, well, yes, you can have that, but it's still an asset that you're trying to manage, however, you word it. (CG3)¶

So, understanding the particular roles and responsibilities for each individual and the ways in which we connect. I often hear people talk about swim lanes and swim lanes are fine, but you need to recognize that in a swim lane process type diagram, what's important is the connections between the swim lanes. Very often, people will talk about swim lanes, but they're actually saying my "Silo" and this is the challenge that you have within our organization. (CG6)¶

And so that means from a question 3, which was around critical culture, the Act is why the Treaty of Waitangi is a big legislative requirement, so, we are driven by that from a cultural perspective. It's ingrained in the business case process, and our procurement process. We have a whole team dedicated to work alongside the delivery process to ensure that the Treaty of Waitangi is embedded into any investment and has been constantly considered, whether it be a bridge replacement or whether it be a new highway. (CG3)¶

As we go back to that demystify the concept of that Asset Management, that language appropriate, we talked about ICRs. The social aspects of it and it is about embedding as best you can the concept that asset management is everyone's business. It's just demystifying the concept of what asset management is. So, there's a whole aspect of people, culture, competence and stuff that you need to manage to get there. (CG3)¶

I think the tone from the top is actually critical. So having the support from the governors and having the support from the executive leadership team for the need for good asset management planning and then through that commission, establishing a really cohesive team across the organization so that people understand the value of the asset management because it is more than looking after the asset it's actually about your financial, long term financial planning, it's about, protecting your assets currently, but it's also setting up the community to be successful into the future. (CG4)¶

And then you come to the culture of the organization. You know whether the organization has got the cultural aspects of asset management. You know, where they accept that, you know, they're spending someone else's money, then they need to be looking to maximising the use of the assets, that the decisions they make today need to have relevancy in the future. So this is all about fit-for-purpose,

you know, efficient and effective asset management and the behaviours of, you know, am I maintaining my assets because if I don't, then they will fail; you know, and, am I able to get that broader community to accept that they need to pay to maintain because they don't pay to maintain then things that could last longer, will fail and then we'll have to build them and it's difficult for them to see that. But I can see it because I work in that and I'm an expert in this. So how do I get that message across to the political leaders you know, so, a lot of that you know, so the normal what I call the normal management and leadership attribute that you look for in any kind of business or family structure, some, all of that is required in the management of assets as well, OK, because it's just part and parcel of the same thing it's a societal it's a critical component of society, these assets. (CG5)¶

Well, the cultural aspects for both of them extremely important because culture is all about how we do things, the acceptable way of doing things. And so, from a broad cultural point of view, from a societal point of view is, I tried to say earlier, that it's the culture is one that we are here for one another, right, we are here, we are willing to give and take for the greater good. If that's an embedded cultural norm, then people are more willing to fund social infrastructure. (CG5)¶

...takes heritage and Iwi-type cultural issues very seriously. It has to, because particularly if you want to build something new, or you need to modify something in a major way, you cannot do it without having everyone on board. (CG6)¶

And some of the barriers that would get in the way of an asset management system are deeply, deeply cultural. So I always say in a thing like an asset management system, that 20% of your effort is in the technology in an 80% is in the people and that's where it gets hard because there's nothing more difficult than people. (CG7)¶

The issue is culture, and people and change, and leadership. So, to that end, in an asset management system, there is three things. There's the system which is that that technological system which we need to land. There is leadership and I'm not just talking from just the Minister, SLT down to, you know, a manager at a site. That is integrated leadership that needs to be upskilled and informed, and told what good looks like, and have them lead it and own it, and then there is a whole bunch of symbols and other things that that need to go with that. (CG7)¶

A system has a large number of subsystems, and those subsystems are owned by different places, as they should be across the organization. And each one of those subsystems might have independent people being accountable for the delivery of those subsystems, but the overall system owner needs to be across all of those subsystems and ensuring that the dependencies and interrelationships and that there are controls on the performance of those subsystems to make the overall system work. (CG7)¶

...we have our own Titiriri framework written by a team of people which include Mana Whenua, so it's nice for having Mana Whenua on staff as opposed to pay someone for a minor thing where to put to talk to them about your Titiriri framework or policy. But just imagine having there in the room as you do everything, no matter what that is, whether it's talking about prioritization of assets, redevelopment risk and assurance, I think that's the beauty of our organization is that it represents a whole bunch of Tamaki. (CG8)¶

you've got to start with the asset management policy, but it's got to be a policy with teeth. And that means you need to have, very often, people focus on the one page but that's a statement for the public perspective. But in your asset management policy, you need another bit which actually talks about roles and responsibilities. And I know generally people think of that as being in the asset

management system framework and right, but very often you got to establish your policy before you've developed your asset management system framework. (CG6)¶

My unit is involved in balancing the different capital needs across the entire business. There will always be winners and losers and managed through understanding of risk and benefit. Peter always gets robbed to pay Paul you know, and I accepted that a long time ago. But no, that's not the sort of conversation you want to have. They are difficult conversations, but it's about people hopefully getting the point of recognizing "why". It's all about the "why". So why did we make that decision? I mean and it's how you might be the one that didn't get what you wanted. You understand, you go, why, understanding why we've done, what we've done and agreed what we've agree. Yes, and that's the trouble calling a group an asset management because I think we need to get better at asset management, well, yes let the Asset Management Group over here do it. Doesn't work, because we're all part of asset management. When there's some functions are sitting sort of outside like customer service and all that sort of stuff, shift customer-facing, telephone support systems of, and HR functions and all that sort of thing, the necessary business functions that sit around, but at the core of an asset heavy organization, you need good asset management because this is what's delivering your service. Yes, your people. So, you need to make the right sort of people, customer service, etc. Ultimately, your assets are delivering the service and when the assets failed, you won't be delivering the service. So, when a manager comes to me and says these bloody assets causing me real problems which I can't deliver on the go. That's okay, we can take it out of service. We resolve the problem by getting rid of the bloody asset. But that's not the answer isn't it. For disposal of assets, sometimes delivery a service doesn't have a value proposition anymore because you know really want to consult very widely on that before you try to take that. (CG6)¶

I think the centralized view, you've got the champions driving the work, that's about, back to people. So how do you make people right? How do you get that? You know those people that are more passionate about Asset management and a group, to give us again, just like getting a fish to climb the coconut palm. So, you've got to understand the strengths from within your team. But you don't want to set the team up as a silo that asset management team work away, busy as bees and they produce a document, that thick and amazing asset management plan but nobody uses it. (CG4)¶

...we're probably at a very early maturity of the journey. I mean, when it comes to social factors I think we probably do quite well there in terms of understanding the service needs, the demographics, you know, whenever we're going out to more in the sense of renewal, building a new asset, we're always looking at the demographics, the service requirements, the impact, you know, so making sure we're building something fit for purpose when we're going to renew our assets. We've also changed our view of just renewing like for like but making sure we're updating the needs of the current, you know, and I put it into social impact factors in terms of service. (LG6)¶

For social factors consideration, you got leadership, culture, collaboration that is absolutely collaborative. You cannot have asset management when some people were not included or when they are in opposition then there are opposed to because they need to be on board. And so, as a word I'd use here is ownership. If people are really engaged and then taking ownership, they won't walk past things, they won't take shortcuts and trying to cut corners, they'll have this mentality that 'I want us to be as good as it can be. I'm looking after the long-term benefit of the plant. And so having that mindset will change how they engage with what's in front of them, the quality of job, they'll do, the number of incidents in their report or breakdowns they will notify you of. (LCE2)¶

You will always get people that oppose you, but you can't help that. But you want to have as few of them as possible and have more people on board and promoting what they have done, help them see the transition through to a future state and how they adapt to their day-to-day job that enforces

strategic objectives for the company. That's really essential that they that they can get. "Ah, OK, we're not do this, we're gonna have, it's gonna make more money, people are gonna be safer". When they can see the alignment, not just simply, 'I'm spending a wrench because that's what I've got to do before I'm allowed to have Sluggo. And it creates a more fulfilling work environment as well as a it getting more heavily engaged workforce, better outcomes, better quality outcomes, social outcomes. All that leads to correct culture around ownership, you then get to see better outcomes for your assets that will last longer, they'll report failures and observations of damage sooner, so you'll actually mitigate a lot of your problems before they become big issues causing downtime and breakdowns. (LCE2)¶

For the social factors, there's a classic saying: "The culture will eat strategy for breakfast." So, you can sit there and say what we're going to do, we're going to be the greatest asset managers in the world, we're going to do all this amazing stuff. The key decision makers are absolutely across what this is and they are directly doing their jobs as the custodians or the decision making custodians of the assets. I've seen it work a number of different ways, but generally, the people that get those roles as the decision makers really don't understand infrastructure. So, investment is required to upskill them to broaden their understanding of what's actually going on, they might not want to hear it, and they might not have time for it, but fundamentally, that is absolutely essential. I can have the best asset management team in the world, but if you start going up the food chain to the decision makers and they're not engaged and they don't get it and don't handle them right, it is pointless. . . But at the end of the day, if the culture of the business isn't firmly established and reinforced to deliver that it'll never happen. And fundamentally, that comes down to me, leadership. (LCE3)¶

The other one is the culture of engagement and challenge sharing. . . I think that's a really important one as New Zealand is very bad at that. We're too busy doing bespoke solutions, or we need to do it our own way. I think that's a huge issue. I think a lot of what we do could be a cookie cutter. And therefore, the real value add is in the innovation space and in the continuous improvement space, not in the development of methodology for counting population at terminals turning it into a demand model. That's ridiculous. You know, there's so many core aspects of asset management that should be standardized, or should be based on a standard formula, standard methodology, standard guide, whatever you want to call it with standard training. Because that's not the value add part, the value where there is innovation and the strategic long term view. (LCE3)¶

Another key aspect of social considerations is diversity. I'm lucky to work with a team where I was initially the only engineer. We had an Economics major, Maths major, a Bachelor of Commerce and some with Science degrees. We also had people with no formal qualification. It was my first excellent experience of diversity of thought, and how different people looked at the same thing but also more importantly, which made a massive difference was the diversity of communication style. So, I could stand there and talk to whoever in the decision making structure. (LCE3)¶

I've seen it in an organization where the organization lives and breathes it and just does it, you have, so, it's baked in right away from the top all the way down to; it's very easy to just become part of that is expected, to become part of that. And I've seen it the other way around where public organization has had no real engagement with iwi and so forth and all the local community and has recognized that and doesn't know how to start. So, I think, from the property perspective or an asset management perspective, it's possible that we can be a catalyst to start that ball rolling, but we actually need to get the leadership to do the hard work because it's a bit beyond just an asset management issue. It is a cultural issue, societal issue; it's about recognizing that if you are using public money and public aspects, as it's that you are accountable to the public in all its forms. So, I think if it doesn't exist in an organization that if you're an asset manager, you just do small steps, you do what you can in the limited ways that that might be open to you. . . But if you can be a catalyst for asset management and

property, often is, if you could be a catalyst for bigger change than great, you know, you can be the people person, sort of, like, posing the question and getting the organization to change. I think it is mostly a top-down that requires a very special mission. (OTH1)¶

Let's start from social, which probably I would call them cultural, but OK, let's call them social, so in terms, of let's call it cultural, because really, that's it's about asset management system. It's all about what sort of culture do we have like for example, in CAMA, they are making massive focus on a culture because asset management systems will not deliver value up to a certain level of maturity. So, let's mean if you manage by accident, doesn't matter what systems you got, they not gonna deliver the value because nobody gonna use it. Then we're going through another two cultural steps, and we still will not see any benefits from asset management systems because people were just not using them. And only in a fourth, top culture of organizations, that's when we actually can get some benefits. And then I saw it, with my, and it's been through all my experience. (OTH5)¶

Asset management is actually by its nature, is a very strategic endeavour, but it comes a point at which you push it out wider and wider into your organization. And of course, you're taking feedback from the grassroots and then it gets connected, but it starts on the start of topic gets pushed out. Like a lot of new initiatives, you absolutely need the buy-in of your chief executive or your chairman of the board and they have to commit resources, it takes resources to do asset management properly. And if they set off on that journey, it's not just one or two million dollars this year, it's actually millions of dollars every year so that it definitely has a top-down starting point. (OTH1)¶

I guess I'm probably wouldn't necessarily broaden out the asset definition to all aspects of the organisation, but I think you could do, but I think, it kind of keep it simpler, as most organizations that are dealing with tend to think about the physical assets that's their core asset, which is typically as in my case, the XXX. But then people say, oh, that's the asset management team, that doesn't include the operations of it, does it or doesn't include the planning, or say no, it's operations and planning a very much part of this, you know. But it's very much the asset management life cycle. And they might say, well, it doesn't include HR or finance or IT. Does it then say, well, it probably does because those are core functions that we need in order to effectively manage the assets for community outcomes, we need to be able to manage the financials. We need to be able to have the right people, skilled up and recruited and trained. We need to have the right, supporting systems so if people can maybe accept the first thing, operations and planning is a part of asset management. But it's much a bigger leap to say finance, HR and IT as also part of the asset management system. (OTH2)¶

So, I guess because of the three campuses and they're different locations and then obviously the different demographic systems across the city so, when you talk about critical cultural, so, overall diversity for us is a really important factor to take into consideration. Yeah, I sort of understanding about how do we provide? How do we make university accessible? How do we provide stuff to our students. Fundamentally for us, I guess from my perspective, is that we're looking at what our student base is coming from? A lot of research is showing that the student base is changing given because of COVID. So, it's looking at how do we adapt and how we modify that, but definitely for us, it's quite heavily student driven in terms of the kind of students that we're getting into the university who are already in here? Who are potentially going to be coming in? What are their needs and wants going to be? We facilitate a survey that goes out to students as well to provide their feedback. So, we take on board those comments and feedback, and use that with regards to making decisions, the whole transition around the elements of provision for pastoral care, etc. It's all sort of taken in line with what are the needs of our students so when it comes to asset management. We do look at again at what type of learning do students want. So obviously we've been through COVID, just gonna be a bit of a transition space so we're seeing more requirement for technological requirements and lecture

theatres upgrades to systems and infrastructure, to be able to accommodate teaching and learning in a virtual environment, which is proving challenging in some cases, so all those. (OTH6)¶

But how do we put that up collectively? I know that a lot of those sort of the more in-depth strategic side of that happens at a much higher level to me, so I know that there are conversations that go on throughout Council and at the SLT level within the university that do talk around strategy. What are people saying we need? What is upcoming? What is the change in the market happening? How is COVID affected us? What is the learning look like in the future? So, all of that is taken into consideration but how that sort of drip feeds down to me is quite, is very then watered down, I suppose as a result, I would prefer more than just water down. I think my personality would yes because it's ultimately about how what we're doing applies to the entire university. So, we're trying to really roll out asset management across the faculties as well in terms of capturing their assets so it's not just a property-based focus around. And I think, a lot of times that's sort of the attitude or that when we talk about assets of the faculty, to think of what's on their fixed asset register from a financial perspective. They don't think about it in a tangible sort of how do we help you to make sure that your asset is maintained correctly, how it performs better, etc. So, it's trying to sort of work more into those spaces a bit more, to have those conversations to help them understand the benefits that they will have not just for themselves in terms of their bottom dollar, but also for the teaching and learning of our students to ensure that their equipment is going to work when they go into a lecture hall. Or they go into a lab and they push a button and the piece of equipment that's required actually turns on so. (OTH6)¶

So, one of the things in my career, there was this gap analysis done for asset management. You know there was a whole list of things for different categories and said well, I'll come to your organization, and I'll tell you where you are with this while you're 6 out of 10 on this and five out of 10 on that. And then I used to say because I didn't agree with it, I used to say that, you could get 10 out of 10 for all of them, but you could still have a lousy asset practice. Because that does, you know, being 10 out of 10, or 9 out of 10, or 8 out of 10, does not mean that you've suddenly become good at something. It just means you've understood or have put the system in place, but it can measure you for how efficient you are or how effective you are. Which becomes a cultural thing and more importantly, if you don't have enough money or enough resources, then you do have to prioritize and say of all those things that need to be done, which are the things that are most important or when you address them or put the funding or the effort or the resources we'll give you the biggest bang for the buck, you know. So, in terms of timing, which is best right now, and which could be done later, which need to be done first, because they could be better building blocks for the bits that come later. (CG5)¶

Appendix H – ENABLING STRUCTURES AND PROCESSES

CATEGORY – CAPABILITY AND CAPACITY ¶

I personally am more of an advocate for standardization, the challenge in standardization is that you have customers that have desires and etc, etc, so to me, the greater level of standardization means you get a much more consistent product. I have seen this work in other industries to a degree because you are limited by the types and nature of assets that you can actually manage and replace. (CG3) ¶

That's part of my role and my big managers role is to try and bring the awareness of what we're trying to do because we have, like a lot of organizations, we've grown considerably, we are quite a large organization now and the risk is you can silo what is effectively, the life cycle chain of delivery. And each of those little silos do this, but they don't really understand their wider picture of how many delivers asset management. (CG3) ¶

Like all government agencies that goes in waves, depending on the passion of the staff that are around, we're currently probably starting to ride another wave of enthusiasm to drive this. So, asset management is not new as roading has been around since time began. The science hasn't hugely changed, materials haven't hugely changed, it is a little bit of reinventing the wheel to a degree. But we're now, we are starting down the path again, of defining policies, asset management strategies, lifecycle management plans and establishing again, the framework to enable the delivery of those, that's what we're trying to achieve, our objectives. So, we're probably, I would say mature, but in it's in infancy. (CG3) ¶

Asset management is top-down and bottom-up. At same time you gotta work in both directions and look it's not easy, you've got its perfect and ugly, and you have the ups and downs options to downs and one my comment would be is, an asset manager has been incredibly resilient person because you'll have your good days and then really shockers. (CG6) ¶

I think now we're talking about sort of like an operating model. That is giving me to your asset management system. And look, every organization will make their own choices about an operating model, given their context and issues. OK, so I'm gonna talk purely from a departmental perspective, I personally believe and want to retain an operating model that looks like a hub and spoke model. So, what I would say, and another terminology is you've got three options. You've got a fully centralised, so the centre does everything, you've got a centre-led model, which is the centre develops the systems, the processes, the operating disciplines and then runs, things from the centre, but relies on people at site which is the hub and spoke to do some but not all of the work at the site within their capabilities and risks and things like that. And then you've got a decentralised regionalized model, which is where DOC has come from. My preference is an operating model is the middle one. (CG7) ¶

I think the ISO 55000, ISO 9000 and there's so many tools that can be used, they are but tools. You can't say that one is better or supersedes the others. So, some of them are frameworks because in ISO 55000 in a way is a framework. It is sort of saying good practice requires you to have, you know leadership, and the vision, and coordination of all the other aspects. So, it's trying to, it's trying to be an umbrella document. Other ISO documents are to say these are critical components that you should have. It does not try and tell you how you do it and because again, if you tell people how to do it, it's like a prescription and then you can lose innovation. And you're almost saying that everything is transferable to other industries, in other countries, when they're not, because you're dealing with people and you're dealing with environments that all have their own uniqueness. So, there are some similarities, and the bits that are similar, and the bits that you can bring consistency, you put that into

a standard. Because you can say these are simple things. You should have these things. The things that are complex, the thing in complexity comes with people, and environment, and time, and funding, and ability, and affordability. So, things that are complex, you can't say, do this. (CG5)¶

Culture will only change from the top. So, when you're not as an asset manager necessarily, the one in charge of a business unit, its profit earning operational business units, you need to start with the people at the top of the food chain. The best place to start is establish a policy. Get everyone on board that this is the right thing to do, and you will have different perspectives on them but ultimately it is a belief issue. (CG6)¶

A lot of organizations have green dashboard culture, and green dashboard culture is basically I can't put anything up to show the Execs we're not performing. So, you see some really weird behaviours like KPI measures get distorted, definitions get changed or things like "I know that was my target but I'm only ten percent above it". It's really green and it's not that bad though. It's really green, the painted green. And then then after a while they go "I'm losing staff". My reason and the reason you're losing staff is because you are green. And then when you want to put more process back in that actually say they can actually perform, and I can get out of this death spiral. They go but I don't have enough staff to do. I'll say you should have reported the truth from Day 1. (CG6)¶

I've discovered well before the AM Maturity assessment because that's typically where I start to understand what's going on in the bells of the business, as well as where you recognize it. People aren't creating work orders that they wanted in time, that kind of time code to prepare the time things, they don't really care about what they're actually delivering. It's cool what I call it just do it, the Nike company "Just Do It"; react, "I've got to go and do that, I don't get any to book my time, I'll raise a work order. And so, what's the description of that? Did you actually did you actually repair something, or did you have a morning tea? But what did you actually deliver? And when you can see you don't have clarity within your work order practices, you know you got a problem. So that's telling you got a process problem because there's no discipline in the regions or whoever's using it to actually follow the process to get work approved. So, what are the roles and responsibilities? Who raises a work order? Who approves it? What's it to you? I see all that as a key function of asset management. That's how I get my information. Unless that's working well, garbage out or garbage in to my eyes. I get garbage into long-term planning. And over time, no one knows, and after all, no one cares. Because you got people that meant to go out there and inspect the assets every year, right? After a while, people aren't stupid, "I can put whatever I want in here. No one ever sees anything" and then they go, "Why do I need to do this at all?" Even though it says it in the maybe a standard something but "I'm not getting in trouble for it, I've got it all these other fools on my time. Either won't do it or I'll do it on a bit of paper, and I put in my drawer, but I won't put it in the CMMS. No one cares and they are quite right. But when you start looking at it, people know you're looking at it, that changes the culture in Transpower, for example, until we actually started doing this and put it, rolled out the new processes. We didn't know there was one particular region, there was an engineer for the Contractor just making up the condition scores in writing. They weren't actually going out and doing any inspections yeah. You've to fight against that as an asset manager, but actually fight for that clear process and discipline to execute. Leader up here will make it happen; you can't do it from the side. (CG6)¶

The processes are very important and I'm spending a bit of time on that at the moment documenting for the organisation. This is not to tell people how they should do things, there's arrows and swim lanes, it's about how do they connect as an overall system. You're responsible for your efficiency around process, so continuously improve that as these. But if you want to change some of the inputs you need, or you're going to change some of the outputs, talk to the people that you're connected to before you do it, don't do it unilaterally because that way won't work. Because if you get lower than that, you end up doing the procedural space. You start with what you do today. Don't try to develop

something that they don't do, and that was one of the problems we had is that, there was a heap of documentation that was produced off the back of the IIMM guideline, all theoretical, business didn't understand it, business didn't want to engage with it, business hasn't used it, it was a waste of time, waste of effort. I just threw it away. We start with what the business does today, for example, working on work management with the guys in the regions at all levels, financing how we all connect, but mainly the regional guys because they're the ones who can be impacted, the production managers, the asset engineers, build engineers, etc. We all workshop, workshopping them to pull out what are the procedures used today? And some of them are in their head, that's fine. But we're actually going to develop a Work Management Standard. That actually has these high-level processes involved and when you have to deal with your CMMS, but all the other things that they do as well in terms of connecting, in terms of scheduling. So, tools are one thing, but it's actually the process. (CG6)¶

Good asset planners can come from a financial or physical perspective, but the best ones are ones that actually dwell in the field at some capacity and that might have been a financial capacity. They actually understand what goes on. The caring bit should come from the top. I have an asset information management team and a strategy team. The asset information team is the custodian of those reports, and the strategy team is the definer of those reports. So, whatever you produce, there is a very clear definition from day one and you need to maintain it and we have rigorous change control over fiddling with the reports. Otherwise, they do drift and it's okay for them to change but it needs to be managed. As mentioned earlier, you BAs that are quite far away from reality. And even then those organizations actually map what they do today. They tend to be in non-sustainable twirls and get forgotten a year or two down the track. So, we've got to have a more sustainable way of mapping process, so you don't want to be too heavy, but you don't want me to light, as well as the key thing is we would have measure what's right? (CG6)¶

I think it's about functional design. I think you can work most of these things in any org structure provided. You've got the right leadership, and the right functional design and people understand that functional design. People spend far too much time reorganizing structure organizational structures. There are certain things that are necessary but a lot of it's just fiddling with deck chairs while the ship sinks, right? So, let's agree what we are trying to achieve first, get everyone aligned at a leadership level and agree that this function sits with which and we need them to communicate. And as leaders we're going to make sure they communicate because we have swim lanes with communication for information flows, we don't have silos. (CG6)¶

AM-INTELLIGENCE¶

The next thing is and again I've seen this in my career a particularly in regional councils where the oscillated in, say, 3 waters, for instance, just use that example, between doing it in-house and then, you know, where XXX, was that, you know, which was a devolved model out to a consultant is the network, you know, running everything, and that sort of thing. I am, in terms of outsourced vs insourced, I would never ever outsource asset management as a system in any organization that I could influence and was part of. That is a recipe for disaster, though that doesn't mean to say so you own the system. The organization owns the system and owns all the parts of the system. Now, that doesn't mean to say that in some of the subsystem elements of the overall system, you will employ consultants and contractors to do some of those elements, but they report back into the system from the subsystems, and the data ownership and the IP and everything stays with the organization. So, they're delivering a service, they're not owning the system and delivering it for you. So can I just say, take XXX on asset management, I could never run a fully centralized model. Never right. I am always going to need all of those rangers and that resource at place to do stuff for me. So that takes my definition to a centre led rather than a centralized and my definition a centralized model is you don't need anybody dispersed at site. But it's not in your line that you are doing everything in your line from

the centre and that could never work with the type of assets and their geographical distribution that XXX has. (CG7)¶

For the use of Quality management standards, Baldrige, ISO 9001 and ISO 55000, my answer is yes, but I'll qualify that answer. Those systems give you the absolute discipline that you should be measuring yourself against, and if you can't measure yourself successfully in terms of what those systems are trying to retain, and you can't, you know, benchmark successfully against them, then you're probably not achieving what you want to out of your asset management system. But I do make the differentiation between what I've just said and actually going through the full process of being accredited. Well, when I said when I said benchmarking before, I didn't mean benchmarking between organizations. I meant looking at your asset management system and benchmarking against what ISO 55000 requires. So, my hypothesis is this. You could actually be doing everything that ISO 55000 requires without having the accreditation and the independent audit, that's telling you that, but you may choose to go that extra step of getting accredited with the independent auditing to give you that independent assurance. Now when I come to benchmarking with other entities and other entities, XXX could do that and should do that, but it shouldn't benchmark as a whole of an asset, all of our asset classes, because there's no one has a mix of asset classes like XXX. But what we could benchmark is on individual asset classes like roads and three waters for instance. I take your 240 residential properties. We could benchmark right now if we wanted to and have the resource to against XXX, against XXX City Council and XXX City Council, for instance. (OTH4)¶

One of the things that I'm reflecting right now, the practitioners of asset management, their biggest challenges that the decision makers don't understand asset management, so no matter how good you are in your asset management, if the people who are going to make the decision do not understand asset management, the principles, you got a real problem and I think in New Zealand there has been a major problem that the people who are making the decisions come back and say I want you to cut your budget down because we don't have enough money. And so, the people who prepare the asset management plans and all that they might lose the interest there was the point of doing all this effort when it just gets cut back or there isn't the necessary communication about. Well, OK, we don't have enough money, let's talk about how we may prioritize it both parties together in a consultative manner. It's usually, I'm gonna approve, you go away, you're preparing, you come and then, I'm gonna say yes or no. You know, it's not the same as let's talk about what the risks are, you know, all the building blocks that are in your questions they they're missing because you wanna know, what are the attributes that you wanna take into account, and what will the community think and what will your narrative be, you're the decision maker, you're the politician. (CG5)¶

I actually think the asset management maturity assessment as part of the improvement journey. So, you need to start how you intend to continue. So, the reason I like something like the GFMAM 39 subjects model, honestly, this part of it is just like why we got certain bits and just too much detail, it's but one of the industry's. Yeah, but it's actually what's really good about it, shows how everything's interconnected. It's got the alignment inherently part of it. So organisational strategy, asset management strategy, and planning, decision-making, people, risk, asset information, lifecycle and it's a great place to start. (CG6)¶

I often start a conversation when you do that Asset Management Maturity assessment, "what does asset management mean to you?" And I like to hear what people say, but invariably it will vary from something like it's about maintaining assets. Some people just think of that, and other people think, it's about my running of my retirement fund, I've got an asset manager looking after that doing my planning. And the reality is, it's all of those together because ultimately it is bringing the financial and the physical together. That's the other catch phrase. I like to use about bring financial and physical together. So, the ISO 55010 guideline is a perfect document has been helping people realize that. It

gives a little bit more detail on how to align. Start up with that model and people get it straight away. (CG6)¶

They realize we're making decisions at each stage of that life cycle. And we need a decision-making framework for doing that, and everything's got to be informed decision-making and information. And obviously, risk is a big part of an understanding of performance and how I do my job. But ultimately, I like the end of it, people do asset management not assets. The people component is really critical to it. It immediately starts you off on the right conversation with this is an all-encompassing model. That's why I like it. (CG6)¶

We have a couple of tools that we used. I was just looking at some of the data. We've got some good asset management information system. It's got tons of stuff in it. One of the things that I made my poor asset analyst who is now gone, do the other, quite recently was look at whether our maintenance costs were increasing or not. You might go, while actually, look at this, it's costing us this much in the maintenance, costs are going up year on year. What should we do here? And that's when I realized that actually, that's really good, really useful information, but it's not useful information to me that needs to go to the original asset managers. They need to be ready to prove why that's happening to their estimate. Actually, when I see this, we need to have a different approach for these. So, I was just thinking, actually what we have to do is, take that to them. So, because we've got there's so much information about these properties. The problem is not a lack of information and it's a lack of being able to actually use well, to even see it, to understand it, what does it mean? and I see how can we act differently as a result of it? So, I think that's the key message that we need to get through as our asset management improvement plan, is essentially how do we target our own efforts so that we're working on the things that are actually going to make a difference. (CG1)¶

I suppose if we touch on first, our operating model and that kind of idea of centralized, decentralized, outsourced. No, I think it's a hybrid, I don't think it's one or the other. So for me, where we've seen real benefits is decentralizing the collection of data, for instance, and using all the different sources so being able to have our asset information team and our operational team who are on the ground all the time, giving them the tools to capture asset data in terms of, you know, the metrics of the asset, the condition of the asset, you know whether it's changed, those type of things, decentralizing that function has benefited us in the way that we can collect more data than what we ever could, you know, we would have had it increase our asset team many, many times if we were to stay on top of that data collection. And that comes a little bit to that outsourcing bit as well. So, collecting that information from the contractors has also enabled us to improve the amount of information where we're receiving on our assets. (LG6)¶

That said, the trick with outsourcing, though, is making sure we've got consistent systems to be able to capture that data and get it into our system. And I think that's where it has been a little bit tricky, if I'm honest is, you know, making sure that the contractors are providing the information to us in a form that we can then easily put that into our system rather than it just sitting there and it's clunky and it's not being used so. (LG6)¶

But in terms of decentralizing that asset data, what's been really important and being strengthening now through the structure change that's coming up is centralizing the accountability and oversight of that information so where it hasn't worked is when we've decentralized, and you've got multiple people accountable for collecting information and you don't have that overview of how it's looking across your entire asset management portfolio. And you don't have someone with the authority that can go out to all those areas and really push the information. Then it kind of falls down because then you get patchy data in terms of, you know, some is really good quality, it's up-to-date, it's really, you've got confidence versus other areas where you've got pretty low confidence because that hasn't had the same level of drive. (LG6)¶

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So the decentralising works when you've got, I suppose, a centralized view, overview of the portfolio of asset information and management. I don't think it works when you just decentralize it and leave people to do their own things because inevitably, particularly what's such a big asset base we've got, and inevitably, you will have disjointed data and you will end up focusing funding the areas that have got the best confidence rating because their data is up to date versus the areas that aren't up to date and might have some stuff that need more investment. (LG6)

Because to your point, yeah, cause to your thing around processes and systems and stuff. I mean, the more we can automate simple stuff that doesn't need that intelligent thinking, the better we are off because we've got staff who can then, you don't have to have staff who are just capturing data and updating systems. You can actually move your staff skillset to people who can really review those facility management plans, do the integration around PPM plans and be really focusing in on how we using that information to the best use possible, which I don't think we're quite there yet. And possibly it's a failure of not having the right systems in place. There's still a real focus on having the right data, because although that's improved significantly, we're not there yet in terms of really high confidence and also in terms of then using that information and integrating between the PPMs, the maintenance and stuff, I think happens on our big risky assets, but not necessarily on everything. And so, what we're trying to define at the moment as you know what is the category of assets that are really sophisticated system of asset management needs to apply to versus you're really low risk assets which you can be more reactive to because the health and safety risks low, the financial and all the other social kind of risks are quite low. That will be carried out by our asset management team. (LG6)

It's a hybrid model and I cannot see it moving away from this at the moment. Different areas have different approaches because assets are different. So, you look at Auckland Transport's assets have a different nature to the likes of facilities which are different to the likes of water assets, to the zoo, stadiums and performing arts centres and things like that. My understanding is that, and this is the technology now exists, you don't need common platforms. That's not necessary what is now available as technology that allows platforms to talk to each other and that's a real benefit. And you can actually see the total asset plan, the asset inventory or whatever and plan and programme without having everyone in the public platform. (LG7)

For predicted analytics, I think the asset management system, not sure about RAMM for roading but I think the new breed of INFOR, SAP and HANSON, potentially have the ability to do that, it's not cheap. And that becomes another value equation, doesn't it? It's how much you, how much effort and time and resource you put into doing all the clever stuff that asset management systems could theoretically do. But you know, we come back to the point of data and information is an asset and it deteriorates over time, so there's a cost in just dealing with that. So it is, it always comes down to costing, for one of a better word, value for money, but I hate using that word 'cause that's just means too many things to too many people. (LG1)

With regards to asset management, I think it must be centralized. There are different perspectives on that but, fundamentally, the foundations of any business processes should be centralized if they were

across the whole business. Your implementation of that can be staged and prioritized. Because that's the priority. (LCE3)¶

We need to mature asset management and grow our business and grow that asset management capability and we need the capacity inside the machine to do that. For me it's about centralizing that, but then applying it to generate the most value to your company, and I guess the last piece is that the whole in-source--outsource thing... There's definitely a piece that needs to be inside the machine to help stabilize the machine and give the machine consistency in the AMS (asset management system) consistency and stuff like that... At the end of the day, I don't think there's any right or wrong answer, but I would imagine the 'more right' answer is a balance of internal and external skillsets, leadership and capability of the decision makers. Then I guess the role of the asset management system inside the organization is to best support those decision makers. (LCE3)¶

With regards to implementing asset management top-down, it's a combination of all those things you need good data from the ground to present rock-solid business cases and arguments that it makes it hard then, through leadership not to accept. Especially for University, if you've got poor data, the first thing they will do is pull it apart, and then you're out. And then it's another six weeks before you have the opportunity to go back in and present again, right? So, you need good data, a good argument for good business case, and then hopefully, you get members of the senior leadership team, who will act without individual portfolio bias. Sure, you can represent the interests of your portfolio, but at the end, in terms of the requirements or the concerns, but you must make a decision that is in the interests of the wider strategic needs of the university. And at times, I'm not sure we always achieve that. (OTH3)¶

It requires a lot of experience, it took, and that's where, you know, having the conversation with others and having an open mind to be challenged by others so that they can put their views and then being able to take those the feedback. And say, OK, given what I've heard and given the challenges we've got will have to make some tough calls and this is what we're gonna do and that's where you do need leadership. And leadership isn't about someone who's good dictatorial power to say we're gonna do it this way. Leadership is about someone who is able to engage with everyone, bring them together and that way, and you know, you have terms like buy-in now because you say, OK, even if, despite all that, we get it wrong, the people are more accepting of it because they contributed in their own way to those decision-making processes. And when you see public outcry, it is where these processes haven't been followed. OK, so when the government announced that they were going to put a cycle bridge across the Auckland Harbour, the outcry they came out, you know it it's because it's like well, not only is it done, it's like, have you not been listening to people and on the one hand you don't have money on the one hand, we've got waiting lists in, in other sectors other than transport. Which bit did you not understand? You know so you gotta be. (CG5)¶

You know the enabling structures that you talk about, the enabling structures, there's so many bits. I was gonna say, Raymond, you gonna have common sense. So sometimes you know when you have the dictatorial position where people feel I'm all too powerful. I'm gonna do it. That's actually bad. Let's actually when the wrong kinds of assets get built. You've that has happened in the private sector as well. You know, it has happened mostly. (CG5)¶

And you know, if you talk to people with who are involved with IT, they will tell you so many IT projects fail because people want to do it without knowing why they want to do it, they don't really understand the purpose, they just wanna be part of the technology and they don't know how. And in the event brought the people with them because IT isn't anything unless the people have contributed to it. And so that's why so many IT projects fail because all those bits that are necessary for any infrastructure to work and have been ignored, and then when they come up with things like Agile now, which seems to work more is because Agile requires people to be involved. You bring lots of people together, you

brainstorm, and you get the Scrum approach and this excitement, and you know the old Waterfall approach is by the time you have spoken to everyone, and you've prepared and delivered an IT, the whole industry and the whole technology has moved on you know. (CG5)¶

I mean the principles apply for everything that we do right? But when it comes to assets and infrastructure, it is more important because the assets tend to be, or infrastructure tends to be lumpy and expensive. So, you're making a decision that is going to be quite expensive, and you can't undo it. So, it requires a little bit more thought process, a little bit more. what I call, I used to say to people in when I was in Watercare, it's like playing chess. Unfortunately, many people don't play chess, so they didn't know what the hell I was cooking. Yeah, they didn't know what I was talking about but when you really play chess, good chess, you have to foresee possible moves that others may make, you don't know what move exactly. (CG5)¶