



Contractor Report 2017-01 **IMPLEMENTATION GUIDE FOR AN ISO 55001 ASSET MANAGEMENT SYSTEM**

A PRACTICAL APPROACH FOR THE ROADS SECTOR IN EUROPE



Conférence Européenne
des Directeurs des Routes
Conference of European
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IMPLEMENTATION GUIDE FOR AN ISO 55001 ASSET MANAGEMENT SYSTEM

A PRACTICAL APPROACH FOR
THE ROADS SECTOR IN EUROPE

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The aim of the CEDR Transnational Road Research Programme is to promote cooperation between the various European road administrations in relation to road research activities. The topics covered by this Call were developed by TG Research to fulfil the common interests of the CEDR members.

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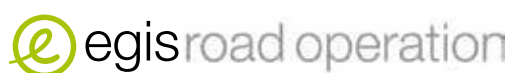
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KEY TO USING THIS DOCUMENT

Light blue box-outs are used to highlight quotations, particular examples from case studies and research, or other publications.



Blue box-outs are used to highlight conclusions and 'tips' that may aid an organisation considering the implementation of an asset management system which conforms with requirements of ISO 55001.

Visual 'flags' are used to highlight sections of particular relevance to each of the three types of readers:



POLICY



MANAGER



OPERATIONS

Advisory link to another relevant section of the document, for further information:



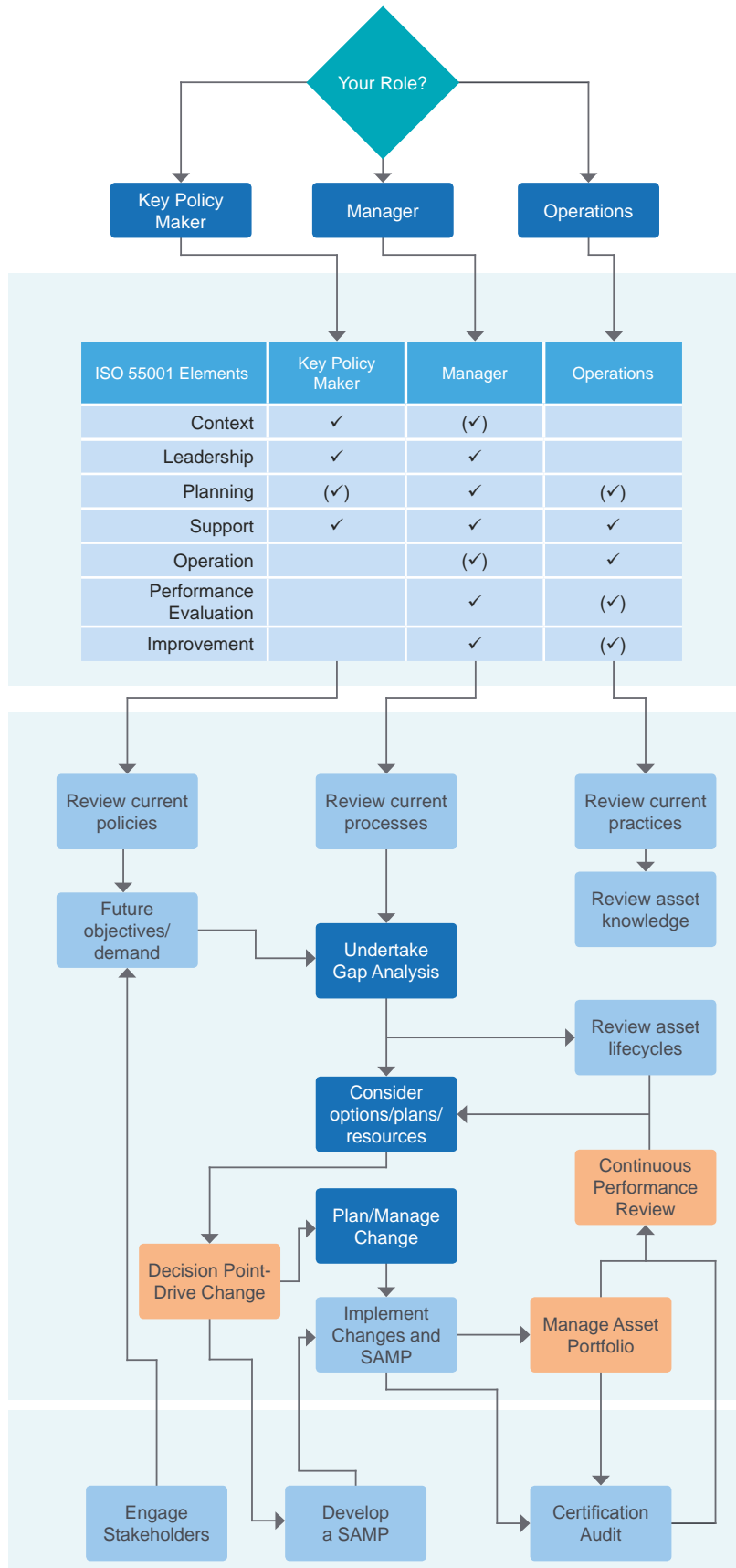
'SIGNPOSTING' FOR DIFFERENT READERS

Your Role?

Preliminary assessment stage – assess relevance of ISO 55001

The Journey to Maturity

ISO 55001 Specific Actions



PREFACE – THE ARISE PROJECT

Following the publication of ISO 55000 in February 2014, the ARISE project (Application to Roads of ISO 55000 using Exemplars) was initiated by the Conference of European Directors of Roads (CEDR) in its 2014 Research Call through the topic 'Why and How to implement ISO 55000'. CEDR is an organisation which brings together the road directors of 25 European countries, and the funding partners of the current Joint Research Programme are the National Road Administrations (NRA) of Austria, Belgium-Flanders, Finland, Germany, Ireland, the Netherlands, Norway, Sweden, and the United Kingdom.

Road Administrations around Europe have been on an evolving journey towards more systematic and holistic management of their assets in recent years. Standardisation in the approach to establishing an Asset Management System (AMS) – in its broadest sense – started with the publication of the British PAS55 specification in 2008. This has now attained international standing through the development of the new ISO standard, built on the PAS55 foundation. CEDR has instigated and supported a number of research and development programmes with Asset Management (AM) as their theme, and in particular established a Task Group (N2) under TD Network Management. In addition, CEDR inherited the results of the ERANET Road II (2010 Research Call) 'Effective Asset Management' in 2013.

The ARISE project was awarded to an international team of experts from the UK and France, with access to resources in Portugal and Denmark. The team was led by WSP | Parsons Brinckerhoff, with partners EGIS Road Operation and Hyperion Infrastructure Consultancy.

ARISE has focussed on producing advice and guidance for road sector organisations considering why and how to implement ISO 55000; more specifically, after adopting the approach of ISO 55000, delivering an AMS means using ISO 55001 which is the management System Requirements. This Guide represents its primary published output, based upon examples gleaned from case studies of organisations which are at various stages of their asset management system implementation, and which have specific experience of ISO 55001 or its 'parent', PAS55. The project's aim is to facilitate open and practical dissemination of the principles of asset management as defined in ISO 55000 to as wide an audience as possible, and this Guide performs a key role in that process.

The Guide is intended to offer options and advice, rather than a 'one-size fits all' solution to establishing a formal Asset Management System that will help organisations to obtain value from their assets. It provides evidence and examples gained from the earlier stages of the ARISE research project, including priorities based on typical costs and benefits. The Guide does not contain a detailed way of assessing 'maturity', as this can be found in other literature cross-referenced in the document. It does explain the 'journey to maturity'; along the path of which certification to ISO 55001 is one key milestone. The Guide does not primarily equip those tasked with performing asset management activities with new solutions, but rather explores the reasons for adopting a strategic approach to asset management against the main themes in the international standard, ISO 55001.

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1 GETTING STARTED

WHAT IS ISO 55000?

The International standard for asset management comprises three complementary documents ISO 55000 – Overview, principles and terminology, ISO 55001 – Management System Requirements and ISO 55002 – Management systems – Guidelines for the application of ISO 55001. The standard is aimed at enabling an organisation to obtain value from its assets. It is aimed at enabling an organisation to achieve its objectives through the effective and efficient management of its assets. It offers a structured and well-researched approach to Asset Management (AM) which can be applied whether an organisation already has a mature Asset Management System (AMS), or is just starting its journey to obtain value from its assets.

The ISO 55000 Standard is primarily intended for use by:

- Those considering how to improve the realisation of value for their organisation from their asset base
- Those involved in the establishment, implementation, maintenance and improvement of an asset management system
- Those involved in the planning, design, implementation and review of asset management activities; along with service providers.

ISO 55000 para 0.3

WHY SHOULD IT BE OF INTEREST TO A ROAD ORGANISATION?

The Roads sector was perhaps a little slower than other infrastructure sectors to formally adopt the concept of 'asset management', even though it may be argued that they had been 'doing asset management' for many years. Road Administrations around Europe have been on an evolving journey towards more systematic and holistic management of their assets in recent years. A wide variety of business models are now being adopted by this industry, from a traditional fully in-house arrangement, through a sliding scale of outsourcing of services, to a full PFI/PPP approach. This is discussed in Chapter 3. Standardisation in the approach to establishing an AMS – in its broadest sense – started with the publication of British PAS55 specification in 2008. This has now attained international standing through the development of ISO 55001, the adoption of which can bring many benefits to a Roads Organisation. These are explained in more detail in Section 2.4 and Chapter 6. From this point forward we shall refer only to ISO 55001 unless otherwise stated.

WE ALREADY ADOPT AN 'ASSET MANAGEMENT' APPROACH, DOES THIS APPLY TO US?

It is clear that many roads sector organisations – public administrations, contractors, operators and concessionaires – have seen the need to embrace the concept of holistic asset management. Many have re-engineered their business processes accordingly and taken new approaches, for example to the outsourcing of asset management services. Data, and the information systems required to manage them, are widely recognised as key to underpinning an asset management approach. The combination of policies, processes, procedures and methods of working may be seen as an 'asset management system', but this cannot be objectively benchmarked unless a standard approach is taken; so, even if your organisation is using an asset management system approach, the adoption of a standard can provide an accepted way of comparing with other similar organisations and benchmarking good practice.

In this Guide, you will find how ISO 55001 views the establishment of an AMS as a 'journey'. Every organisation starts at a different point of maturity, and has unique challenges in developing further; the point at which a decision to aim for formal ISO 55001 certification will also vary from organisation to organisation, and should depend on a sound internal business case being made.

HOW WILL THIS GUIDE HELP ME?

This Guide is aimed at people working in a roads organisation at a range of levels; Policy, Management, and Operations. You will find 'flags' drawing attention to which section may be particularly relevant to you (see the key on page ii). The Guide draws upon real-world case studies, from a range of countries and industries. This is used to provide you with lessons learned and hints and tips for your own 'journey'. In developing the Guide, work has been done on costs and benefits that, at a broad-brush level, will assist you in making the initial investment decision whether or not to conform to ISO 55001 requirements. It is important to remember that this is not a 'one size fits all' approach; what your own organisation needs to do to adopt ISO 55001 and become compliant will depend on a range of factors such as your starting 'maturity', and the level of resources available and their competence.

WHAT IS THE BEST APPROACH TO READING THIS GUIDE?

You will find advice on how to navigate round the document, and find the parts which are most relevant to you, in the 'Key to using this document' on page ii. We have adopted a visual style that we hope will help you identify sections and paragraphs of particular relevance to you.

HOW DO I FIND
OUT WHAT TO
DO FIRST?

In Chapter 5, you will find a description of the tasks you may need to go through in establishing an asset management system in a way that is compliant with ISO 55001. It contains practical hints and tips, and these are taken a step further in Chapter 7 which looks at the factors involved in a successful implementation.

HOW DOES
THE GUIDE
HELP ME MAKE
A BUSINESS
CASE?

By explaining the general approach to setting up an ISO 55001 implementation project, the relative scale of costs and benefits, the Guide will assist you in constructing a business case. A lot will depend on your starting position, but you can learn from examples from the case studies in the Guide. Ultimately, your business case can only be produced by those with intimate knowledge of the particular organisation concerned.

DO I NEED
TO READ THE
WHOLE GUIDE?

In short, no. We have designed the Guide so that you can focus on sections of relevance to you, and find the key sections quickly and easily.



2 THE CONTEXT OF INFRASTRUCTURE ASSET MANAGEMENT

2.1 THE BACKGROUND OF THE ARISE PROJECT

POLICY

MGR

As a reader of this Guide, you may feel familiar with what constitutes a ‘road asset’, and how your organisation approaches the maintenance and operation of that asset. You may wonder what a standardised ‘asset management system’ (AMS) can add to your organisation and how benefits can be realised if you were to do so. Beyond that, you may well be asking the question ‘Why and how should I implement ISO 55001?’ – the question posed by the ARISE project.

In this Guide, we have described a ‘journey’ that any organisation with an interest in improving its approach to asset management may join. It is a journey that many in the roads sector are already embarking on, and it is a journey which you can pick up at whatever is the stage of maturity of your organisation. The journey applies whether or not an organisation intends to seek certification to ISO 55001 or not, but it should be noted that this Guidance document focusses on the specifics related to adopting the ISO 55000 suite.

The ARISE project has investigated a number of real-world case studies and at various points in this Guide we share with you the lessons learned by others, for your benefit. In some cases, your organisation may have already encountered the challenges and opportunities described; in others, you will find inspiration to help plan the next stages on your own journey. One thing is certain; every organisation is unique, it starts from a unique stage in the development of its AMS and has as its ultimate business objectives a unique set of goals.

The first questions your organisation should be asking itself are:

- Are the most senior levels of management in my organisation committed to the development and implementation of an AMS?
- Do we understand the scope of our 'assets'?
- Do we understand the needs and expectations of our stakeholders?
- Do we have clear organisational objectives and is it clear how these relate to our asset management processes?
- Have we checked the competencies of our resources to deliver asset management in a way that optimises the benefit to our business and our stakeholders?

An asset is an item, thing or entity that has potential or actual value to an organisation.

*ISO 55000:2014
Para 3.2.31*

More details on how to implement the steps relevant to your organisation may be found in Chapters 5 and 7.



2.2 INTERNATIONAL INDUSTRY CONTEXT

The hypothesis adopted at the start of the ARISE project was that the generic approach to adopting a robust and auditable AMS applicable to physical infrastructure, is likely to be common across a number of industry sectors, and countries. From the findings of our research, which included examples from the energy, air traffic, tunnel operation and highways sectors, this has been confirmed.



We found that, at the time of carrying out the project in 2015/16, ISO 55001 is still a relatively new standard in most industries. That has not, however, stopped a number of organisations, who were already on the journey to obtain asset management maturity, update their PAS55 aligned systems to meet the certification standard in quite short timescales. In our study we found 1 to 4 years was a typical timeframe.

2.3 WHERE ISO 55001 FITS IN

As with any standard which addresses a management system, ISO 55001 does not attempt to prescribe exactly how an organisation should perform asset management – that is, the precise processes and activities that apply to the organisation in question.

Asset management is the coordinated activity of an organisation to realise value from assets (3.3.1) which involves the balancing of costs, opportunities and risks against the desired performance of assets, to achieve the organisational objectives.

ISO 55000:2014 Para 2.4.1

Rather, it describes a framework for developing, documenting and continuously monitoring and improving a rigorous Asset Management System (AMS). ISO 55000 is a suite of documents which in this Guide we generically refer to as 'ISO 55000':

- ISO 55000:2014 (E) Asset management – Overview, principles and terminology
- ISO 55001:2014 (E) Asset management – Management systems – Requirements
- ISO 55002:2014 (E) Asset management – Management systems – Guidelines for the application of ISO 55001.

ISO 55001 contains the requirements for conformance against which organisations can be audited, while ISO 55002 provides additional guidelines and explanations which will assist in the development and implementation of an Asset Management System which complies with the requirements of ISO 55001. A cross reference between these key documents and the highways industry context may be found in Appendix 3.

**GO TO
APPENDIX 3**



From the experience of the organisations analysed in this project we have observed synergies between ISO 55001 implementation and other ISO Quality Systems including 9001, 14001, 18001, and 27001. These synergies exist

because there are some common requirements and approaches in these standards regarding general management principles. This emphasises that ISO 55001 does not 'stand-alone'; with this awareness, organisations could ensure a better management of resources in case they decide, or are contractually required or under regulation to implement several ISO Quality Systems. Identifying synergies between standards can bring bankable benefits in terms of audit cost savings when combining audits.

**GO TO
CHAPTER 8**

**GO TO
CHAPTER 6**

2.4 HOW A STRUCTURED APPROACH ADDS VALUE

ISO 55001 aims to add value to an organisation and in Para 2.2 of the ISO 55000 document it identifies nine general areas in which the AMS may deliver benefits:

- a) Improved financial performance
- b) Informed asset investment decisions
- c) Managed risk
- d) Improved services and outputs
- e) Demonstrated social responsibility
- f) Demonstrated compliance
- g) Enhanced reputation
- h) Improved organisational sustainability
- i) Improved efficiency and effectiveness.

The following chapters in this Guidance expand on these areas, taking on board lessons learned from the case studies (Chapter 4), describing reasons why to implement an ISO-compliant AMS (Chapter 3) and explore relative costs and benefits of adopting the ISO approach (Chapter 6).



3 WHY IMPLEMENT AN ISO ASSET MANAGEMENT SYSTEM IN A ROADS SECTOR ORGANISATION?

In this chapter, we start by exploring the general approach to establishing an Asset Management System, recognising that many organisations are already in the process of doing that. We then move on to explore why, in the roads sector, it would add value to go on to implement an ISO-certified AMS? This question finds some answers in the following chapters, namely Chapter 4 which summarises the lessons learned from the case study organisations, and Chapter 6 which summarises the findings of the cost-benefit review which was carried out with the help of the case study organisations.

3.1 BENEFITS OF AN ASSET MANAGEMENT SYSTEM



Coordinating the many facets of Asset Management requires a system of direction and control – a ‘management system’.

An Anatomy of Asset Management, version 3 – IAM 2015



ISO 55000 defines an asset management system (AMS) as a set of interrelated or interacting elements which establish policies, objectives and the processes to achieve those objectives in respect of the assets. Design of an organisation’s ‘Asset Management System’ can be done from a number of different perspectives and starting points; each one will be uniquely tailored to the needs and constraints of that particular organisation. What ISO 55000 does is provide in addition a structured framework – a maturity milestone – within which that can be done. At that stage, it can also facilitate benchmarking of one organisation against another. Whatever an organisation’s starting point on the asset management journey, the decision to adopt ISO 55000 as the formal standard against which its AMS will be judged, must be driven by a rational business case. This is explained further in Chapter 5.

The comments which follow in this section apply in general to the establishment of an AMS. More specific guidance related to establishing an ISO 55001-compliant AMS are in the following section (3.2).

Specifically in the roads context, preservation of the road network over long term to deliver the expected level of service to road users is the overriding objective of Road Administrations. It requires timely and efficient maintenance activities that comprise, broadly:

- Routine maintenance, covering maintenance activities which are undertaken on a regular basis – typically at least every year – and/or with a high degree of certainty as to when they would need to be conducted
- Heavy maintenance, covering major repairs and renewals activities which heavily depend on the condition of the asset to be undertaken – significant capital expenditures are usually associated with these activities (they therefore require planning and an on-going review to determine the best capital expenditure strategy throughout the life of the asset)
- Improvements/upgrades.

If not planned and documented properly, and with a view to minimising whole life costs, heavy maintenance represents a major risk for any road organisation. Examples include:

- Lack of planning will increase the cost of works and the cost of Traffic Management, will disturb the availability of the carriageway and interfere with seasonal constraints to optimise maintenance
- Lack of available funds will delay lifecycle investments leading to an increased cost of routine maintenance, severe degradation of the assets which in turn will cost more to rehabilitate
- Lack of documentation will increase the difficulty of convincing stakeholders that the AM Plan is robust, will reduce lessons learned and maintaining organisational knowledge and will fail to support the on-going asset management process including handback (if applicable).

As mentioned above, an asset management system is a set of interrelated and interacting elements of an organisation, whose function is to establish the asset management policy and asset management objectives, and the processes, needed to achieve those objectives.

In this context, the elements of the asset management system should be viewed as a set of tools, including policies, plans, business processes and information systems, which are integrated to facilitate delivery of organisational objectives by obtaining value from the assets.

As previously stated but repeated for clarity, ISO 55000 identifies nine general benefits areas which implementing a robust Asset Management System, developed through a step-by-step documented process:

- Improved financial performance
- Better-informed asset investment decisions
- Better management of risk: reducing financial losses arising from failure of an asset, improving health and safety
- Improved services and outputs
- Demonstrated social responsibility
- Demonstrated compliance: transparently conforming with legal, statutory and regulatory requirements

- Enhanced goodwill and reputation: through improved communication, customer satisfaction, stakeholder awareness and confidence
- Improved organisational sustainability
- Improved efficiency and effectiveness

3.2 BENEFITS OF ISO 55001 CERTIFICATION



There are basically two drivers to develop an AMS into ISO certification:

- Either a business decision; or
- A contractual obligation.



Of those organisations we considered which formed our case studies and which are aiming for ISO 55001 Certification; some are driven by a contractual obligation and others by a business decision, and alignment with their client objectives.

The relevant requirements of the ISO 55001 Standard provide a framework for the asset management process and organisation. While not claiming to be a 'best practice' guide, the standard ensures that an organisation's AMS contains all the key components, structure and accountability that would be expected from a formal quality-assured approach.

As a starting point on the road to certification, ISO 55001 stresses the need for the organisation to understand wider context of how its assets contribute to delivery of its objectives, as well as the needs and expectations of stakeholders.

The concept of maturity of the organisation in respect of asset management will determine the 'gaps' it needs to fill, and thus the actions it needs to take. This is described further in Chapter 5. Application of the standard may, arguably provide more benefit to a less mature organisation, but the extent of the actions will be greater.

The standard describes in some detail the importance of having the right 'support' in place (resources and competencies). This means roles, responsibilities, authorities and identify asset management resources and competences have to be formally identified.

It then enables the organisation to determine that the scope of the asset management system is correctly defined and documented. In addition, good management practice such as continual improvement is required.

Importantly – and this is a subject we will often return to – the organisation, led from the top and in particular by the General Manager and the Asset Manager, is required to demonstrate leadership and commitment, to, among other things, develop asset management awareness and communication across the organisation, and implement internal and external relevant processes.



The ISO 55001 Standard, while optional, adds value to an Asset Management System by the nature of being a structured management framework for the asset management process and the organisation.

For any organisation, be it a public body or a private Operator or Service Provider, if it has already been ISO certified in a number of domains (ISO 9001, ISO 14000...) the step up to ISO 55001 is incremental.

The potential overall savings of adopting a structured AMS have been estimated by one respected governmental body in the UK (CIPFA)¹ at around 5% for the highways sector. In the ARISE project, we developed a broad-based model for evaluating costs and benefits against the main elements of ISO 55001, and this is described in more detail in Chapter 6. The model was used to analyse feedback from the project case studies.

There is a synergy between ISO standards in the area of management systems that makes the extra effort involved in the certification process for adding an additional one at the same time relatively small. This was the case in the UK for NATS and Durham County Council (see Appendix 1).

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CHAPTER 6

Combining ISO standards can enhance an organisation's ability to become more efficient through common continuous improvement. Savings can also be made in the direct cost using existing documentation and knowledge as well as through employing external auditors, through the efficiency of carrying out more than one audit on the same visit.

The standard is not a universal system for all organisations, but rather a structure for a specific management system that must align with the needs, requirements, and objectives in each case.

While this standard can be applied to both tangible and intangible assets by all types and sizes of organisations, it is most commonly applied to managing physical assets.

Benefits can also start to be realised through the implementation of the Standard even before the final certification takes place.



The implementation of the Standard is a first step to structuring the asset management process so that value is obtained from the assets. Going to Certification can provide additional benefits.



© Anthony Cullen

¹Local Authority Transport Infrastructure Assets – Review of accounting, management and finance mechanisms, CIPFA (UK), 2008

Beyond operating an asset management system, there are numerous benefits in being certified to ISO 55001. From evidence gathered in the Case Studies in Chapter 4 and Appendix 1, we have suggested a possible list of benefits relevant to an organisation managing its assets through ISO 55000:

- Formal assurance that the organisation is in line with Industry best practice
- Enhanced confidence from regulatory authorities that assets are being managed in an optimal manner
- Strength in negotiating position with regulators during settlement discussions
- An endorsed asset management approach for parent companies to showcase as well as learn from
- Added confidence to key stakeholders that a robust approach is in place to manage their network, including (where applicable depending on the industry and in the case of PFI/PPP contracts, contractual context) the owning Authority, any Government Regulator, the general public, any Concessionaire and Operator's Boards, any Lenders, the Lenders' Technical Advisors, and potential investors
- An opportunity to generate answers and roll out of asset management training in parallel
- An opportunity to integrate different parts of the organisation and explain their role and integrate with other organisational departments in the context of asset management
- A qualified third party auditor reviewing systems and procedures providing an external perspective on the effectiveness of asset management on the road network
- Added clarity in the division of responsibilities with regards to asset management between Owner/various integrating parties
- A framework and opportunity for reviewing and continually improving the current asset management system.

GO TO
CHAPTER **4**

GO TO
APPENDIX **1**

To weigh against these benefits, for most organisations, implementing an AMS compliant with ISO 55001 represents a significant investment (see Chapter 6 for more on the specific Costs & Benefits associated with an ISO-compliant AMS).

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CHAPTER **6**

Now reflecting more specifically on the evidence given by the case study organisations and also from experience, we can draw the following lessons. Initial costs of adopting a new system are mainly due to the fact that, in road organisations, there is a lack of 'AM culture and experience' at the top management level. Chapter 4 explores the experiences of each case study organisation, and lessons learned that provide useful learning points for the roads sector.

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CHAPTER **4**

On top of that and also because of that, the budget for AM purposes is, in most cases, insufficient to fund the resources (human and financial) necessary to implement all the required processes and to integrate the complete and necessary set of asset data and information for the decision making process.

The significant investments necessary to implement an AMS compliant with ISO 55001 are needed mainly for:

- Having the necessary qualified and competent human resources to Plan, Check and Do everything that the AM end-to-end process requires
- Implementing an effective AM communication process between the relevant stakeholders
- Implementing a risk based approach for all AM decisions
- Implementing the AM's IT supporting tools
- Supporting the actions (repairs and maintenance works) that the AM processes will identify as necessary, considering all Lifecycle Cost (LCC) aspects and Contract requirements.

It seems appropriate to believe that, if an organisation has already invested (or plans to invest) relevant resources to implement such AMS, it should take the less expensive course of action on that process, that is apply for the ISO 55001 certification?

For a road organisation, whatever the source of drive towards the implementation of an AMS, compliant with ISO 55001 (business perspective, or contract requirements perspective), this certification provides the structure for an effective system relevant to the organisation and will represent the evidence of that achievement.

That evidence (ISO 55001 certificate) will be a significant and positive performance message to the road market, since it will be given by a recognised qualified third party auditor.

The perspective of the certification depends on the Road sector organisation: Road Authority, Motorway Concessionaire or Maintenance Operator.

- Road Authority, focusing on Policy
- Concessionaire, focusing on asset monitoring and performance, and also on delivery when the Operator is only in charge of routine maintenance.
- Operator, focusing on the actual delivery of asset management as opposed to monitoring of performance
- Supply chain?

Road Administrations are less flexible to move on to certification or even may not be attracted to this type of standard because they have to deal with a number of different contractors.

The benefit of certification increases with the degree of involvement of the Road Administration, on a sliding scale (see Diagram 1 in Section 4.2) between carrying out the whole maintenance using in-house resources to complete outsourcing.

For a Public Road Administration/Asset owner managing their supply chain through a performance contract, benefit could be marginal, essentially by having reassurance that their contractors are wedded to it, however, this could be useful for structured/best practice approach.

OPS

It is important to note where asset owners use a supply chain to deliver their maintenance operations that certification applies to the whole asset lifecycle process. Strictly, it is assumed that a single organisation is responsible for the whole AMS and only that owner can gain the certification. An outsourced activity such as operation is only part of the whole picture, so such an operator could not usually fulfil the requirements for ISO certification unless they had responsibility for everything including determination of every lifecycle stage and associated activity. Thus, while there is an unwritten assumption in ISO 55000 that it will be the asset owner which drives the adoption and certification process, in some cases an outsourced entity may take the lead. This can vary country-by-country, and organisations should check with their national accreditation body (eg UKAS). In any event, outsourced supply chain partners must be engaged with the organisation leading the accreditation as appropriate to ensure that their contribution to achieving the outcomes fully complies with the AMS.



The end-to-end asset management process should be 'owned' by a single organisation which takes the responsibility for the project to implement ISO 55000, even if the business is delivered across several organisations.

3.3 CHALLENGES TO ISO 55001 CERTIFICATION

POLICY

Just as there are benefits, there are a number of potential challenges to an organisation in pursuing certification to the ISO 55001 standard, including:

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- Short term contracts do not incentivise long term asset management approach. Benefits not realised in short term or not wholly realised by party undertaking ISO 55000
- Certification to the Standard is (generally) not yet a contractual, statutory or regulatory requirement in most countries, therefore ISO 55001 certification must prove to be a sound investment for the organisation(s). This however could change as governmental asset owners consider the benefits of requiring the standard to be met by its agents and suppliers
- The cost of maintaining and training in-house staff implementing and continuing to meet the requirements of the Standard
- Direct costs of preparing for and undertaking an audit, including fees for external auditors
- Limited availability of resource due to other activities occurring within the business
- Continued dedication to maintaining the requirements of the standard after the initial accreditation process
- Reputational risk if the organisation(s) fail to achieve the certification from an external auditor on the first attempt or subsequently lose certification
- Perception of short-term financial impact of initial certification: the benefits of such process are normally noticeable by road organisations only over a medium/long term. In the short term, implementing an AM system can be seen as expensive and complex, particularly if senior management do not buy into the principles of asset management.

3.4 SUMMARY AND CONCLUSIONS



Depending on the starting point of maturity within an organisation, the options are either:



- Start developing an AMS with general reference only to ISO principles
- Change the objectives of the AMS under development to become ISO 55001-compliant, or
- Re-engineer the existing AMS to meet ISO 55001 requirements and seek compliance.

When deciding whether to seek ISO 55001 certification, an organisation should ask itself the following questions:

- Does the top management demonstrate leadership and commitment to manage the assets optimally over their lifecycle
- Can achievement of the organisations objectives be facilitated through the assets
- Are both an AM policy and objectives established?
- Are the processes required to achieve the AM objectives, in place?
- Is the existing asset information (inventory and condition data) accurate and organised?
- Are there efficient existing management information systems already in place to efficiently assemble, manage, analyse and use asset data?
- Does the organisation have documented processes and procedures in place to specify how organisational objectives are aligned and converted to asset management objectives and the role of the asset team and the AMS in supporting this
- Do all parties to the asset management process (Owner, Service Provider, Concessionaire or Operator) communicate efficiently regarding AM?
- Are the contracts with external service providers and contractors aligned with the organisation's overall asset management objectives and in supporting the AMS?
- Does the top management recognise the need to improve communication and interaction across functions and are there the systems and processes to do this?
- Are the AM processes cross-functional and equivalent for all asset groups?
- Are the assets managed in an integrated manner, based on lifecycle considerations over a long-term and sustainable approach to decision making?
- Is there a framework in place for the identification, understanding and integration of the many technical standards, codes, guidelines and best practices that affect AM?
- Is the asset value measured, which may be in cost terms or by using other metrics such as life-expiry?



4 EXPERIENCE OF ISO 55000 IN DIFFERENT INDUSTRY SECTORS

In this chapter we summarise the case studies, in order to ‘signpost’ key lessons learned for the different readers of this Guide. When reference is made to the different parts of the standard, it should be remembered that ISO 55000 is the overview, while ISO 55001 sets out the detailed requirements against which audits are carried out.

4.1 GENERAL CONSIDERATIONS



Our detailed case study investigations involved eight organisations from four different industry sectors (utility, public urban transport, road and airport services). It enabled us to examine relevant experience from organisations that were at different stages during the ISO 55001 certification process. Some of the case study organisations were only committed in principle to ISO 55000, and had yet to make a final decision on whether to seek certification.

The organisations surveyed and the relevant industry sectors, are presented in Table 1. It is worth noting that a large proportion of these organisations are listed as ‘Not Currently’ or ‘Not at Present’ going for ISO status although several of these do have plans in place to achieve future ISO certification as a future goal.

Table 1 – Summary of ARISE Case studies

Company name	Country	Information date	Industry sector	Certification status
FINGRID	Finland	October 2015	Utility (Electricity transmission in high-voltage)	Not currently (planned for 2016). PAS55 certified since 2011.
Surface Transport For London (TfL)	United Kingdom	November 2015	Public Urban Transport	Not currently (planned for 2017).
M25 Connect Plus (CP)	United Kingdom	January 2016	Road	Not currently (planned for spring 2017).
Highways England (HE)	United Kingdom	January 2016	Road	Not at present, but Licence requires 'AM consistent with ISO 55 ISO 55000'.
Balfour Beatty Mott MacDonald's – Area 10 (BBMM)	United Kingdom	January 2016	Road	Not currently. PAS55 certified since 2014.
National Air Traffic Services (NATS)	United Kingdom	January 2016	Airport services	Yes, since 2014. PAS55 certified since 2011.
ASFINAG Service GmbH	Austria	January 2016	Road	Not currently.
Egis Road and Tunnel Operation Ireland (ERTO)	Ireland	March 2016	Road (urban tunnels)	Not currently (planned for the end of 2016).

The questionnaire sent to the selected organisations was organised by themes to enable cross-referencing to ISO 55001 requirements in order to facilitate the analysis process, such as:

- Context of the organisation
- Stakeholder engagement and communication
- Leadership
- AM policy and objectives
- AM planning
- People and training
- Data and information
- Risk management
- Improvement and change management.

Table 2 shows the correspondence between the questionnaire themes and ISO 55001 requirements. We deliberately designed the questionnaire this way round, as most organisations have a level of asset management underway already and would feel comfortable with these themes, and so then to reference them to the relevant parts of the standard.

Following the case studies, and shortly before the conclusion of the ARISE project, we became aware of a Highway Authority which had successfully achieved ISO 55001 accreditation in January 2016, and was probably the first in Europe to do so. This Authority, Durham County Council in the UK, subsequently gave us information that, while not part of the formal case study analysis, has been included in Appendix 1 for information. Their feedback has been helpful in confirming some of the conclusions and advice offered in this Guide.

We have presented in the following sections the key aspects ‘on the road’ to ISO 55001 certification according to the same format already applied in the questionnaire. This is based not only on the information collected under the scope of this project, but also on the AM experience of the project team and other published papers.

Table 2 – Correspondence between ARISE questionnaire themes and ISO 55001:2014 requirements



Questionnaire themes	ISO 55001: 2014 clauses	Highways context – examples
Context of the organisation	4.1 4.3 4.4 8.3	Ownership of the public road network is with governmental organisations, but the extent of outsourcing asset operation and delivery varies widely across countries. The scope of highways assets on a network is very large, and in different contexts the scope of the associated AMS is found to vary among road administrations – even if an AMS exists.
Stakeholder engagement and communication	4.2	Our research shows that the effective engagement of stakeholders on a road project AM relies not only on having an effective communication process, but also on the ability and willingness of different organisations to align strategies and objectives.
Leadership	5.1 5.3	Our research confirms the central importance of obtaining high-level ‘buy-in’ by senior decision makers in the Highway asset-owning body, project sponsor and also within the supply chain/ implementors.
AM policy and objectives	5.2, 6.2.1	Our research shows that the existence of an AM policy and AM objectives on road businesses seems to be essentially triggered and controlled by Contract requirements or Road Authority, than by business analysis/evaluations.

Questionnaire themes	ISO 55001: 2014 clauses	Highways context – examples
AM planning	6.2.2 (a) to (j) 8.1	Our research shows that AM planning is an activity performed by all the organisations, at different levels of detail, even if it has different characteristics and it is mainly ruled by business needs.
People and training	7.1 7.2 7.3 7.4 8.3	ISO 55001 sees this as part of the ‘Support’ needed for the AMS. The first three elements of this relate to people and communication, and in particular competency requirements. This is a continuous process linked to business improvement.
Data and information	7.5 7.6	Importance of complete and current inventory of assets; had been well recognised by many Road Administrations. Deciding what asset condition surveys on the road network are required; most Road Administrations have good technical expertise, but is the strategy optimised for business outcomes? Information Systems including Road databases are well established in many countries, but are they ‘fit for purpose’ in the AMS context? Issues of data quality are often not adequately addressed.
Risk management	6.1 6.2.2 (k)	Most highways organisations now adopt some form of risk-based approach to managing their assets. The question is, whether this approach is robust and satisfies the needs of ISO 55001 and associated Standards such as ISO 31000.
Improvement and change management	8.2 9.1 to 9.3 10.1 to 10.2	Most highways organisations use some form of Business Management System which includes these aspects; some go further and adopt a Quality System such as ISO9001. ISO 55001 is complementary to such systems.

4.2 CONTEXT OF THE ORGANISATION



Formerly PAS55 and, since 2014 the ISO 55000 standards, have increasingly become of interest to owners of complex and large asset portfolios, because other relevant organisations have implemented a PAS55/ISO 55001 compliant AMS and gone through certification, either on their own volition, or imposed by contract requirements. Also the importance of good asset management is increasingly understood by the Industry. Rightly, though, a degree of caution is expressed by those organisations until they see a clear benefit that exceeds direct costs of going down that route.

Road examples:

Connect Plus (CP) – Asset portfolio includes about 150,000 assets, organised in 13 asset categories over 400 linear kilometres pavement and 40km of footways. There are about 1,850 structures of which 760 bridges, 1 cable-stayed bridge, 5 tunnels, 18,000 street lights, 8,000 signs.

Balfour Beatty Mott MacDonald (BBMM) – The asset portfolio includes 1,303, 2 c-way km, 2,223 bridges/structures, 33,000 gullies, 11,650 signs, 4,971 technology assets, 16,995 lighting columns, 1,182km road restraint systems.

Egis Road and Tunnel Operation Ireland (ERTO) – Dublin tunnel is a twin bore tunnel of 4.5km in length with a height clearance of 4.65m. The assets are divided into 11 groups, such as tunnel and other structures, roads and associated infrastructure, ventilation systems, lighting systems, drainage system, fire-fighting system, communication system, traffic control and SCADA system, electrical and emergency power system, service buildings and plant rooms, toll collection systems.

Medium/large organisations which have relevant public participation and/or organisations which perform services over complex public owned assets portfolios, have become more aware of the impact of a performing AMS. This new awareness has been mainly implemented by asset owners, through:

- Tender rules
- Contract requirements
- Contracts management/follow-up/supervision.

The eight organisations which responded to our call for case studies under this project are at very different stages 'on the road' to implement an ISO 55001 compliant AMS. Only one has already implemented ISO 55001. They are either:

- Large Public/Public-Private organisations (example: TfL – Surface Transport For London), or
- Private organisations under demanding Contracts/Clients (example: Connect Plus), or
- Organisations dealing with large and complex asset portfolios (example: Connect Plus, Egis Road and Tunnel Operation Ireland-ERTO).



There appears to be a trend for the implementation of an ISO 55001 compliant AMS to be incorporated in an increasing number of public or public-private road concession/operation Contracts. To be prepared for this, puts an organisation in an advantageous position.

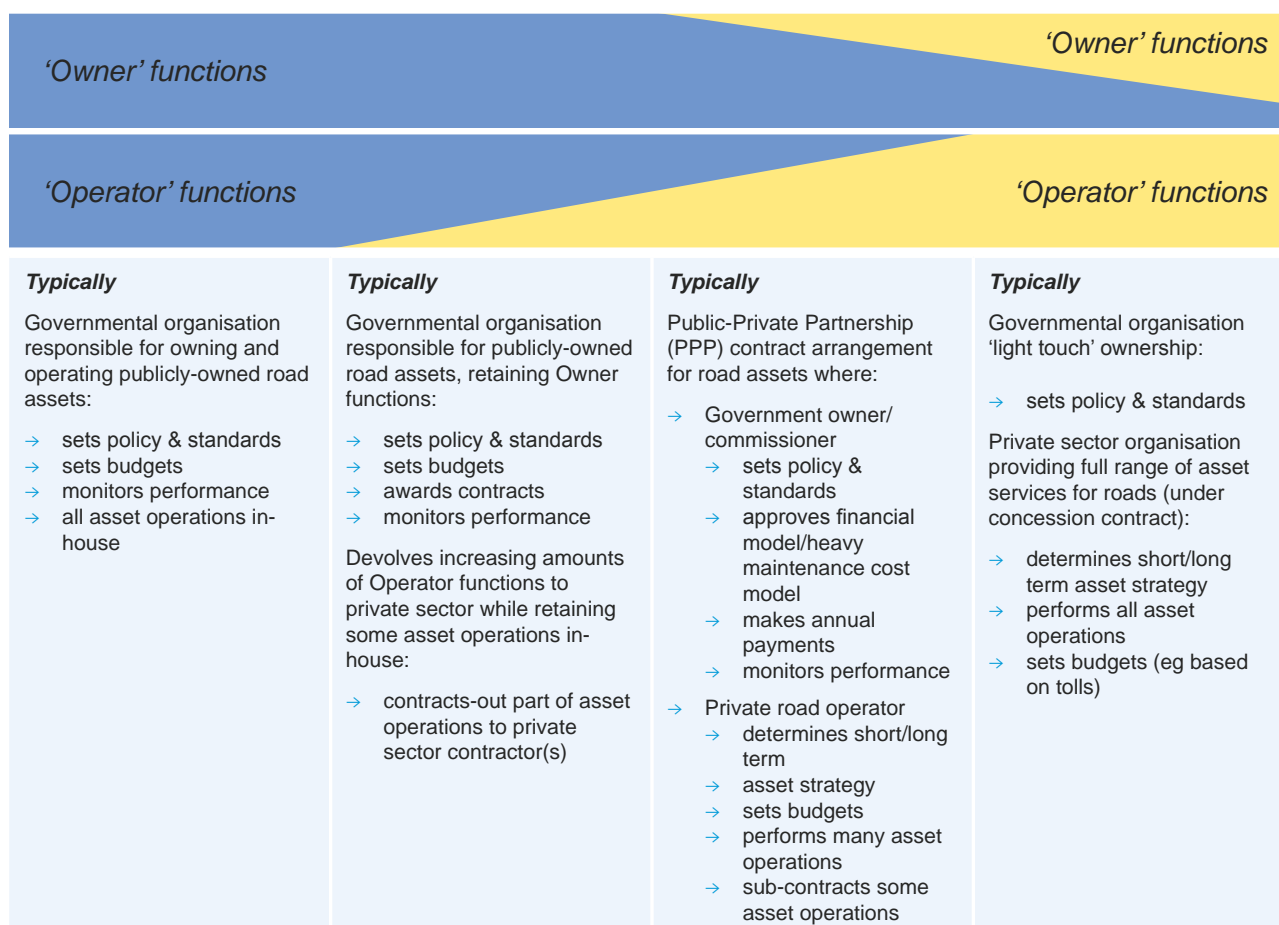


From the AM perspective one key characteristic of many road concession contracts is that the AM process is not under the responsibility of a single organisation. Also, an external organisation (rather than the asset owner) might only be responsible for part of the asset lifecycle. In most cases, the asset owner/concessionaire/operator is not in charge of all AM activities and the certification of the end-to-end AM process may require the agreement of two or three organisations stakeholders of that decision (eg grantor, concessionaire, operator, etc). These delivery responsibilities are shown in Diagram 1. Because no two organisational or contractual situations are the same, it is helpful to view this as a 'sliding scale' of responsibilities. This sliding scale would need to be reflected in the overall asset management systems adopted by the respective organisations, which it is then necessary to map onto ISO 55001 if that is adopted as the 'guiding standard'.

Diagram 1

*Delivery Responsibilities of the Asset Management Organisation
Asset Owner vs Operator – 'Sliding Scale'*

KEY ■ Government sector (blue) ■ Private sector (yellow)



Despite the different business perspectives, such agreement between asset owner and service providers, concessionaire or operators will be easier to setup and implement if all AM requirements are clearly defined and established under ISO 55001 principles at the tender phase.



Good communication is essential between the responsible organisation(s), stakeholders and outsourced service providers from an early stage in establishing and documenting roles and responsibilities. This will make the journey into a combined ISO 55001-compliant system much easier, helping to avoid duplication and 'gaps'.

Given the complexity and degree of outsourcing in many road-asset owning organisations, it is tempting to consider the possibility of only making parts of the AMS compliant; this is not possible under the approach adopted in the suite of documents that form the organisation that has decided, or needs to be certified under ISO 55001. This can be an initial step. It can be problematic getting the whole scope certified at once and it involves more resource and risk. Also issues when asset management system ownership is divided up between renewals, O&M and improvements. This is not the intention or the spirit of ISO 55000 standard. In the guidelines for application of the standard (ISO 55002) it is clear that the whole end-to-end process forms the AMS and therefore becomes the scope of the system being matched to the requirements of ISO 55001.

**GO TO END
OF SECTION 3.2**

The concept of ensuring alignment and consistency between the organisational objectives, the asset management policy, the SAMP, the asset management objectives and the asset management plan(s), should reinforce within the organisation that asset level activities support the delivery of the organisational objectives.

ISO 55002 para 4.1.13

In the road sector an organisation moving towards the implementation of an ISO 55001 compliant AMS, should consider including in its outsourcing contract/tender requirements, the provision of strong evidence not only of the relevant maturity of an existing supplier but also of its business management maturity and performance culture. Since certification will be sought by the organisation responsible for the asset management overview and system, it will be up to that organisation to ensure that suppliers make a relevant and consistent contribution to meeting their organisational objectives, and thus also contribute to the successful implementation of the AMS.

A move towards ISO 55001 compliance will be understood by the market as a clear message that "Our organisation wants to increase the value for money from the assets under our responsibility, through an effective and efficient AMS that provides assurance that the existing objectives can be achieved consistently and sustainably over time. We are reliable asset managers!"

If your organisation is in that situation, congratulations! You have already realised that asset management has a strong impact in your business model.

Asset management does not focus on the asset itself, but on the value that the asset can provide to the organisation.

ISO 55000 para 2.4.2

4.3 STAKEHOLDER ENGAGEMENT AND COMMUNICATION



Effectively engaging and communicating with stakeholders is one of the most important aspects of the AMS. It is also a crucial element within ISO 55001, and a vital input to developing a Strategic Asset Management Plan (SAMP).



Case studies examples:

Transport for London (TfL) – already identify the need to improve the planning and management of the communication about assets, its management and the AMS to relevant staff, suppliers, third parties and stakeholders. They have already established a Customer Experience team, surveys, monitor of Twitter feeds, but acknowledged that the communication with suppliers needs to be more proactive.

Connect Plus – a more structured approach is being considered to ensure/demonstrate that its staff, suppliers and delivery partners are aware of the asset management framework and objectives. BS 11000 supports collaboration and communication with the Supply Chain. Nevertheless suppliers are briefed through a quarterly forum (supplier days) and staff are briefed in a more 'ad hoc' fashion through meetings and when requested. There are also other forums (R&D, Safety, Emergency services, Residents and businesses local to schemes, as well as neighbouring networks) and publications in place.

The effective engagement of stakeholders in a highways AMS relies not only on having an effective communication process, but also on the ability and willingness of different organisations to align strategies and objectives.



A good understanding of internal and external stakeholder expectations and requirements will drive the whole AMS, from top to bottom, and is therefore a key starting point.

Implementing an effective communication process within an organisation and with the organisation's stakeholders is not an easy task, but needs to be done if you want to 'harvest' the AMS benefits.



The AMS benefits are enhanced if the organisation has deeply embedded an AM policy/strategy which relies mainly on the capacity of the organisation to ensure that every individual in the organisation perceives AM as the assurance of good investments with positive long term benefits.

For the wide range of organisations involved in road maintenance and projects, their business models often differ completely, and the communication process between stakeholders is not yet fully adapted to and in line with ISO 55001 principles. It is still a work in progress.

What is clear however is that an AM communication process will be effective if:

- It ensures a common understanding, between and within all stakeholders of an organisation, on:
 - What an AMS is, its purpose/objectives and the necessary resources for its implementation and success?
 - How it could impact the performance of the project/business, its scope and objectives?
 - What are the expected roles/contributions of everyone within the AMS for it to be successful?

A by-product of success in this area is that organisations could profit from the effectiveness of team cohesion, involvement and alignment toward common objectives which:

- Facilitate/promote cross functional working
- Allow an updated perception of stakeholders' needs and expectations
- Contribute for an efficient change and risk management processes
- Allow the gathering of accurate data/information for AM purposes.

Highways England, UK treats the communication plan as a 'project' with 2020 target date. Until then they have several actions including newsletters and communications about the management plans.

4.4 LEADERSHIP

Leadership has a strong impact on how the organisational culture is built, its type and if it supports the delivery of good AM.



Although the quality of an organisation's leadership, experience and competence on AM are not aspects easy to perceive from answers to a questionnaire, it is a key factor, not only for the implementation of an AMS but also for its continued successful operation.



From the case study analysis of the case studies we concluded that the eight medium to large organisations have all planned their investment in AM aspects of their organisational structure. This alone will not guarantee that AM is considered at all levels of an organisation so it is important to also consider whether the existing leadership can demonstrate business management competencies and if they cover all competences which include AM aspects.

Even in road and highway organisations it should not be assumed that there is AM awareness at Board level. This aspect was identified in this project as a critical success factor.



To ensure AM success in a roads business it is essential to have management leaders committed, with leadership capacity, experience and competency with regards to AM.

Often the lack of AM competences at a managerial level is only identified by organisations as a problem in the medium to long term, when negative indicators are achieved, or the positive results are rare or inexistent and when it takes longer to change.



Competent AM leadership is imperative, because AM must be supported within the organisation at top/senior management level in order to be possible to implement, operate and improve the AMS.

4.5 AM POLICY AND OBJECTIVES



The existence of an AM policy and objectives in the road service industry seems to be essentially triggered and controlled by contract requirements, rather than by business analysis/evaluations. Road-owning organisations (mainly public bodies) are more likely to have a top-down set of policy objectives driven by stakeholders and the general public.



It is likely therefore that organisations that are contractually obliged to have an AM policy, strategy and coherent objectives for the complete AM end-to-end process, are working on those aspects, or have them already in place.

The percentage of organisations that have invested in, or are investing in deciding to implement an AM policy and strategy that could make their business more profitable, without being forced to do it by contract, is still marginal.

In order to establish an AM policy and strategy and objectives, an organisation should also evaluate:

- The relationship between the AM policy and objectives and the organisation's overarching corporate policies
- That the AM policy and objectives are adequate for the purposes of a profitable business, without neglecting the compliance of the applicable regulations
- If the AM policy and objectives are written in a way that is clearly understood by all the participants in the AMS, including the definition of how the actions of each individual in the organisation's structure will contribute towards its achievement/success; setting goals that are relevant at each level in the organisation is important, but should retain transparency of how they link high level objectives
- If the organisation has the necessary resources and competences to achieve the defined objectives.



For an organisation capable of defining and implementing an AM policy, strategy and objectives that could be positive for the business, a basic rule is to involve a competent and experienced AM leader in that process and ensure line of sight and integration with wider organisational objectives.

By following the main principles of ISO 55000 standards for an AM policy – consistency, appropriateness, commitment, framework and communication – together with an aligned strategy and objectives, any organisation working in the road business (Grantor, Concessionaire, Operator, Contractor, etc.), should be capable of maximising the value that the assets provide in meeting the stakeholders' and asset owners' aspirations and objectives.

4.6 AM PLANNING



Within this topic it is important to identify the differences between the concepts of AM strategic planning and AM planning.



According to 'An Anatomy of Asset Management', version 3 – published by the IAM, December 2015):

- Strategic AM planning aims to establish AM objectives and develop the AM strategy, for example, the processes for determining long-term renewals, enhancement and maintenance work volumes and associated risks and costs to meet the AM objectives. It is usually undertaken as part of the overall organisational strategic planning process. A key document produced at this stage is the SAMP.
- AM planning concerns the activities to develop the AM plan(s) that specify the detailed activities, resources, responsibilities, timescales and risks for the achievement of the AM objectives. It follows on from the strategic planning process.

A SAMP is the documented information that specifies how organisational objectives are to be converted into asset management objectives, the approach for developing asset management plans, and the role of the asset management system in supporting achievement of the asset management objectives.

ISO 55000 para 3.3.2

What was found from the case study analysis was that AM planning is an activity performed by all the organisations, at different levels of details, even if it has different characteristics and it is governed by different business needs.

Case studies examples:

Connect Plus – there is a rolling annual, 5 and 30 year plan developed annually. In these plans the Lifecycle Cost (LCC) concept is used and the duration of contract and long term Handback tests are part of the analysis. Additionally, Connect Plus prepare an Annual Asset Management Plan summarising works carried out over the past year versus planned works.

Egis Road and Tunnel Operation Ireland (ERTO) – they developed generic Asset Management Plans individually for each project area (Dublin Tunnel, Jack Lynch Tunnel and Motorway Traffic Control Centre). The documents provide a planning framework and address specific requirements included in the contract agreement for development of AM Plans. Additionally, ERTO have developed, and maintain, Annual Asset Management Plans for each system/asset group, and submits them annually to the Service Manager (Client's representative) for approval.

Regarding strategic AM planning, the case studies showed that this is something that only the organisations already certified, or on the road to certification, have or are implementing.

General case study observation:

Road organisations (except some Road Administrations) are not yet used to, or convinced of the value to the business, in performing a structured and strategic AM planning aligned and coherent with the overall organisation strategy, unless they decide, or are obliged to move towards a certification process.

4.7 PEOPLE AND TRAINING

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Because it is people that perform the asset management function on the ground, their knowledge, competences, experience, motivation, teamwork capacity, alignment with objectives and attitude (proactive/passive), have a huge impact on the AM outcomes.

The conclusions of this project showed that human resources are a key area of concern of the participating organisations, because mainly those who already have the ISO 55001 certificate, or are on the road to the certification, are aware of the requirements for strong governance and staff competences to be in place and consistently demonstrated. This is particularly true in the case of road organisations that have extensive outsourcing operations.

Tools and technologies are important: but engagement of the workforce, clarity of leadership, and collaboration between different departments and functions are the real differentiators of a leading AM organisation.

*An Anatomy of Asset Management,
version 3 – IAM 2015*

Case studies examples:

M25 DBFO – The Asset Management business process runs across two companies: DBFO (Connect Plus) and O&M Co (Connect Plus Services). Connect Plus has 10 Asset management staff (includes investment, technical and commercial/procurement); Connect Plus Services has circa 100 staff which it considers as asset management (these include asset teams, inspectors, commercial, in house designers, AMS-IT, project managers and works supervisors).

Balfour Beatty Mott MacDonald (BBMM) – There are 26 Asset management staff in the core team in one contract Area 10. There are significant operation and maintenance activities outsourced to the supply chain:

- Schemes (90%)
- Asset Maintenance and Operational Requirements (AMOR) (c.15%)
- Design (50% including in-house partner Mott MacDonald).

It can be observed from the case studies that if organisations organise and allow their internal AM workforce to participate at appropriate and frequent training sessions, performed by qualified and experienced trainers and focused on the improvement of AM skills, it motivates, improves operational knowledge and competences, and allows the opportunity to align with an organisation's AM strategy and objectives. It also integrates cross departmental teams.

In the case of AM outsourced services and as a pre-requisite for the start of the activities, it is highly recommended to demand the participation of all external teams to undergo introductory AM training to align with outsourcing organisation. The main purpose of this training is to align the external workforce with the *implemented AM objectives and practices* and its complexity will vary depending on the complexity of the works to be performed and their possible impact on the AM strategy/objectives.

In the event that the outsourced services/activities have an impact on achieving an organisation's AM objectives, the associated risks shall be assessed and those activities/processes controlled.

4.8 DATA AND INFORMATION



The performance of an Asset Managing organisation is strongly dependent on the quality and availability of asset data and information. This was a major concern for the organisations surveyed in this project because all of them deal with significant and highly complex physical asset portfolios. Most published literature on Asset Management makes extensive reference to the importance of the subject of data and information management, including previous reports² and recent work carried out within CEDR³.

As part of its Asset Management System, and therefore within its SAMP, the organisation should address not just the question of the data it needs to support its business, but also to question the ownership, governance, quality assurance and change management.

Effective Data Management results in:

- Better data quality
- Improved service quality
- Greater responsiveness to change
- Cost savings
- Improvements in cooperative working
- Co-ordinated service provision across organisations
- Employees better equipped to take decisions
- Faster and more cost effective system development

*Data Management for Road Administrations,
A Best Practice Guide, v 2.0, WERD, 2003*

An organisation should determine its information requirements, to support its assets, AMS and the achievement of organisational objectives.

ISO 55001 para 7.5

² *Data Management for Road Administrations, A Best Practice Guide, v 2.0, WERD, 2003*

³ *Management; Draft Report of CEDR Task Group N2, v1.1, November 2015*

Asset data should be accurate, complete, consistent, valid, on time and unique. Consideration may need to be given to ISO8000 concerning Data Quality, but certainly ISO 55001 (para 7.5) provides further detail on more detailed considerations, for example:

- Identifying data risks
- Allocating data roles and responsibilities
- Information exchange requirements
- Impact of quality, availability and management of information on decision making
- Data attributes required
- Data quality requirements
- How and when information is to be collected, analysed and evaluated
- Information management processes
- Alignment (consistency) of terminology
- Consistency and traceability of data in respect of legal, regulatory, stakeholder and organisational requirements and objectives.

Consequently the subject data/information for AM purposes should be approached from three perspectives:

- **Acquisition process:** key parameters to collect/measure that support implementation of strategy and decision making criteria; measurement equipment accuracy; data acquisition/analysis methodology; measurement/acquisition conditions (weather, luminosity, etc.); data format (particularly when outsourced).
- **Analysis and storage process:** significant asset portfolios generate big amounts of data/information that needs to be analysed and stored in a way that supports easy and efficient access. For this purpose it is widely recognised in the industry that there is benefit to be gained from implementing a comprehensive and integrated Asset Management Information System (AMIS).
- **Quality Assurance approach:** verification audits, QA included in suppliers' contracts, system reports to identify gaps and discrepancies.

An effective AMIS should support an organisation with relevant AM processes and activities, such as asset inventory, planning, identification of repairs and maintenance needs, investment modelling, storage and spare parts management, road space booking, management of assets condition monitoring (inspections, tests, monitoring devices), routine maintenance, major repairs, etc. Above all it should allow the storage and management of all assets related information in an integrated way. The subject of Data Quality is another example of an area of business which has an ISO standard applicable to it; ISO 8000 Data Quality was published in 2011.

It may be particularly said to be true in the road industry that a user-friendly and effective AMIS should be accessed and visualised spatially to have a cross asset view and document asset performance. For example, the information/data regarding accidents that occur in a specific road section (including weather conditions and consequences), the surrounding environment and topography, the road geometry itself, pavement surface parameters and drainage conditions on that section, when seen graphically make multifactor analysis easier and more intuitive.

Deciding on the best solution for an AMIS will depend on the organisation's AM strategy and resources, and, to some extent, legacy systems. The power in modern IT systems allows near real-time multifactor analysis to identify alternative intervention strategies – leaving more time for the asset experts to consider options and optimise action plans within budget constraints.

Depending on the organisation and the complexity of their assets, the implementation of an AMIS could require significant investment (both upfront and on-going) and it could be a huge task and difficult to implement in a single stage, therefore some organisations have decided to do it in prioritised planned stages over a period of time.

For example, Highways England's key enabler of the new AM approach will be a comprehensive and Integrated Asset Management Information System (IAM-IS). This will be introduced in stages over the next five years, adding one asset type after another as they gather improved data and the associated sub-systems come online.

4.9 RISK MANAGEMENT



The eight organisations surveyed seem to be familiar with the identification and management of the major AM risks and their possible consequences. This may be because of the general emphasis and high profile of risk assessment in road construction, in particular, which is now being translated across into AM activities. Adopting a risk-based road inspection regime can also bring direct efficiency savings by allowing priority for repair to be based on risk of failure.

Several categories of risks that could possibly affect AM were identified (eg physical, resource, environmental, political, operational) and the major concerns of organisations were specific risks such as: non availability of resources (human and financial), not having adequate AMS-IT support tools, lack of AM awareness at Board level, poor quality of AM data/information, major accidents/incidents, failures on the management of outsourced activities, weaknesses of communication processes and the potential impacts of climate change.

Risk management is an inherent part of ISO 55001, namely that asset management related risks must be considered in the organisation's overall risk management approach including contingency planning (see clause 6.2.2). Further guidance may be found in the companion standard, ISO 31000:2009. It seems from our investigations that formalising this aspect of the AMS is work in progress for many of the organisations on the road to certification.

The idea that risk management creates and protects value for the organisation already exists in the road industry and it is embedded in many AM activities. The management opportunity is less with a structured/developed organisation compared to risk, but still important for supporting a long term approach.

When planning how to achieve its asset management objectives, the organisation shall determine and document [inter alia]:

- Actions to address risks and opportunities associated with managing the assets, taking into account how those risks and opportunities can change with time, by establishing processes for:
 - Identification of risks and opportunities
 - Assessment of risks and opportunities
 - Determining the significance of assets in achieving asset management objectives
 - Implementation of the appropriate treatment, and monitoring, of risks and opportunities.

The aspects of risk management that will continue to require some effort from road organisations that want to achieve ISO 55001 certification, are:

- How to implement a structured process to identify and assess risks and opportunities associated with managing assets, and consider how these can change with time
- How to manage the implementation of the appropriate risk control and to monitor risks and opportunities in an integrated process which aligns with the organisation's overarching risk management approach including contingency planning
- Focus improvement and change on key system aspects (otherwise would be too vast). A system approach leads itself to cycle improvement.

4.10 IMPROVEMENT AND CHANGE MANAGEMENT



Monitoring and continual improvement is embedded in all ISO standards. The case study analysis shows that all eight organisations have already moved through to certification in other ISO management systems (eg quality, health and safety, environment, etc.) and therefore improvement and change management is a generally implemented practice.

Nevertheless, the effective application of an improvement and change management approach to the management of assets is still a challenge for road organisations, because there are many unpredictable changes impacting on AM results, such as new legislation/regulations, new technologies/processes, loss of experienced staff with relevant knowledge of ageing assets, accidents/incidents with significant consequences, etc.

A good example of this challenge is that although most of the organisations we contacted considered applying a 'Lifecycle Cost (LCC)' approach to the management of their assets, what we generally found for the road sector is that the results/conclusions of this approach often do not reach an operational level (routine maintenance and repairs management) within the organisation. This means that despite being a good management exercise, the practical consequences of it still need improvement.



The capacity of an organisation to really benefit from the implemented AMS and ensure continuous improvement and change management, requires a high level of management and technical skills/competences, only found in highly mature, innovative and flexible organisational structures.

4.11 SUMMARY AND CONCLUSIONS



Concluding the evidence given by the case study organisations and also from the experience of the project consortium, we can draw the following lessons. The initial costs of adopting a new system are mainly due to the fact that, in many road sector organisations, there is a lack of 'AM culture and experience' at the top management level. As a consequence, AM on road projects is generally not approached in an integrated way, but rather focuses only on a few aspects of the AM process. Consequently the budget for developing AM is, in most cases, insufficient to fund the resources (human and financial) necessary to implement all the required processes and to integrate the complete and necessary set of asset data and information on the decision making process.

It can also be summarised that the important areas to invest in to implement an AMS compliant with ISO 55001 are:

- Development and alignment of processes and procedures to plan, implement, review and maintain the AMS
- Having the necessary qualified and competent resources to plan and manage the assets over the whole lifecycle, led from the top tier in an organisation
- Implementing an effective AM communication process between the relevant stakeholders
- Improving the competencies of the people involved at all levels
- Implementing and maintaining a suitable enterprise asset management system that fulfils business needs supporting the actions (repairs and maintenance works) that the AM processes will identify as necessary, considering all Lifecycle Cost (LCC) aspects and Contracts requirements
- Improving data in a way that better supports decision making
- Implementing a risk based approach to all AM decisions
- Ensuring a continuous improvement and change management process.

It seems appropriate to believe that, if an organisation has already invested (or plans to invest) relevant resources to implement such an AMS, the marginal extra cost to that process of applying for ISO 55001 certification, would make business sense. At least one example of this is given in Appendix 1, namely Durham County Council.

The perspective of ISO 55000 certification depends on the Road sector organisation: Road Authority, Motorway Concessionaire or Maintenance Operator. The end-to-end asset management process runs across all these organisations and needs inputs from each even if only one organisation is pursuing certification (each can be certified independently). Examples include:

- Road Authority, focusing on Policy
- Concessionaire, focusing on asset monitoring and performance, and also on delivery when the Operator is only in charge of routine maintenance
- Operator, focusing on the actual delivery of asset management as opposed to monitoring of performance.



Road Administrations are less flexible to move towards certification or are not attracted to this type of standard because they have to deal with a number of different contractors.

The benefit of certification increases with the degree of involvement of the Road Administration, on a sliding scale (see Diagram 1 in Section 4.2) between carrying out maintenance using in-house resources to complete outsourcing.

For a Public Road Administration/Asset owner managing their supply chain through a performance contract, the benefit could be marginal, essentially by having reassurance that their contractors are complying with it but not improving the overall value of the assets.

Implementing ISO 55001 requires an investment in a high level of awareness/knowledge about:

- How the ISO standard approaches asset management and an asset management system
- What are the gaps between the organisation's AM process/system and what is required by the standard
- The need for senior-level buy-in from the outset
- What are the necessary investments to close the gaps
- What are the expected benefits from implementing ISO 55000.

With that knowledge, a business case can be made, and a project established to implement the asset management system, with a timescale and a budget.





5 IMPLEMENTING AN ISO 55001 SYSTEM IN YOUR ORGANISATION



This section sets out how you could introduce the requirements of ISO 55001 into your management system, and implement it in order to derive value from your asset operations. It follows an asset activity flow structure with three implementation owners; policy maker, asset manager and asset operator. Whether you wish to adopt specific ISO 55001 elements to add to your existing asset management system or adopt the complete set of ISO elements and achieve ISO accreditation is up to each organisation and their business drivers.

You may decide to start by setting up a generic AMS, based loosely on ISO 55000 principles. You may decide to start, from the outset, with the intention that your new AMS fully complies with ISO 55001. Or you may use your existing generic AMS and reverse-engineer it to meet ISO 55001 requirements. Each will carry its own resource needs and costs, and will be delivered in different timescales.

There are some fundamental 'do's' and 'don'ts' for each route to ISO 55001 that the owner will need to consider, as these determine how successful and quickly benefits can be embedded into your organisation. This is not intended to give you the complete answer but raise some valid learning points from those organisations we have talked to. You may also find the '18 Steps' identified in the recent CEDR Asset Management Draft Report useful⁴.

Appendix 3 presents, in tabular form, a cross reference between the ISO 55001 requirements, the ISO 55002 guidance, and notes about the application within a highways context. You may want to turn to this at regular points as you read through this chapter.



⁴ Asset Management; Draft Report of CEDR Task Group N2, v1.1, November 2015

5.1 DEFINING YOUR ISO 55001 ORGANISATION AND ROLES

It is important to recognise that ISO 55001 defines the asset system within an organisation but not how the organisation manages or derives value from the system. It is also based on a matrix approach, combining lifecycle activities (horizontal elements) with strategy, planning and operations (vertical elements). Where each element intersects requires organisational ownership and an appropriate set of skills/competences. The diagram below shows the three roles of Key Policy Maker, Manager and Operations together with their responsibility for the seven ISO elements; either a primary ✓ or supporting (✓) secondary responsibility.

Each role requires strong ownership to derive maximum value from their sphere of influence. It is acknowledged that in some organisations these roles may be combined to satisfy staff manning constraints. Where this is unavoidable it is important to have clear outcomes and ownership for each ISO element.

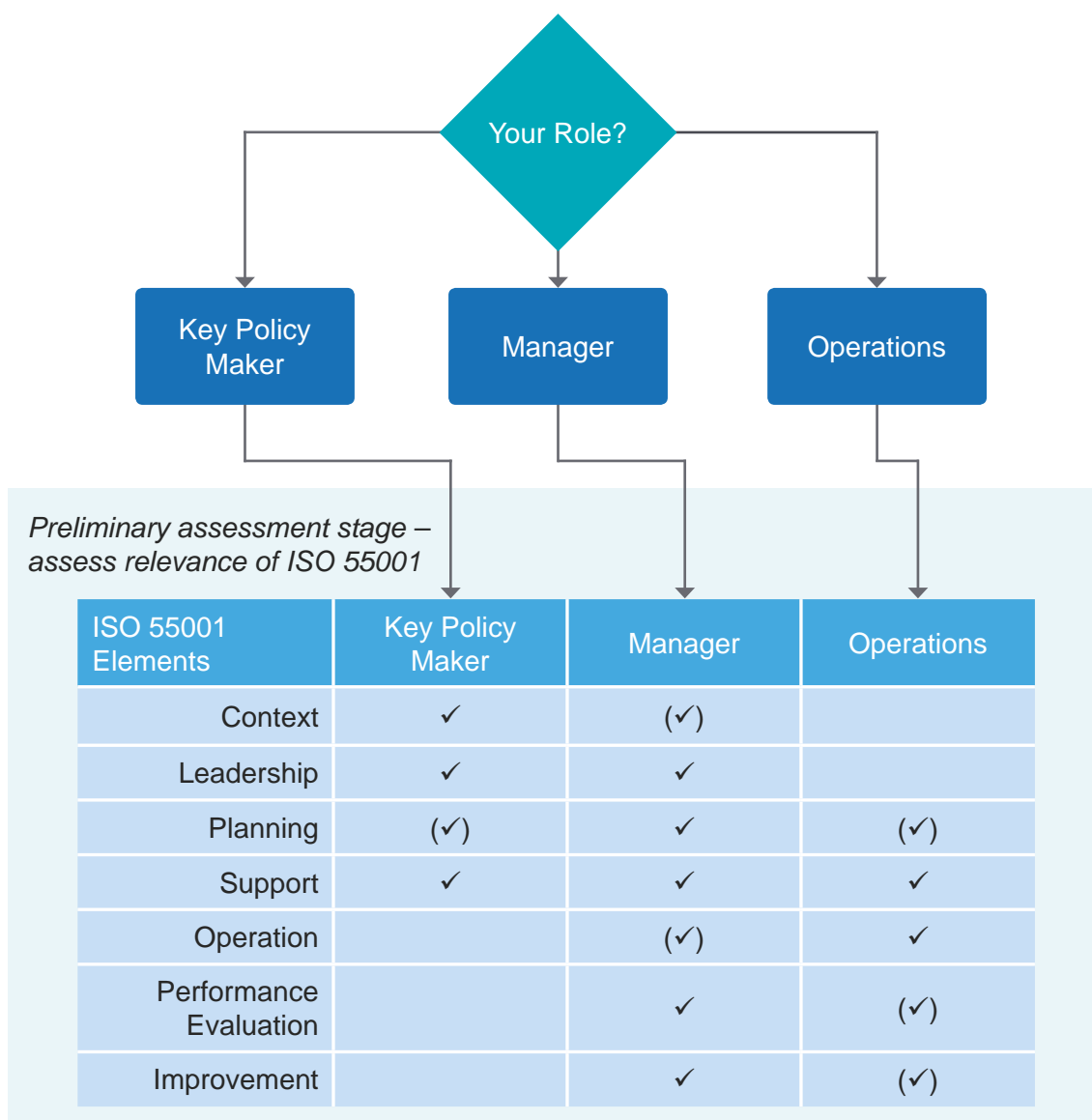


Diagram 2a

Note that the ISO 55001 definition of support includes resources, competence, awareness, communication, information requirements and documented information.

It is important to recognise that ISO 55001 requires engagement with asset system stakeholders such as the supply chain, adjacent highway Administrations and environmental authorities. Managing these relationships is carried out differently in highway organisations: some appoint dedicated stakeholder managers, for others it is managed by peer relationships at the three functions of policy, management and operations.

5.2 MAPPING YOUR ISO 55001 MATURITY JOURNEY

Each road organisation will start their ISO 55001 maturity journey at a different level. Some organisations may already be accredited to PAS55 and others may have developed an in-house asset management system. It is therefore recognised that not all organisations wish to gain ISO 55001 certification but instead only align their asset management system with ISO principles. The diagram below suggests the minimum set of activities which will allow an organisation to develop an integrated asset management system and to derive value from its assets.

Making the decision to achieve ISO 55001 certification is shown as a separate activity which not all road organisations will follow. The inputs and outputs of these activities will be the key documents, processes and decisions that form the asset management system requirements of ISO 55001. These activities should also be part of a formalised continuous improvement framework of reviews that document lessons learned to improve the asset system.

Four activities have been highlighted which are considered on the road to achieving ISO 55001 compliance and should be the responsibility of the core asset management team within the road organisation.

- Reviews:
 - Current policies
 - Current processes
 - Current practices
- Undertaking a gap analysis. This will confirm the current level of an organisation's maturity comparing the current asset system to its aspirations. Standard toolkits such as the SAM (Self-Assessment Methodology) produced by the Institute of Asset Management may be used to assist this process specifically with reference to the ISO 55001 standard. The output is a future action plan to enhance maturity.
- Business case, resource and road map
- Managing change and communication. It is important that the asset team manage the approved asset system change activities against agreed outcomes in order to derive the expected value from an organisation's assets.



The Journey to Maturity

```

graph TD
    A[Review current policies] --> B[Future objectives/  
demand]
    C[Review current processes] --> D[Undertake Gap Analysis]
    E[Review current practices] --> F[Review asset knowledge]
    F --> G[Review asset lifecycles]
    B --> D
    D --> H[Consider options/plans/  
resources]
    H --> I[Plan/Manage Change]
    I --> J[Implement Changes and  
SAMP]
    J --> K[Manage Asset Portfolio]
    K --> L[Certification Audit]
    L --> M[Continuous Performance Review]
    M --> G
    M --> N[Decision Point-Drive Change]
    N --> I
    O[Engage Stakeholders] --> B
    O --> J
    O --> L
    P[Develop a SAMP] --> J
    
```

The flowchart illustrates the journey to maturity, starting with three parallel review activities: 'Review current policies', 'Review current processes', and 'Review current practices'. 'Review current policies' leads to 'Future objectives/demand', which then feeds into 'Undertake Gap Analysis'. 'Review current processes' also leads directly to 'Undertake Gap Analysis'. 'Review current practices' leads to 'Review asset knowledge', which then leads to 'Review asset lifecycles'. 'Undertake Gap Analysis' leads to 'Consider options/plans/resources', which then leads to 'Plan/Manage Change'. 'Plan/Manage Change' leads to 'Implement Changes and SAMP', which then leads to 'Manage Asset Portfolio'. 'Manage Asset Portfolio' leads to 'Certification Audit'. 'Certification Audit' leads to 'Continuous Performance Review'. 'Continuous Performance Review' leads back to 'Review asset lifecycles' and also leads to 'Decision Point-Drive Change'. 'Decision Point-Drive Change' leads back to 'Plan/Manage Change'. 'Engage Stakeholders' (a specific action) leads to 'Future objectives/demand', 'Implement Changes and SAMP', and 'Certification Audit'. 'Develop a SAMP' (another specific action) leads to 'Implement Changes and SAMP'.

Diagram 2b

Another view of how ISO 55000 links together an Asset Management System with enabling and control processes, as well as the resources needed in support is shown in diagram 3 below.

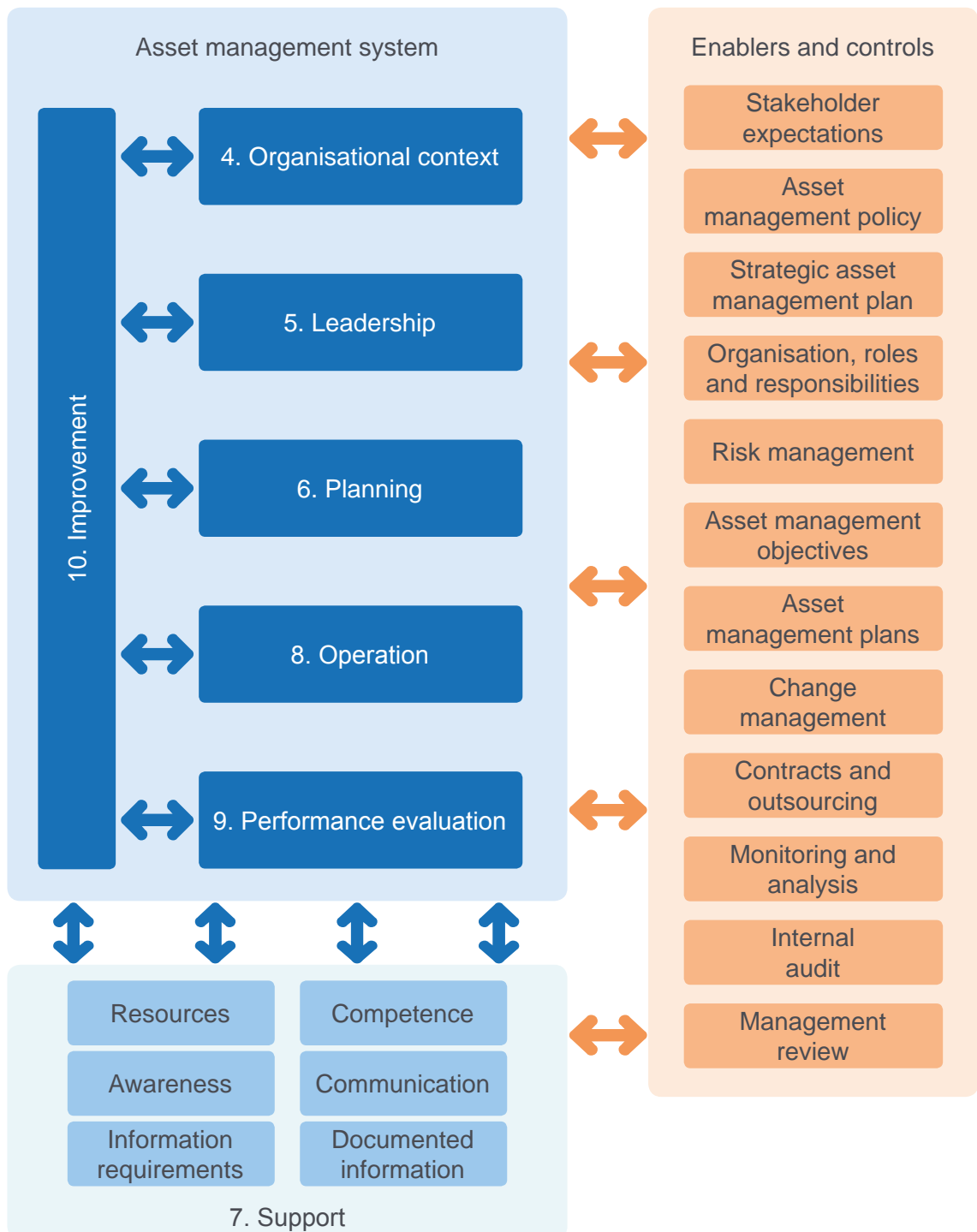


Diagram 3

Each set of implementation activities are described in further detail below and grouped under the key roles of policy, management and operations, preceded by some general implementation activities.



5.3 IMPLEMENTING THE REQUIREMENTS OF ISO 55001 – GENERAL ACTIVITIES



Table 3

ISO Maturity Activity	Value Outcome
<p>These are general and preparatory activities that are necessary for a road organisation to implement its maturity journey and gain credibility and commitment. They include:</p> <ul style="list-style-type: none"> → Securing senior buy-in → Setting up the change management team and assigning responsibilities, budgets etc → Preparing and monitoring the AMS roadmap and change activities in order to set the direction of the road organisation, align the organisation with asset management thinking, develop the AMS and necessary processes and tools → Setting up and monitoring the change risk register → Insider awareness training in parallel. 	<p>The road organisation has an effective and accountable change management team with clear responsibilities and approved change budget.</p> <p>There is an approved roadmap with linked change activities. Each activity has an owner, input, output, duration (incl. cross department).</p> <p>There is a populated risk register and programme of regular reviews.</p> <p>Change activities are clearly communicated within the road organisation.</p>
Think about	Try to avoid
<p>Who the most appropriate road staff are to implement the change. Do they have the right skills or do they need additional training.</p> <p>Developing a delivery road map based on aspiring to levels of service and performance delivery.</p> <p>Document your change process and including stage gateways and reviews to reflect on progress and gain endorsement for each stage.</p> <p>Aligning the asset risk register and analysis approach with the corporate risk approach so that portfolio analysis can be carried out and existing tools and training can be used.</p> <p>Communicate your change successes and use these to embed wider asset management knowledge in your road organisation.</p>	<p>An unclear mandate for change as it will make asset management embedment more difficult.</p> <p>Don't make the change process too complicated as it will require excessive management.</p> <p>Insufficient resilience in your change team.</p> <p>Consider staff succession planning to mitigate programme delays due to team changes.</p>

Case study notes	ISO 55002 Ref 4.x, 6.1, 7.2, 8.2
<p><i>Connect Plus operates the M25 network in the UK under a 30 year PPP contract. Following award it mobilised and developed a road map to implement its AMS within two years. This includes anits Asset Management Framework (Objectives, Policy, Asset Category Strategies), asset management objectives which are linked to Project Road Objectives (the overarching objectives our client is trying to secure from the project) and renewals investment cycle.). There is a rolling annual, 5 and 30 year plan published annually aligned to the asset delivery strategy and hand back criteria. It is distributed internally, provided to shareholders (through a briefing), reviewed by the client and provided to banks/lenders.</i></p> <p><i>The AASHTO TAM guide presents a business model approach to developing an AMS. this poses five core questions related to current asset state, levels of service and performance delivery, criticality, investment strategies and funding requirements.</i></p> <p><i>The 2015 CEDR Task Group N2 committee interim report distinguishes between European road agencies that have used a formal process to develop a high degree of asset system components and use specific aims and objectives with measurable milestones, and those with some components in place but without clear policy direction. The report also suggests that a third of CEDR members have an asset management system although this includes some systems where connectivity is not fully integrated.</i></p>	



5.4 IMPLEMENTING THE REQUIREMENTS OF ISO 55001 – ACTIVITIES FOR POLICY MAKERS

ISO Maturity Activity	Value Outcome
<p>These are activities for key policy makers to ensure that the AMS changes align with the road organisation's strategic policies, objectives and external factors such as the legal responsibilities and stakeholder commitments. They include:</p> <ul style="list-style-type: none"> → Developing the AMS business case and identifying costs and benefits, and measures for capturing and tracking them → Confirming the senior management team's commitment to developing your AMS → Securing cross organisational support → Reviewing and aligning the current road asset policy against your corporate vision and other policies → Reviewing the future operational objectives and transport demands to confirm the asset requirements and initiating a gap analysis process → Making an operational or investment decision based on options and investment plans and driving change → Directing continuous performance reviews. 	<p>Organisation has an Asset Policy that aligns with the corporate policy objectives for managing its road infrastructure and mandates the AMS.</p> <p>Senior road organisation management fully endorses the AMS and change programme.</p> <p>Proposed changes to the AMS reflect future operational demands on the road infrastructure.</p> <p>The investment case for change is based on optimised cost/benefit scenarios which can be monitored through benefits realisation.</p> <p>There is a programme of policy and business case reviews by road organisation senior management.</p>

Think about	Try to avoid
<p>The importance of asset management leadership empowered by an Asset Policy to drive strategic thinking, stakeholder management, risk management, and governance.</p> <p>A named senior management sponsor for your Asset Policy, AMS and change programme.</p> <p>An Asset Policy that is integrated with other organisational policies such as ISO9001, ISO11000, ISO14000, ISO27001 and ISO33000.</p> <p>An Asset Policy that is aligned to operational policies such as Planned and Reactive Maintenance and Severe Weather as well as internal enabling policies such as Communication, IT, Risk Management, staff Learning and Development.</p> <p>An annual calendar with defined reviews and approvals of AMS policy by senior management.</p> <p>A sequence of annual policy review process leading up to the approval date.</p> <p>A corporate Data Policy that includes standards for asset referencing, data dictionaries, data quality and validation and storage.</p>	<p>An Asset Policy that is not signed by senior management.</p> <p>Silos between road asset policy creators and operators.</p> <p>Conflicting demands between long-term asset management performance and short-term operational maintenance.</p> <p>Unclear governance in connection with outsourced tasks and operations and communication points.</p>
Case study notes	ISO 55002 Ref 4.1, 4.2, 5.x
<p><i>NATS has achieved ISO 55001 through delivering all the ISO elements, including the Strategic Asset Management Plan (SAMP) and a Tactical Operating Model, in its business planning cycle.</i></p> <p><i>NATS is working towards ‘shrinking’ the ‘line of sight’ from strategy to operations and increasing efficiencies. It is required by UK Government to produce a Service Investment Plan which includes benefits to service capacity(airlines), safety, environment, risk etc. the Business Plan also includes the AM Policy, AM Objectives, SAMP, AMPs and key business processes.</i></p> <p><i>ASFINAG has an asset management strategy which directly links to the company strategy.</i></p> <p><i>High level policies and/or objectives that inform or direct its implementation of asset management include:</i></p> <ul style="list-style-type: none"> → <i>Ratio of construction sites on the network</i> → <i>Safety of construction works</i> → <i>Safety of pavement (eg skid resistance)</i> → <i>Cost certainty (concerning construction site)</i> → <i>Annual profit.</i> 	

Case study notes (continued)	ISO 55002 Ref 4.1, 4.2, 5.x
<p><i>CP/CPS joint business case signed off for integrated assessment of both parties, reflecting the integrated nature of the system.</i></p> <p><i>In 2010, the national road Administrations (NRAs) of 13 European countries launched the BEXPRAC survey (Benchmarking of expenditures and practices of maintenance and operation) in an effort to benchmark the performance of their maintenance and operation (M&O) policies within the framework of the Conference of European Directors of Roads (CEDR). The benchmark was to be completed by sharing figures and best practices. The study considered:</i></p> <ul style="list-style-type: none"> <i>→ How to better justify budget allowances</i> <i>→ Deliver service levels and priorities within a fixed budget, defining performance targets and improving performance levels by sharing best practices.</i> <p><i>Durham County Council (UK) was the first local authority to achieve ISO 55001 accreditation through a staged process alongside ISO11000 (Collaborative Business Relationships). It had already achieved ISO9001, ISO14001 and ISO18001. It developed a Transport Asset Management Plan (TAMP) aligned to several internal and supporting strategies and plans including a Communication Strategy, Highway Maintenance Plan, resilience policies such as winter maintenance, customer satisfaction surveys, benefits realisation and best value reviews to promote savings and efficiencies, knowledge sharing and a procurement strategy.</i></p>	



5.5 IMPLEMENTING THE REQUIREMENTS OF ISO 55001 – ACTIVITIES FOR ASSET MANAGERS

ISO Maturity Activity	Value Outcome
<p>These are activities for asset managers working in a road organisation's asset team and who are responsible for tactical level delivery and translating policy into strategy and lifecycle operations. They include:</p> <ul style="list-style-type: none"> → Reviewing the current asset management processes and interfaces with other teams and stakeholders → Undertaking an asset gap analysis based on the future road objectives/demand and review of asset knowledge → Considering the road asset options and investment plans → Planning and managing approved operational or investment changes → Develop a Communications Plan → Managing continuous performance reviews and team capability/resourcing. 	<p>The road organisation has a core asset team with autonomy to deliver AMS change.</p> <p>An asset gap analysis is carried out that identifies the current maturity level and has prioritised costed improvement actions that are aligned with future road demands/objectives.</p> <p>The road organisation has a programme of planning and managing change to improve AMS maturity.</p>

Think about	Try to avoid
<p>Review of information requirements:</p> <ul style="list-style-type: none"> → Ownership → Data capture → Data Quality → Data Management. <p>When compared to the existing data in the organisation, the data gap analysis should be performed.</p> <p>Review of operational processes; to ensure they support:</p> <ul style="list-style-type: none"> → Risk based approach → Lifecycle analysis. 	<p>Duplication, out-of-date and inaccurate data (need to define criteria for each data type and the controls put in place to manage quality etc.).</p>
Case study notes	ISO 55002 Ref 4.4, 5.3, 6.2.2, 7.4, 7.5
<p><i>Highways England operates with 19 Guiding Asset Management Processes. These help the organisation to move from a traditional approach with maintenance standards and compliance to a new approach based on assets, customers and other stakeholders. They have also developed a proactive cross-asset based investment programme which balances stakeholder requirements eg safety.</i></p> <p><i>NATS operates a Business Management System (BMS) to manage the large number of stakeholders and communications. Internal AMS communications are scheduled through an Asset Review Board and assurance workshops. NATS has key role profiles with asset competences. Due to the complex asset infrastructure the legacy business had 47 asset managers. Due to the ISO 55001 process including breaking down silos and rationalising job titles there are now 5 key ‘asset managers’.</i></p> <p><i>ERTO’s contract requires full communication with stakeholders and to make this effective asset management documentation is provided to the AMS stakeholders.</i></p> <p><i>TfL operates with 500 staff that have AM duties and an Asset Investment team with defined roles and responsibilities for the implementation and support of asset management. AM competencies are defined in staff job descriptions. TfL ensures appropriate provision of skills and levels of competence to support the implementation of the asset management system through ‘role families’ these also define competencies and training requirements which are reflected in job descriptions. AM training is at 3 levels to match competence requirements of roles:</i></p> <ul style="list-style-type: none"> → Level 1 – intro to AM ½ day. For all in TfL business, approx 1,000 attended to date → Level 2 – principles of AM. 3 days. Suitable for IAM Certificate → Level 3 – 5 No. 2 day modules. Suitable for IAM Diploma. <p><i>TfL’s training programme has been a big success and ensures common understanding/language with respect to asset management.</i></p> <p><i>BBMM (UK) has 8 dedicated Asset Champions, each responsible for an asset group such as Pavements, Structures and Lighting. They develop an AMP which is reviewed annually by the Asset Group Leader.</i></p> <p><i>Each AMP contains the approach to collecting asset data through inspections and surveys, managing and analysing asset defects, scenario planning based on a risk-based approach, investment requests and tracking asset interventions such as planned and reactive maintenance, renewals and improvements.</i></p>	

Case study notes (continued)	ISO 55002 Ref 4.4, 5.3, 6.2.2, 7.4, 7.5
<p><i>Connect Plus Services M25 has 700 staff of which 100 are Asset management staff (includes asset teams, inspectors, commercial, in house designers, project managers and works supervisors). Job descriptions are in place for all roles, with required levels of AM competency. Training is identified as part of the annual Personal Development Reviews and the delivery teams are adjusted according to the scale of investment required through the Asset Management Forward Plan. Improvements could be made to how resourcing decisions are structured/documentated. CP/CPS also developed a bespoke AMS diagram for its project, which is used as context for briefing all teams (internal/external) on the importance of an end-to-end approach and the inputs of different teams on each other.</i></p> <p><i>Rijkswaterstaat uses an infrastructure management maturity model which focuses on organisational communication (internal and external), culture and leadership.</i></p> <p><i>The IAM's Asset Management Landscape (2014 2nd Edition) sets out the importance of people to implement an asset management system. It describes the role of key people enablers such as asset management leadership, supply chain management, organisational structure and competence management through training and qualifications.</i></p>	



5.6 IMPLEMENTING ISO 55001 – ACTIVITIES FOR ASSET OPERATOR

ISO Maturity Activity	Value Outcome
<p>Training and education of staff at all levels; obtain buy-in to concept that their actions affect the ultimate achievement (or not) of the organisation's objectives. Are stakeholder expectations understood and being managed?</p> <p>Review systems – including processes as well as IT systems; are they fit for purpose? Do they facilitate the necessary communication for efficient asset operations on the ground?</p>	<p>Operational efficiency savings.</p> <p>Minimisation of risks.</p> <p>Satisfied stakeholders.</p>
Think about	Try to avoid
<p>How to integrate road operations and planned and reactive maintenance activities with asset management planning to achieve mutual outcomes.</p> <p>Developing a set of operational processes which include measures to monitor ISO 55001 elements.</p> <p>Including the supply chain within process development.</p> <p>Including asset data updates as part of scheme completion requirements.</p> <p>Providing asset management and ISO 55001 principles training to operational teams.</p>	<p>Road organisation operational teams not communicating with the asset team.</p> <p>Making short-term operational decisions which do not save long-terms cost or add whole life value.</p> <p>Appointing outsourced supply chain partners on a majority cost only basis.</p>

Case study notes	ISO 55002 Ref 7.2, 8.x, 9.x
<p><i>ERTO has developed a Contractor's Plan which includes all document in a project library, structured at four levels:</i></p> <ul style="list-style-type: none"> → <i>Level 1 – high level management and governance documents (ie IMS Policy, IMS Manual, SAMP)</i> → <i>Level 2 – high level plans and business management procedures (ie AM Communication Plan, AM Risk Identification and Management Procedure, Asset Management Plans, Maintenance Plan, Internal Audit Procedure)</i> → <i>Level 3 – operational manuals and guidelines</i> → <i>Level 4 – operational procedures and forms.</i> <p><i>Fingrid has developed its AMS based on investing in knowledge management, with a strategy strongly centred on Fingrid's expertise and with all information (data) in Fingrid's possession. It has a system for recording and monitoring contractors qualification/performance through KPIs and incentive program for service providers. It has also training, education programs and seminars in place to upskill its suppliers.</i></p> <p><i>CP/CPS has implemented BS 11000. Contractors are evaluated using a balanced score card that reflects the asset management objectives.</i></p>	

5.7 SUMMARY – PRINCIPAL CONSIDERATIONS FOR IMPLEMENTATION OF ISO 55001



ISO 55001 sets out the elements for an asset management system within an organisation. It suggests what but not how an organisation uses its people to make this happen.



The second part of the standard, ISO 55002, gives further guidance on application, and a cross-reference table between the two parts, and links into the Highways context is provided in Appendix 3.



The principal considerations to successfully implement ISO are the organisational structure, communication, culture and leadership. The IAM's Asset Management Landscape provides support with developing people skills.



It is vital when embarking on an ISO 55001 implementation project to ensure that all staff, at all levels, and with various roles in relation to the asset (Policy, Management, and Operations), are clear about what it means for them, and what their contributions to achieving the corporate objectives for the asset are.

Each European road organisation will approach ISO 55001 implementation differently. But to derive value from an organisation's asset management there are five fundamental questions to be addressed:

- What is the current state of my assets?
- What are the levels of service and performance delivery that I aspire to?
- What are the critical asset groups which if fail will impact on service and performance?
- What are the optimal investment strategies to meet or exceed service targets?
- What forward investment is required to meet or exceed service targets?

There are many factors which when combined will improve an organisation's asset management maturity. Key among these are:

- Gaining full and transparent commitment from senior management and interfering parties backed up with an Asset Policy which mandates change
- Developing specific organisational functions to support the core asset team and embed asset management culture. Examples include cross organisational committees, management and change teams, staff development and communication
- Having available and understandable asset data and information in the required level of detail to make value decisions
- Adopting a whole lifecycle approach to developing the AMS in a phased, measured and confirmatory process
- Communicating the benefits of asset management with all stakeholders at all stages of AMS development to increase the transparency of decision making for; asset criticality, investment, risk and service levels.

For a road organisation, whatever the motivation to move towards the implementation of an AMS, compliant with ISO 55001 (business perspective, or Contract requirements perspective), certification will represent the evidence of that achievement.

The evidence of having an ISO 55001 certificate will also be a significant and positive performance message to road stakeholders and for road concessionaires their lenders, since it should be given by a recognised qualified third party auditor. It is worth remarking, however, that there is no binding mandate on what qualifications an auditing organisation should possess; it is up to those seeking certification, to satisfy themselves that their auditor is bone fide and comes with recognised experience and competence. For example, an organisation accredited by a national accreditation body such as UKAS.



Once a decision in principle has been taken to implement ISO 55001, it is essential that an internal project is established, with the usual roles, timetables, governance and review processes put in place. As the project proceeds, and at its conclusion, the realisation of the expected benefits should be measured and monitored.





6 COSTS AND BENEFITS

6.1 INTRODUCTION

POLICY

As a further reminder, ISO 55001 identifies a number of potential benefits to organisations from the implementation of an asset management system, as follows:

MGR

- Improved financial performance
- Informed asset investment decisions
- Managed risk
- Improved services and outputs
- Demonstrated social responsibility
- Demonstrated compliance
- Enhanced reputation
- Improved organisational sustainability
- Improved efficiency and effectiveness.

Studies reported by the Chartered Institute of Public Finance and Accountancy (CIPFA) and the Highways Maintenance Efficiency Programme (HMEP) in the UK note that the implementation of a full AMS for highways should achieve long term budget savings of the order of 5% for highways, and that savings of up to 15% have been reported in other sectors⁵⁶⁷.

Nevertheless, the consultation exercise undertaken for the ARISE project shows that development and implementation of a certified asset management system is generally driven by contract or other external requirements, rather than the self-identified aim to improve business performance. This is in part due to the level of investment and resources required for the implementation of such a system.

GO TO
SECTION 3.6 4.2

⁵ Highways – Maintaining a Vital Asset (UK Roads Liaison Group, August 2013)

⁶ Local Authority Transport Infrastructure Asset – Review of accounting, management and finance mechanisms. CIPFAS UK, 2008

⁷ Highway Maintenance Efficiency Programme, Highways – Maintaining a Vital Asset Management Guidance (UK Roads Liaison Group, August 2013)

It may be, therefore, that the perceived costs are a significant barrier to implementation of a certified asset management system and are generally only outweighed where the principal benefit is market access, ie where asset management certification is required for contractual and/or regulatory compliance.

It is, therefore, important to be able to make a rational assessment of both costs and benefits at all stages, from conception to implementation, of the development of an asset management system to the requirements of ISO 55001 in order to build a business case for justifying the investment in a certified AMS.

6.2 CBA ANALYSIS FRAMEWORK

A framework was developed by the ARISE project team to identify the relative scale of costs and benefits likely to be attributable to the various elements of ISO 55001. This framework has been used to analyse information obtained from a number of organisations that have implemented asset management systems to determine the key findings and recommendations presented in the following sections.

The framework has some potential to be used as a simple ‘ready reckoner’ tool, eg for the development or optimisation of a business case for the development of an asset management system. It could be easily expanded to a greater level of granularity if required and supported by the available data, but this did not form part of the project.

The framework together with summary results and analysis from the consultation exercise are presented in Appendix 2.



6.3 DO NOTHING COSTS AND BENEFITS

In assessing the overall value of implementing asset management ideally the ‘baseline’ costs of ‘doing nothing’, ie the organisation’s current position, should be understood.

The evidence from the consultation indicates that these ‘baseline’ costs are not routinely known or established prior to embarking upon the development and implementation of AMS. It is however evident that they will depend on both the scale of the organisation and the existing level of asset management maturity, eg:

- Little or no existing asset management capability, or
- Asset management in place or in development but not certified, or
- Moving to ISO 55001 from existing certified system, eg PAS55.

In practice, the majority of organisations with an interest in developing an asset management system to the requirements of ISO 55001 will already have developed many of the elements of the system to a greater or lesser extent.



It is recommended that as far as possible ‘baseline’ costs and/or performance metrics are established at the outset to provide a benchmark for evaluating the benefits of asset management.

The establishment of ‘baseline’ costs and/or metrics to demonstrate the performance of the AMS will be important in developing and maintaining support for the business case, as well as objectively evaluating the usefulness and value of asset management, and a certified AMS in particular, to the organisation. It will also be valuable in identifying the appropriate cost and benefit parameters and how to capture and track them.

Case studies examples:

Transport for London (TfL Surface Transport) – Prior to implementing a structured AMS – with the intention of achieving PAS55 and then ISO 55001 certification – TfL already operated asset management practices, so the baseline costs of the AMS were not readily identifiable. However, by evaluating the additional costs of implementation and establishing appropriate performance metrics, TfL was able to demonstrate that the start-up costs were recouped within one year.

Highways England – Highways England’s current costs for the asset management operations are £800m pa. They estimate that implementation of an ISO 55001 AMS will save £84m pa and that start-up costs will be recovered in less than one year.

6.4 TIMESCALE FOR EVALUATION OF BENEFITS

In implementing an asset management system ‘up front’ costs will be incurred in establishing the system as well as continuing costs in operating the system. Benefits are, however, likely to accrue over a longer term.

Evidence from the consultation has shown that, depending on the size and complexity of the organisation, and also the approach taken, it can take as long as 10 years to implement a compliant AMS. It is likely, therefore that benefit realisation will be on a similar, if not longer, timescale and this must be recognised both in planning and evaluating the performance of the AMS and in determining the appropriate payback period when developing the business case and commissioning its development.



Case studies examples:

The organisations consulted had not established a payback period for the anticipated realisation of benefits, though **TfL** stated that AMS start-up costs were recouped within one year and **Highways England** expected to achieve a similar initial return. **TfL** has a three year programme to develop their current AMS status to full ISO 55001 certification.

Fingrid took about four years to achieve PAS55 certification, with development of their business case being a particular challenge, followed by resolving the issue of outsourced services for certification once the implementation was commenced. This has informed their planning and programming for the targeted implementation of ISO 55001.

NATS adopted a 'journey' approach to the implementation of PAS55 and certification was achieved 10 years after the initial process alignment, though more focussed planning for maturity development began around halfway through that period. Although no formal business case was prepared the principal motivation for the implementation of the AMS was financial. The development from PAS55 to ISO 55001 was rather quicker, building upon the work already done for PAS55 and synergies with other ISO systems, ie 9001, 14001 & 18001.

6.5 IDENTIFICATION AND ALLOCATION OF COSTS AND BENEFITS

In practice, defining the boundaries of what constitutes the AMS, and the delivery of asset management, will require careful consideration by each organisation for the identification and appropriate allocation of costs and benefits, both for determining 'baseline' costs and also during the development and operation of the AMS. This is likely to include consideration of the tools and resources required, the activities undertaken and the parts of the organisation which are involved.

It is likely that costs and benefits will not be directly aligned within the various components elements of the AMS, and the respective elements of ISO 55001, ie costs occurred in one area (eg Planning) may give rise to benefits in another (eg Operation). This suggests that it is not likely to be practicable or effective to attempt to selectively implement only those elements of the AMS that indicate low cost and/or high return, rather that the AMS should be managed and evaluated as a whole.

Furthermore some costs and, in particular, benefits – such as enhancement of reputation or profile from achieving ISO 55001 certification – may be difficult to monetise.

Case studies examples:

TfL stated that the facility to identify the benefits that accrue from implementing an AMS (note; TfL is not currently certified) is essential to maintain the business case and secure appropriate investment in resourcing.

NATS reported year on year savings of 2% on operational costs from the operation of AMS.

6.6 SUMMARY OF POTENTIAL COSTS AND BENEFITS TO ROAD ADMINISTRATIONS

ISO 55000 is necessarily a very broad, generic standard as it is to be applied to a very wide range of 'assets'. In consequence, the terminology and also the practical application of the text, require careful consideration for application to a particular asset type. From the work on the ARISE project, which encompassed a range of assets types, the following table has been developed to give some general guidance on typical interpretation or application of the ISO 55001 elements in a highways context.

It is worth noting that ISO 55001 is, in principle, designed to accommodate the fact that:

- The asset owner and operator may be different organisations, but
- One organisation has to take responsibility for the complete AMS and submit it for certification, and
- The arrangements may change during the lifecycle of the asset.

This should allow application to the majority of highway assets, but needs careful thought about the division of responsibilities, duties and operations involved. Outsourcing (for example reported by Fingrid in their case study), can present challenges when adopting the standard and approaching certification. However, ISO 55001 does provide explicitly for such circumstances in its Section 8.3.

Appendix 3 presents a tabular cross referencing between the elements of ISO 55001, ISO 55002 and the highways industry context. Table 4 below uses the same main Elements from ISO 55000 as that table, but lists potential costs and benefits of each.



Table 4

Asset Mgmt Element	Asset Management Sub-element	Potential Costs	Potential Benefits
4 Context of the organisation	4.1 Understanding the organisation and its context	Activities likely to require significant competent resource, ie	Clarity of organisational objectives
	4.2 Understanding the needs & expectations of stakeholders	→ Establishment of organisational structure and governance to support AM	Establishment of AM resource
	4.3 Determining the scope of the AMS	→ Definition of scope of AM	Team roles and purpose letter
	4.4 Asset Management system	→ Development of AM policy, objectives and SAMP → AM process & documentation development	

Asset Mgmt Element	Asset Management Sub-element	Potential Costs	Potential Benefits
5 Leadership	5.1 Leadership & commitment	Specific AM related costs should be low	<p>Strong committed senior leadership support for AM development and implementation is essential for success.</p> <ul style="list-style-type: none"> → Secures funding and provides project sponsorship → Provides awareness at senior organisation level → Ensures a stable organisation with clarity of roles
	5.2 Policy		
	5.3 Organisational roles, responsibilities & authorities		
6 Planning	6.1 Actions to address risks and opportunities for the AMS	Significant requirement for competent resource for planning activities.	<p>Principal benefits realised in terms of efficient operation and delivery (see element 8)</p> <p>Clarity in terms of key risks & opportunities: improved risk management and potential opportunity realisation</p>
	6.2.1 AM Objectives	Comprehensive, good quality data is required to support effective planning.	
	6.2.2 Planning to achieve AM objectives	<p>Costs of tools such as:</p> <ul style="list-style-type: none"> → Asset system → DST → EDM 	
7 Support	7.1 Resources	<p>Provision of appropriate resource:</p> <ul style="list-style-type: none"> → Numbers → Skills competence → non-human resources (tools) 	<p>Improved recruitment requirements, training and knowledge relations</p> <p>Efficient operation and delivery</p>
	7.2 Competence	Identification/development/delivery of training	<p>Efficient operation and delivery</p> <p>Continuous improvement</p>
	7.3 Awareness	<p>Development of communication strategy</p> <p>Continued routine implementation of communication to all stakeholders</p>	<p>Increased buy-in and commitment within both organisation and supply chain</p> <p>Efficient operation and delivery</p>
	7.4 Communication		Continuous improvement

Asset Mgmt Element	Asset Management Sub-element	Potential Costs	Potential Benefits
7 Support	7.5 Information requirements	Data collection Data management Data QA	Asset knowledge Robust investment decision making and prioritisation Efficient operation and delivery
	7.6.1 Documented information general	Potentially expensive to develop implement and maintain procedures and documentation to standard required for 3rd party certification. → Version control and configuration management → EDM	Efficient operation and delivery
	7.6.2 Creating and updating documented information		Right first time – avoidance of re-working
	7.6.3 Control of documented information		Clear cross team relations
8 Operation	8.1 Operational planning and control	Significant requirement for competent resource, including outsourcing, for operational activities throughout asset lifecycle	Assure asset performance throughout the lifecycle
	8.2 Management of change		Better quality for outsourced services
	8.3 Outsourcing		
9 Performance Evaluation	9.1 Monitoring, measurement, analysis and evaluation	Resource – performance and quality review team	Reinforcement of quality culture
	9.2 Internal audit		Synergies with complementary ISO systems
	9.3 Management review		Improvements to system
10 Improvement	10.1 Nonconformity and corrective action	Implementation and maintenance of reporting systems	Reinforcement of quality culture
	10.2 Preventive action		Performance improvement
	10.3 Continual improvement		Synergies with complementary ISO systems

6.7 PRINCIPAL CONSIDERATIONS FOR IMPLEMENTATION OF ISO 55001

Careful evaluation of each of the elements of ISO 55001 indicated that element seven 'Support' (see tables in Appendix 2) is the principal heading under which costs would be incurred and/or benefits accrued in contributing to activities under the remaining elements. In the tables of the framework these headings are compared against the other six elements.



In collecting and analysing the information from the ARISE project consultation exercise potential sources of cost and/or benefit that could most readily be quantified/monetised were considered and rationalised as:

- Time
- Expenditure
- Risk exposure/mitigation.

Thus, costs were defined to include time, expenditure or increased risk, while benefits included savings in time or expenditure or mitigation of risk.

A brief analysis of the responses to the CBA consultation is presented in Appendix 2, while principal findings to inform planning for the implementation of a certified AMS are presented below.

A. COSTS

Across the scope of the asset management elements, greatest investment is likely to be required in Resources, Information and Competence (ie skills development and training). This reflects the experience of the responding organisations in the importance of ensuring that appropriate resources are directed to the development, implementation and operation of asset management and the critical need for comprehensive and current data and information to support operational delivery and investment planning.

Case studies examples:

TfL noted that asset management has to be adequately resourced to be effective and give rise to benefits and it has invested in a bespoke training programme that has proved very successful in ensuring a common understanding and appreciation of asset management across its business. TfL continually reviews the data that is required to support asset management.

Fingrid, Highways England and BBMM emphasised the need for appropriately skilled resources, and tools, for the management, analysis and interpretation of data and information. Fingrid identified data/information as 'the cornerstone of good asset management'.



Obtaining and managing data at the appropriate levels of currency and quality are essential for effective asset management and will require commensurate levels of investment.

B. BENEFITS

The CBA returns indicate that benefits accrue principally under the elements (see Appendix 2) of Planning, Context and Operations reflecting the gains from aligning business structures and processes with organisational requirements and improving efficiency and effectiveness in delivery.



General Lessons learned from case studies:

Organisations already certified, or with AM maturity, identify the main benefits of implementing an ISO 55001 compliant AMS, as improving leadership, skills/competency and communication, which positively impacted team cohesion and the line of sight to the AM strategy, as well the achievement of intended business outcomes. Relevant benefits also mentioned were the improvement on the efficiency and effectiveness in delivery, on knowledge management and performance measurement.

A key success factor is good communication and stakeholder engagement.

Synergies from combining ISO 55000 with operation of existing Quality/ISO systems for example; ISO9001, 14001, 18001, 27001, will help to reduce costs and save audit time.

It is important to recognise the need to make investment in comprehensive and integrated information systems to manage the large volumes of data involved

It is very important to be able to demonstrate benefits – this involves identifying and then collecting the data to measure performance.

C. BENEFIT COST RATIO

In terms of Benefit Cost Ratio (BCR) in Table A2.4, Leadership shows by far the greatest return across the elements of ISO 55001. The costs attributed to Leadership for asset management are low, as may be expected since organisations will have established leadership structures, so the BCR demonstrates the value of having strong commitment at the most senior levels in the organisation to secure and maintain support, resources and funding.



Commitment and support from the organisational leadership is essential for the successful development, implementation and operation of a certified AMS and arguably should be regarded as the first and highest priority in the maturity journey.

Case studies example:

TfL noted that having a senior champion for was a critical success factor in establishing and maintaining their AMS programme.



7 THE JOURNEY TO MATURITY – STEPS TOWARD SUCCESSFUL IMPLEMENTATION



Once your organisation has considered the potential benefits and opportunities that improving its asset management 'system' can bring, it is then appropriate to consider where on your asset management 'journey' you are and where you want to get to. Conformance of the AMS to ISO 55001 is an additional consideration, which, while demonstrating a level of competence and good practice, is not the end of the maturity journey.

The Institute of Asset Management states, 'Asset management maturity goes beyond conformance with ISO 55001' (ref i).

It is convenient to consider the steps an organisation needs to take to improve their maturity, either to achieve 'competence' in ISO 55001 terms, or to demonstrate business improvement, or to show excellence in particular areas, by considering the nine ISO 55000 benefit areas.

7.1 GAP ANALYSIS

Referring to Diagram 2b in Section 5, it will be apparent that the first step in all instances is for an organisation to **review its current policies, processes and practices**. This can be done informally, or, preferably, using the elements of ISO 55000 as a checklist. The advantage of doing it this way, and possibly using a formal assessment tool such as that provided by the Institute of Asset Managementⁱ, is that the 'gaps' between the organisation's current position and attaining the required competence to meet the ISO 55001 standard become immediately apparent. Even if the intention is not to achieve certification, this provides a useful benchmark for a general business improvement plan.

During the review phase, the high-level strategic objectives of the organisation should be considered, and their relationship to asset management processes. From this, a **gap analysis** will show in what respects the asset management processes and practices are helping achieve those objectives, and hence identify improvements needed. The other key aspect of the review will cover asset knowledge – both the 'what' (inventory) and the 'state' (condition). Once again, this is likely to uncover shortfalls which may be included in the business improvement plan.

7.2 CONSIDER OPTIONS/PLANS

The consideration of options and plans at this point will take two forms:

- The Business Improvement actions required to improve the efficiency of the asset management system (incl. basic compliance vs benefit of going beyond)
- The optional approaches to what may form the future Asset Management Strategy and Plan (at a technical and operational level) and impacts on associated planning cycles and teams
- Organisational changes/improvements already planned.

Almost every European road authority or operating company now works to an annual Business Plan, within a strategic plan covering, perhaps, 5 to 10 years. This could be extended in the case of long-term concessions and DBFOs, for example, to 30 years on M25 DBFO. The ways in which the priority list of tactical options (ie maintenance and renewal schemes) is drawn up, varies widely. An underlying basis of a good asset management system is having a good understanding of the lifecycles of each of the assets in your portfolio; If there is not a clear understanding of how an asset performs, and what interventions are required to ensure it reaches its expected life, it is hard to see how an optimal strategy can be developed for managing those assets that delivers benefit to the organisation. Therefore, if your organisation does not have a good understanding of asset lifecycles, this is likely to form one of its first actions, and one which could require considerable research effort.

As there will never be a single solution to the asset management strategy to be adopted, a matrix-based analysis of options should be considered.

7.3 PLAN/MANAGE CHANGE



Having considered the options for improving the asset management system, and the strategy and plans that will form part of it, the next practical consideration is of the resources (human, physical, and financial) that will be required to deliver the preferred plan. Once again, even if your organisation has not yet decided to seek ISO 55001 certification, this is a useful exercise and one which most road administrations and operating companies go through already.

If, at this point, the organisation decides it will embark on seeking ISO 55001 certification, then there will be some actions required to be built into the action plan specifically to achieve that goal. These will include:

- Secure leadership buy-in and cross organisational support
- Establish the certification exercise as an internal project with allocated resources
- Nominate a 'champion' with responsibility for delivery of the project (high level buy-in is essential)
- Engage with supply chain partners and contractors (the end-to-end view of asset management must be considered)
- Appoint an external assessor (registered with the appropriate national accreditation body) and agree a timetable for the audit process with them
- Action any improvements identified in the Gap Analysis as a priority before carrying out any audits.

From the findings of the ARISE research, we can highlight a number of possible change and improvement actions that roads organisations may need to consider before being in a state of readiness for ISO 55001. These are listed in Table 5.

Table 5

ISO 55000 Benefit Area	Key Success Factors	Potential Risks	Typical Improvement Actions
a) Improved financial performance	<ul style="list-style-type: none"> → Create asset baseline → Create financial asset PIs → Implement monitoring programme → Regularly review performance 	<ul style="list-style-type: none"> → Asset baseline errors → Ineffective PIs → Ineffective financial monitoring → Inadequate 	<ul style="list-style-type: none"> → *Introduce valuation of assets to monitor change over time → *Attribute past expenditures to stretches of road and asset elements within them
b) Informed asset investment decisions	<ul style="list-style-type: none"> → Effective Data Management 	<ul style="list-style-type: none"> → Poor decisions, based on poor information 	<ul style="list-style-type: none"> → Identify key data/attributes/formats → specify in contract documents → Introduce basic lifecycle modelling → *Create/Improve asset knowledge (inventory and condition) → Clarify objectives/constraints
c) Managed risk	<ul style="list-style-type: none"> → Understanding risks 	<ul style="list-style-type: none"> → Unexpected outcomes → Increased costs → Impact on reputation (see g) 	<ul style="list-style-type: none"> → Introduce risk-based analysis of tactical options, starting at strategic level and working down → *Identify safety needs of the network → *Define technical life-span of each asset component → Define opportunity register starting at strategic level then work down to project
d) Improved services and outputs	<ul style="list-style-type: none"> → Buy-in to the principles and objectives of the AMS at all levels 	<ul style="list-style-type: none"> → Poor communication 	<ul style="list-style-type: none"> → *Introduce valuation of assets to monitor change over time → Adopt performance-based approach and indicators → KPI to cover end-to-end system
e) Demonstrated social responsibility	<ul style="list-style-type: none"> → AMS strategic and tactical objectives are linked to high level outcomes 	<ul style="list-style-type: none"> → Poorly defined outcomes and/or links to AMS 	<ul style="list-style-type: none"> → Link asset management to Business Objectives that relate to social/environmental outcomes

ISO 55000 Benefit Area	Key Success Factors	Potential Risks	Typical Improvement Actions
f) Demonstrated compliance	→ Clear objectives, well communicated	→ Poorly understood AMS results in non-compliance	→ Seek and obtain certification to ISO 55001 → Consider auditor training and teams auditing each other (semi-external audit)
g) Enhanced reputation	→ Good leadership and communication	→ Secondary effects of poor performance not understood	→ Seek and obtain certification to ISO 55001 → Stakeholder map and integrate management
h) Improved organisational sustainability	→ Robust change management processes	→ 'System' treated as box-ticking exercise	→ Create robust and flexible business management systems (consider integrating ISO 9001, 14001, 11000, 8000 etc. with 55001) → Attempt to measure baseline efficiencies from which planning/delivery cycle to the next
i) Improved efficiency and effectiveness	→ Robust AMS processes taken seriously at all levels	→ 'System' treated as box-ticking exercise	

(*) Actions suggested in CEDR's report⁸

⁸ Asset Management: Draft Report of CEDR Task Group N2, V1.1, November 2015



8 WHERE TO LOOK FOR FURTHER HELP

WEB LINKS/ORGANISATIONS

The Institute of Asset Management (UK-based)	www.theiam.org
Global Forum on Maintenance and Asset Management	www.gfmam.org

DOCUMENTS

- ISO 55000:2014 Asset Management – Overview, principles and terminology
- ISO 55001:2014 Asset Management – Management systems – Requirements
- ISO 55002:2014 Asset Management – Guidelines for the application of the ISO 55001
- The Asset Management Landscape, 2nd Edition, GFMAM, March 2014, ISBN 978 0 9871799 2 0
- Asset Management – An Anatomy, The Institute of Asset Management, ver 3, December 2015
- PAS 1192-3:2014, Specification for information management for then operational phase of assets using building information modelling
- Asset Management; Draft Report of CEDR Task Group N2, v1.1, November 2015
- Data Management for Road Administrations, A Best Practice Guide, v 2.0, WERD, 2003

OTHER RELATED STANDARDS

- ISO/T5 8001-1:2011 Data Quality Part 1 Overview
- ISO 9001:2015 Quality Management Systems – Requirements
- ISO 14001:2015 Environmental Management Systems – Requirements
- ISO/IEC 27001:2013 Information Security Management
- ISO 31000:2009 Risk Management – Principles and Guidelines
- BS 11000: Collaborative Business Relationships (due to be adopted by ISO in 2016)
- BS OHSAS 18001: Occupational Health and Safety Management

APPENDIX 1

SUMMARY OF CASE STUDY FINDINGS

RESULTS ARE PRESENTED, AS FOLLOWS:

1. Relevant Conclusions (summary of 8 case studies)
2. FINGRID (Finland)
3. Highways England (UK)
4. National Air Traffic Services, NATS (UK)
5. Transport for London, TfL (UK)
6. M25 Connect Plus (UK)
7. Balfour Beatty Mott Macdonald JV, BBMM (UK)
8. ASFiNAG (Austria)
9. ERTO (Ireland)
10. Supplementary information obtained from Durham County Council (UK) in July 2016

1. RELEVANT CONCLUSIONS

Case studies analyse approach and relevant conclusions on 09-05-2016 (from 8 case studies analysis).

CONTEXT

1) Nature of the assets

On the existing 8 case studies the scope of the AMS includes only physical assets.

The only exception is NATS that included also data assets on the AMS scope.

In all 8 companies the AMS has in its scope a significant and highly complex physical infrastructure.

2) Quantities

Significant asset portfolios.

3) Type of organisation

On this sample of 8 companies, the organisations that first moved to the PAS55/ISO 55001 certification process, are public, or public/private.

Another relevant aspect is the relevance of Contract requirements on the decision to implement an AMS in compliance with ISO 55001.

4) Size and 'birth' date

Medium/large companies (number of staff > 90).

5) AMS operating in one, or several companies

On this sample of 8 companies, the information available seems to point out that the AMS is running in one company only, even if it does not covers all the steps of the AM process (examples of BBMM and ERT0).

Only in case of Connect Plus – M25-UK (not yet certified) the plan is to include on the certification, the 2 companies that run the entire AMS process.

AM CURRENT STATUS (FORMAL, OR INFORMAL AMS)

6) Processes and documentation in place

In this 8 companies' sample, the relevant AM processes and documentation are already in place, or under development.

7) Resources dedicated to AM

This aspect – appropriate resources – is a key area of concern and investment in all the 8 case studies, because ISO 55001's AM requires strong governance in place.

This is equally important in case of extensive outsourcing.

To support the implementation and operation of an ISO 55001 AMS it is necessary to ensure the appropriate provision of resources with skills and levels of competence.

8) Existing AM IT support tools

Asset information quality is fundamental to an effective AM.

To ensure that is necessary to have a comprehensive and Integrated Asset Management Information System could require strong investments.

Depending on the organisation and assets complexity it could be a huge task to accomplish in one step, therefore some organisations decided to do it in stages over a period of time.

9) AMS maturity journey

The implementation of an AMS compliant with ISO 55001 requires a 'journey' approach, because it has demanding requirements for different areas of the business management.

The required period for the implementation of ISO 55001 depends on the maturity of the existing AM processes and available qualified resources.

AM maturity is also linked with business management maturity, because it has a financial motivation.

There are synergies by linking/integrating ISO 55001 implementation with other ISO Quality Systems – 9001, 14001, 18001, 27001.

Important aspects to consider:

- Engagement with stakeholders to understand their needs and expectations
- Proactive communication with suppliers
- Actively plan and manage communication about AM, to relevant staff, suppliers, third parties and stakeholders
- Implementation of adequate management information systems
- Processes to manage, maintain and review AM procedures
- Data/information accuracy
- Risk assessment.

ROAD TO CERTIFICATION

10) Timetable and plans to full AMS implementation

Depending on the AM maturity of an organisation the certification on ISO 55001 could be a task for 2, or more years.

11) Targets and change management

Change management is a key aspect on ISO 55001 implementation.

In some of these case studies it was pointed out the importance of setting up and control targets and objectives, along the implementation process.

12) Certification for entire AMS, or just for some sub-processes?

Both options seem to be possible.

For example BBMM is already certified and doesn't run the entire AM process. NATS is also certified and seems to run the complete AM process.

LESSONS LEARNED

13) Quick wins

Big push on improving:

- Knowledge management
- Efficiency and effectiveness in delivery
- Team cohesion
- Performance measurement
- Achievement of intended business outcomes
- Line of sight to the AM Strategy
- Leadership, skills/competency and communication.

14) Big challenges/barriers

The certification process could be long.

Effective communication with company's stakeholders and also internally.

Ensure the understanding of what is an AMS, within the various departments of a company and alignment of objectives.

To ensure an appropriate budget for AM to be effective.

Management of outsourced services.

Appropriate data quality.

15) Risks and critical success factors

Critical success factors:

- AM awareness at Board level
- Establishment of dedicated team/resources to lead and progress AM implementation
- Being able to provide evidence to demonstrate benefits of AM approach
- Failures to highlight need for AM approach
- Both inventory and condition data should be kept at high level of accuracy/quality
- Availability of IT support tools for data management
- Lack of resources
- Regular audits to the AMS.

BENEFITS TO ORGANISATION

16) Structuring the strategy

In case the AM strategy is not already established by contract requirements, the process of structuring the AM strategy is still a work in progress.

17) Design for maintenance

No available information.

18) Whole lifecycle approach

WLC approach is a concept that in most of the cases is still a work in progress.

2. FINGRID, DATA COLLECTED IN OCTOBER 2015 (FINLAND)

CONTEXT

1) Nature of the assets

Electricity grid in Finland (lines infrastructure and substations).

2) Quantities

14,000km of 400, 220 and 110 kilovolt transmission lines plus 116 substations, 10 reserve power plants (21 units), including fuel tanks, generators and turbines.

3) Type of organisation

Fingrid Oyj is a Finnish public limited liability company. It is owned by the State of Finland (holding 67.7%), Ilmarinen Mutual Pension Insurance Company (19.9%) and other institutional investors 12.4%. Fingrid is responsible for electricity transmission in the high-voltage transmission system in Finland. It is responsible for planning and monitoring the operation of the Finnish electricity transmission system and for maintaining and developing the system. The government owns almost 70% of the company, so FINGRID is the owner and manager of assets.

4) Size and 'birth' date

The company was established on 29 November 1996. Operations started on 1 September 1997. Number of personnel at 2014 year-end: 313 (287), with 282 (268) permanent employees. Fingrid is headquartered in Helsinki, and the company also has offices in Hämeenlinna, Oulu, Petäjävesi, Rovaniemi and Varkaus. Turnover EUR 567 (543) million. Balance sheet total EUR 2.15 (2.18) billion.

5) AMS operating in one, or several companies

One.

AM CURRENT STATUS (FORMAL, OR INFORMAL AMS)

6) Processes and documentation in place

PAS55 is implemented. Certification since 2011. Investment on knowledge management, with a strategy strongly centred on Fingrid's expertise and with all information (data) in Fingrid's possession. Fingrid has a system for contractor's qualification/performance follow-up and a KPI and incentive program for service providers. It has also training, education programs and seminars in place. They have annual audit programs.

7) Resources dedicated to AM

AM staff = 135. No detailed info, only a general diagram with top management. Organisation chart does not reflect AM system – but roles and procedures do! For maintenance, Fingrid purchased the actual service at market conditions, through long term contracts (3 years) for basic maintenance and local operations, and through short term contracts for special maintenance tasks. Maintenance is planned by Fingrid and service providers plan, perform and report works. Investments are done through turn-key deliveries.

8) Existing AM IT support tools

Large IT project underway (ELVIS). Effective tools for data management, same tools used by service providers as in-house through Fingrid's extranet (FgPartners). The data system that supports asset management and use goes by the name of ELVIS (an acronym for ELectricity Verkkö Information System). ELVIS is an asset management information system that comprises a total of eight integrated products. The integration into each other allows that the master data of the grid network's assets are only located in one application.



ELVIS has been strongly integrated into Fingrid's other systems, such as financial management. IBM is acting as system integrator with overall responsibility for ELVIS. In the ELVIS software package, the ownership register, maintenance management and connection planning take place using IBM software, into which Esri GIS and mapping products are integrated. Other parts belonging to the system are Oracle project portfolio management, an SAP mobile user interface, Intelligent Process Solutions software for protection settings management, Electrocon protection simulation and Siemens' network calculation and network model management applications. The first parts of the system were introduced in autumn 2013 and the last ones were brought in during 2014, so that the whole system was implemented in 2015. In the first stage, the ERP system was introduced, which plans and budgets for maintenance work and grid expansion projects. The equipment information and service history of the grid network substations have also been transferred to the new system. In the next stage, power line service information, structural data, protection and network calculations and transmission outage management, among other things, will all be integrated into the system.

9) AMS maturity journey

PAS55 is implemented. Certification since 2011. The objective is to implement ISO 55001 from 2016.

ROAD TO CERTIFICATION

10) Timetable and plans to full AMS implementation

The objective is to implement ISO 55001 from 2016.

11) Targets and change management

The original goals were to make cheap energy. The push for higher reliability came from owners, not the regulators.

12) Certification for entire AMS, or just for some sub-processes?

No info available for WP2. It seems that includes all sub-processes.

LESSONS LEARNED

13) Quick wins

Success was achieved by having a long term main goal, but breaking it down into manageable sub-projects, each followed by a 'go/no go' gateway decision point. It worked!

Fingrid realised also that their Tech Specs were excellent but there was no line of sight to the AM Strategy. Now have a hierarchy of plans/documents that works. IT project represents a big push on Knowledge Management. Fingrid is better able to measure performance. They have key high-level indicators very visible on their web site. Another benefit was closing of gaps. Fingrid AMS supports the main business goal of 'making cheaper energy' and that is a benefit to customers.

14) Big challenges/barriers

Challenges:

- The certification process takes time (PAS55 took them about 4 years)
- Because Construction and O&M are outsourced, how to deal with outsourced services is an issue and caused lots of discussion in the past with Lloyds Register (assessors).

Data requirements are included in the contracts. After some years, Fingrid realised that a hands-off approach was risky, so have invested in being an 'intelligent client' (eg analyses all data). Efforts being made to measure competencies. Business case for PAS55; 'the most difficult part'.

15) Risks and critical success factors

Performance measurement is key – simple high level supply targets (no interruptions). Data/Information ‘is the cornerstone of good asset management.

- Both inventory and condition data is kept at high level of accuracy/quality
- Skilled interpretation of raw data provided by contractors is carried out internally by Fingrid experts
- IT is important for managing inspections, online measurement
- They use a ‘Master Data’ (single source of truth) principle

Because the Industry is regulated, the Regulator considers monitoring and controls – but so far this has been ‘light touch’ because the business is so successful!

BENEFITS TO ORGANISATION

16) Structuring the strategy

Better able to measure performance; Fingrid has key high-level indicators very visible.

Data control has a key role for years.

17) Design for maintenance

No available information.

18) Whole lifecycle approach

No relevant info. The ‘quick wins’ are described in point 13.

3. HIGHWAYS ENGLAND (UK)

CONTEXT

1) Nature of the assets

Strategic road network. Road assets along 6,880km of motorways and major A roads.

2) Quantities

Their asset base is highly complex including:

- 35,040km² of road surface
- 12,000km of embankments and earthworks
- 18,500 bridges and built structures –
23,040km of barriers
- 150,000 technology assets and signs
- 33,600km of drains.

But the age and rate of deterioration will always be uncertain.

3) Type of organisation

Highways England Company Limited (Highways England) is a corporate body/company limited by shares, and wholly owned by the Secretary of State for Transport. External drivers/stakeholders:

ORR – *The Monitor* and Transport Focus – *The Watchdog*

New focus groups being formed – stakeholder engagement group. Future: will work with Transport Focus.

4) Size and 'birth' date

Highways England (HE) was established on 8 December 2014 as a company. Assets Gross Replacement Cost is £115bn.

Staff number (Annual Report 2013-2014, page 96): 3,350.

5) AMS operating in one, or several companies

One, with significant outsourcing.

AM CURRENT STATUS (FORMAL, OR INFORMAL AMS)

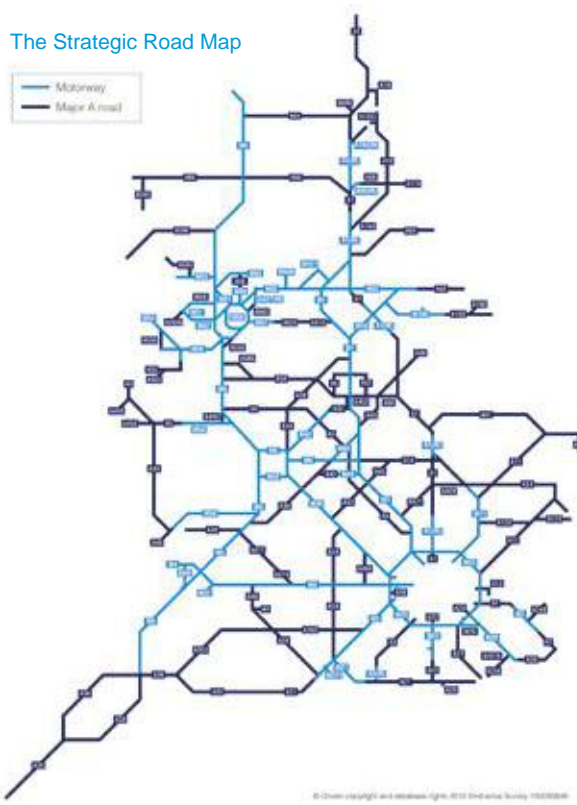
6) Processes and documentation in place

HE published: a Strategic Business Plan 2015 to 2020, a Delivery Plan 2015 to 2020 and an AM Policy has been drafted and is being signed off. SAMP draft is under development – due in March 2016. Next tier is AMPs at Regional level, then by asset groups. Regional Director = Asset Steward (generic term, delegated as the asset owner). 30 year model for Lifecycle AMPs.

First 5 year period planned in detail – To be produced for each Region (RAMP) – will be tactical – has leading/lagging Indicators. 19 Guiding Asset Management Processes. Compare the former way (standards and compliance) with new way – assets- customers – other stakeholders. Aim is for investment programme NOT to be reactive. Aim for cross-asset optimisation. Balancing stakeholder requirements eg safety.

7) Resources dedicated to AM

NDD responsible for all network maintenance, operation and use. Customer Operations responsible for dealing with the public on the ground. Variety of contract forms (MAC, DBFO, ASC etc.). New model (Area 7) is more hands-on for HE as it takes in-house asset management functions including responsibility for identifying investment need and developing asset systems and lifecycle plans.



8) Existing AM IT support tools

HE key enablers of their new AM approach will be a comprehensive and Integrated Asset Management Information System (IAMIS). This will be introduced in stages over the next five years, adding one asset type after another as they gather improved data and the associated sub-systems come online. For this purpose HE will submit an implementation plan in March 2016 to demonstrate how they are improving asset information quality.

9) AMS maturity journey

ISO 9001 not adopted. Principles of ISO 55000 are being adopted. BMS – yes – documented processes, compliance is variable.

'ISO 55000 may not be as daunting as they first thought'. Their AM capability will be measured through a series of AM maturity assessments carried out across RP1. Resource needs and competencies are not measured as such. Generic behavioural measurement under CPD, not AM specific Plan – competency gaps for individuals (follows London Underground example).

All NDD AM Group staff undertakes the IAM Certificate.

For operational planning and control processes there is a multi-tiered approach with 19 draft processes mapped and now under consideration (eg information management, asset risk and criticality, system review).

Non-conformities handled on the ground (incidents, maintenance and repair). Supplier compliance is strong, internal compliance is weak. There is also work in progress regarding 'Level of Service'. It is defined and measured, and targets set through KPI Road User Satisfaction and historical NRUSS and regional ARUSS surveys.

Road Investment Strategy (RIS) comprising Performance Spec and operating Licence (NB this includes reference to consistency with ISO 55000).

ROAD TO CERTIFICATION**10) Timetable and plans to full AMS implementation**

Plan consistency with ISO 55000 (by 2020, end of 1st Reporting period). Ultimately plan formal compliance with ISO 55000.

PAS55 now dropped. Previous PAS55 Gap analysis carried out within HE AIG as first step. HE asset management guiding principles will be outlined in their AM Policy, which was issued in August 2015. This will be followed by the AM strategy in April 2016. Communication about the asset management system is handled internally through Newsletters, Management Plan and Communications Plan. It is treated as a 'project' with 2020 target date.

11) Targets and change management

There are change management processes with NDD having central monitoring role.

- Risk Management is embedded in the organisation's asset management approach, but improvements are identified
- Annex 25 which is used in ASC contracts for O&M currently requires PAS55 level 2 maturity within 6 months with an improvement plan to level 3 maturity within 2 years. HE looking to align this to ISO 55000 in future ASC contracts requires.
- Significant change in operating model for maintenance. The new model will directly manage both routine maintenance and the coordination and planning of capital renewal schemes. This change in approach will require a different internal capability to reflect the different role that HE will be adopting.
- Increase the direct (internal) knowledge of the asset and the factors which generate waste and inefficiency.

Work more closely with the suppliers of activities on the ground in order to improve the quality and value for money of these services. In the new model the works which were previously undertaken by the maintenance contractor will be split into 3 principle packages: design and term maintenance for suppliers + management and direction of operations insourced.

12) Certification for entire AMS, or just for some sub-processes?

Entire AMS.

LESSONS LEARNED

13) Quick wins

By increasing the direct exposure to works, HE will be better placed to ensure the optimisation of the work undertaken. This will positively impact the quality of workmanship that has a major impact on the durability of asset renewals which implies less needs of future maintenance.

14) Big challenges/barriers

The gap is understanding what an AMS is within the various departments of HE. Need to communicate a common AMS and meanings. Current high reliance on outsourced services, need more technical skills in house. Area 7 model is one of the first steps. Also building up internal AM team skills.

15) Risks and critical success factors

The biggest risks to the assets faced by the organisation depends on the stakeholder, but are mainly related to Safety – road users and road workers, Compliance with the Licence, Reputational and resilience (eg flooding/snow/ice).

BENEFITS TO ORGANISATION

16) Structuring the strategy

No available information.

17) Design for maintenance

No available information.

18) Whole lifecycle approach

The organisation uses the concept of 'Whole Life Cost' for optimising its investment in the asset, but needs improvement.

Pavements are OK, other assets less good. This is required under the Licence!

The network infrastructure asset as reported in the annual accounts is based on depreciated replacement cost (DRC), as required by the FReM.

4. NATIONAL AIR TRAFFIC SERVICES – NATS (UK)

CONTEXT

1) Nature of the assets

NATS has to manage all the infrastructures inherited from UK Civil Aviation Authority (CAA), which is very extensive and much of it risk-critical.

Significant physical assets including: Trajectory services, Oceanic, Surveillance, Controller Comms, Navigation, Core services, Simulations, Service Management, Workstations, Flow optimisation, Airspace, Facilities Management, Business IT assets. Also data assets, which are business critical.

Assets ownership is described in Terms of the Licence.

2) Quantities

Asset portfolio has 282 asset types and 174 sites.

3) Type of organisation

After splitting from UK Civil Aviation Authority (CAA), National Air Traffic Services (NATS) begun a new business regulated.

It is a 50:50 government: private owned company. NATS have a Licence to manage all UK controlled airspace (excludes approach/take-off zone at airports).

NATS provides internationally-recognised training services.

Major stakeholders: Air Navigation Service Providers (ANSPs), Airlines, Passengers, Other air traffic organisations (training) and Airports.

4) Size and 'birth' date

NATS was split from the UK Civil Aviation Authority (CAA) in the 1990s.

Total staff 2,000 at Whiteley +3,000 other sites.

5) AMS operating in one, or several companies

One company.

AM CURRENT STATUS (FORMAL, OR INFORMAL AMS)

6) Processes and documentation in place

All the processes and documentation required by ISO 55001.

NATS Business Plan delivers all elements required in a SAMP.

A Tactical Operating Model is under construction. An aim is to 'shrink' the 'line of sight' from strategy to operations.

A Service Investment Plan is required to be submitted to government. This covers benefits to service capacity (airlines), safety, environment, risk etc.

AM Policy, AM Objectives, SAMP, AMPs and key business processes are in place within the business plan.

Due to the huge number of stakeholders, communication is constant and on-going.

NATS has a Business Management System (BMS) in place, compliant with ISO 55001.

Communication about the asset management system is handled internally through: asset Review Board holds Assurance Workshops, Communication to Government eg Service Investment Plan and Lots of communication with other stakeholders.

For operational planning and processes control: Minimum Manual Intervention rather than fully automatic.

7) Resources dedicated to AM

To ensure resources and competences needs, key role profiles have been developed. Emphasis on changing behaviours of all staff.

Regarding responsibility for operation and maintenance there is an extensive outsourcing of operational aspects, under varied arrangements.

NATS has strong governance in place (financial criticality analysis on all suppliers).

NATS had 47 asset managers originally, now after breaking down silos and rationalising job titles, have 5 'asset managers'.

8) Existing AM IT support tools

Systems – use SAP (lifecycle), CONCEPT (facilities)

NATS has management dashboards.

9) AMS maturity journey

In 2001, NATS decided to embark on PAS55, and processes started to be aligned. Around 2006, NATS drew up a roadmap to attain Level 3 competency under PAS55. Certification was successfully achieved in 2011.

When subject to review, it was decided not to renew PAS55 but make the change to ISO 55000, which was about to be formally published.

NATS adopted a 'journey' approach, not overnight change (like introducing a 'virus' in the organisation!).

Clarity first, then consistency. Did not have to make a business case for PAS55, but AM was introduced with a financial motivation.

'No brainer' to adopt ISO55000 when PAS55 renewal came up (2013). Also saw synergy by linking to other Quality Systems – audit of ISO 55000 combined with 9001, 14001, 18001 (soon to add 27001).

ROAD TO CERTIFICATION**10) Timetable and plans to full AMS implementation**

NATS became (it is believed) the 2nd company in the world to be ISO 55000 certified in January 2014.

AMS already in place.

11) Targets and change management

NATS has change management implemented.

12) Certification for entire AMS, or just for some sub-processes?

Entire AMS.

LESSONS LEARNED**13) Quick wins**

No information available.

14) Big challenges/barriers

No information available.

15) Risks and critical success factors

Risks are linked to projects, with mitigations in place.

Bigger risks:

Data – real time, fixed assets, archives, records management

Negligence – 'go to jail'

Incompetence – 'Licence will be revoked'

Insurance is important (based on asset inventory)

Poor service (condition of assets, documentation up to date)

Level of service is delivered via specified 'service lines':

- NATS Airports
- NATS Consultancy
- NATS Defence
- NATS Engineering
- NATS Information.

BENEFITS TO ORGANISATION

16) Structuring the strategy

No available information.

17) Design for maintenance

No available information.

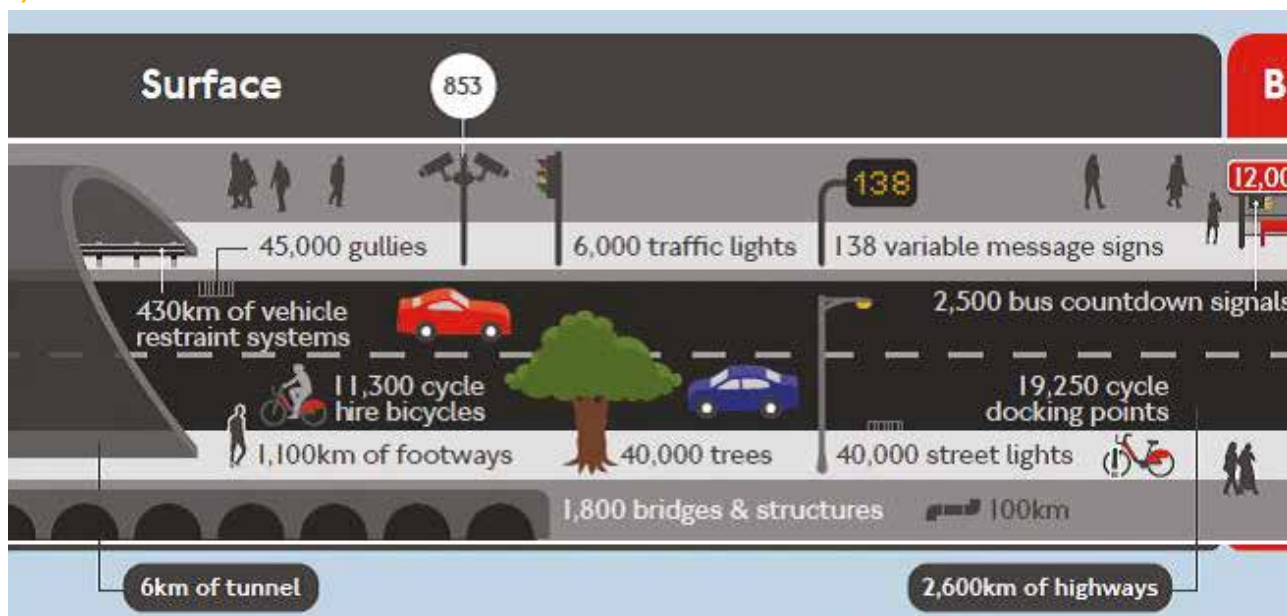
18) Whole lifecycle approach

Reference made to 2% year-on-year savings in operational costs. No specific reference to WLC.

5. TFL – SURFACE TRANSPORT FOR LONDON (UK)

CONTEXT

1) Nature of the assets



2) Quantities

2,600km of highways; 6km of tunnel; 1,800 bridges & structures; 1,100km of footways; 40,000 trees; 40,000 street lights; 6,000 traffic lights; 138 variable message signs; 2,500 bus countdown signals; 19,250 cycle docking points; 430km of vehicle restraint systems; 45,000 gullies; 100km of drains; over 700 acres of grass, trees & verges.

3) Type of organisation

(Pseudo) Public organisation that owns and operates the assets.

4) Size and 'birth' date

Created in 2000 as part of the Greater London Authority. Staff: 3,000. All delivery is outsourced.

5) AMS operating in one, or several companies

One (TfL), but organised in 3 Directorates (Surface Transport, London Underground, London Rail).

AM CURRENT STATUS (FORMAL, OR INFORMAL AMS)

6) Processes and documentation in place

TfL has high level policies and/or objectives that inform/direct its AM. The AM objectives are embedded in TfL policy.

The Asset Management Plan is published and is largely PR, but each asset has its own strategy and plan.

Asset investment programme links into wider TfL Annual Business Planning, spending reviews, etc.

7) Resources dedicated to AM

500 AM staff. There is an Asset Investment team, possibly a little under-resourced for potential full scope of AM activity.

TfL defined roles and responsibilities for the implementation and support of asset management. The AM competencies are defined in staff job descriptions (adopted/adapted from London Underground). TfL ensures appropriate provision of skills and levels of competence to support the implementation of the asset management system through 'role families' (again from LU); defines competencies and training requirements which are reflected in job descriptions.

Have established bespoke AM training at 3 levels to match competence requirements of roles:

Level 1 – intro to AM ½ day. For all in TfL business, approx 1,000 attended to date

Level 2 – principles of AM. 3 days. Suitable for IAM Certificate

Level 3 – 5 No. 2 day modules. Suitable for IAM Diploma

Training programme has been a big success and ensures common understanding/language with respect to asset management.

8) Existing AM IT support tools

A whole range of systems (including SAP) are used to support the implementation of AMS. Plan to rationalise as part of BIM/IMM programme. The data & information required to support AM is continually reviewed. Also under review as part of BIM/IMM implementation programme to improve rigour. To support AM decision making, data is collected from systematic surveys and the use of asset information systems, as well as other analysis tools, etc., inform planning and programme development. Where data/information for AM purposes needs to be based on risk assessment, it's complete and current (80%), otherwise it isn't (20%).

9) AMS maturity journey

TfL procures Lloyds Register in May 2014 for a 3 year contract to provide AM maturity and certification services. Primarily an ISO 55000 certification service (gap analysis and maturity assessment). 25% of activities/processes are compliant with ISO 55000, but 75% are not – principal issue is insufficiency of management system. TfL's certification plan: renewal LU in March 2015. Surface assets to have gap analysis in June 2015. TfL still needs improvements on:

- Engagement with stakeholders to understand their needs and expectations. There is a Customer Experience Team established; surveys, monitor of twitter feeds etc – informs asset strategies and priorities
- Proactivity with communication with LoHAC suppliers
- Actively plan and manage communication assets, its management and the asset management system and objectives, to relevant staff, suppliers, third parties and stakeholders
- Management system
- The process to manage, maintain and review AM procedures
- Data/information accuracy, where it doesn't need to be based on risk assessment (20%).

ROAD TO CERTIFICATION

10) Timetable and plans to full AMS implementation

Seeking ISO 55000 certification. Total completion by 2017.

11) Targets and change management

The change management is established on TfL business processes.

12) Certification for entire AMS, or just for some sub-processes?

Entire AMS.

LESSONS LEARNED

13) Quick wins

Demonstration of benefits engenders trust/faith in approach which facilitates securing appropriate budgets. Efficiency and effectiveness in delivery.

First year's savings were sufficient to cover front-end implementation costs.

See performance success graphs in *AM Slide Pack_Sept 2015* in Evidence/Background documents.

14) Big challenges/barriers

- Organisational buy-in at (most) senior level of management.
- Creation and maintenance of fully documented management system (not yet achieved but in progress).
- Selling benefits of AM across the whole business, ie finance, management, boards.
- Need appropriate budget for AM to be effective.

15) Risks and critical success factors

Critical success factors:

- Senior champion for AM at Board level
- Establishment of dedicated team/resources to lead and progress AM implementation
- Being able to provide evidence to demonstrate benefits of AM approach
- Failures to highlight need for AM approach (Hammersmith flyover)
- Regular audits to the AMS.

Risks:

- Principal risk is financial. Risk that asset knowledge is not adequate – ‘foreseeable’ events not picked up/prevented. ‘Don’t know what you don’t know’. Difference in levels of understanding/sophistication/completeness between assets. Eg recently instigated inspection of traffic signals to address potential risk and consequence post failure. Implementation of AM for VRS another example. Access to network (working window) limits work that can be carried out on the asset.
- TfL does not have procedures for identifying non-conformities and consequent corrective and preventive actions.

BENEFITS TO ORGANISATION**16) Structuring the strategy**

Improvements/lessons-learned are identified and implemented on a case by case basis.

17) Design for maintenance

No available information.

18) Whole lifecycle approach

TfL uses the concept of ‘Whole Life Cost’, or rather ‘Whole Life Value’. TfL is in the process of producing its own handbook on ‘Whole Life Value’.

6. M25 CONNECT PLUS (UK)

CONTEXT

1) Nature of the assets

Highways assets along 400km of network length (200km on M25 and 200km of trunk roads in and out of London).

2) Quantities

About 150,000 assets, organised in 13 asset categories, including main asset as such:

400 linear kilometres (3,200 lane x km) pavement and 40km of footways, 1,750 structures of which 760 bridges, 1 cable-stayed bridge, 5 tunnels, 18,000 street lights, 8,000 signs.

3) Type of organisation

Connect Plus Concession contract with 30 year responsibility for assets. A specialist Construction JV place for initial widening (now completed). A framework of suppliers in place for Connect Plus renewals and Connect Plus Services has separate suppliers. Responsibility for major asset renewals retained by Connect Plus (Concession level) with asset renewals linked to maintenance transferred to Connect Plus Services (O&M specialist). A specialist O&M Contractor in place.

4) Size and 'birth' date

Largest ever contract with Highways England (£6.2bn) awarded to Connect Plus in May 2009. M25 is one of Europe's busiest motorways. It is a ring road around London and local commuter route. Carries 15% of all UK motorway traffic. It is a hub of UK's motorway network and allows access to two of the world's busiest airports. The contract includes:

- Widening of the motorway (Sections 1 & 4) and refurbish Hatfield Tunnel
- Operate and maintain the network for 30 years.

The annual capital expenditure on the assets is £50m (ca. £40m of Connect Plus investment and £10m of Connect Plus Services investment). Connect Plus staff: 25; Connect Plus Services staff: 700.

5) AMS operating in one, or several companies

AMS operates in 2 companies – Concessionaire and Operator. Operator in charge of data collection (inspections, surveys) and preparing the draft AM forward plan, to be challenged and endorsed by the Concessionaire for major civil assets (pavement, structures...). Operators retains the turnkey responsibility for equipment and ancillary assets.

AM CURRENT STATUS (FORMAL, OR INFORMAL AMS)

6) Processes and documentation in place

An Asset Management Framework is in place (Objectives, Policy, Asset Category Strategies). There is a systematic approach to asset management. The asset management objectives are linked to Project Road Objectives (the overarching objectives the client is trying to secure from the project). There is a rolling annual, 5 and 30 year plan published annually. It contains information in the front of the document relating to their delivery strategy. It is distributed internally, provided to shareholders (through a briefing), reviewed by the client and provided to banks/lenders.



The structure of the AM operations is:

- Connect Plus (concession and budget responsibility for majority of renewals works)
- Connect Plus Framework (responsible for delivering ca. £40m of renewals annually)
- Connect Plus Design Framework (responsible for specialist designs)
- Connect Plus Services (O&M specialist with responsibility for 25% of renewals budget)
- Connect Plus Services inspection providers (external parties responsible for delivering some inspections)
- Connect Plus Services designers (external designers who provide support for standard designs developed for CP)
- Connect Plus Services suppliers (responsible for delivering ca. £10m of renewals annually).

Processes and documents are loaded onto a SharePoint site (One Place). To manage, maintain and review those procedures, processes need to be put in place, following system transition.

7) Resources dedicated to AM

Connect Plus staff: 25; Asset management staff: 10 (includes investment, technical, commercial/procurement). Framework: 3 surfacing, 3 civils and 4 testing contractors and 3 designers. Connect Plus Services staff: 700. Asset management staff: 100 (includes asset teams, inspectors, commercial, in house designers, project managers and works supervisors).

A governance statement is in place and is agreed with the client for key organisational roles. Job descriptions are in place for all roles, with required levels of competency. Training is identified as part of the annual Personal Development Reviews. Delivery teams are adjusted according to the scale of investment required through the Asset Management Forward Plan. Improvements could be made to how resourcing decisions are structured/documented.

8) Existing AM IT support tools

- A project is currently underway to transition across to new inventory software and a Decision Support Tool. The team managing the transition (includes the Asset Team) is documenting key parts of the system. This needs to be continued
- The organisation is currently 2 years into configuring an optimisation tool for generating long term plans linked to performance and hand-back obligations. This will demonstrate how schemes deliver the required outcomes in the long run and support long term planning. Time/location charts are produced over a 5 year period
- GIS mapping is used over a 5 year period to identify opportunities to combine renewals projects and generate potential hybrid opportunities with client funded improvement works
- Data requirements are included in client standards and our contract
- Asset data is collected on both local and client systems.

9) AMS maturity journey

- The evaluation of assets is not performed. Assets evaluated mainly based on condition and expenditure (form part of Handback tests)
- Currently trying to secure ISO 55000 accreditation. Gap analysis complete based on Institute Asset Management assessment tool
- Client objectives are updated annually and a new set of Project Road Objectives are issued. Alignment with Asset Management Objectives is reviewed
- Client objectives are linked to their outcomes and road user requirements
- Forums are held with operational stakeholders (eg emergency services) and neighbouring networks are engaged through safety forums
- There are a number of different forums (supplier days, R&D forums, etc) and publications in place, but more formal and structured communication is being considered as part of ISO 55000
- Suppliers are briefed through a quarterly forum (Collaborative Transformation Steering Group) established as part of the BS 11000 initiative
- Residents and businesses local to schemes are engaged as part of a structures process and communications plan
- Staffs are brief in a more ad hoc fashion through meetings and when requests for more structured sessions are requested. A more structured approach to this is being considered in light of ISO 55000 work

- An audit system is in place to capture audit findings and log corrective actions. There is an annual audit plan in place at concession level and operator level. At concession level around 40% of all audits are focused on asset management. Every 5 years there is also a comprehensive review between the concession and operator
- Strategic asset management risks are identified at concession level. These are summarised in the Asset Management Forward Plan and shared with shareholders. Project specific risk registers are also in place;
- A risk register is held at concession and operator level. Risk registers are also shared with the client;
- Opportunities are identified during the production of the Asset Management Forward Plan. These are assessed with high ranking opportunities receiving funding
- Research and Development funding is made available, with funding drawn down through business case submission
- Principal asset's risks are identified and include:
 - Catastrophic asset failure impacts road users and reputations
 - Safety risk to staff and contractors working on projects
 - Lack of budget sufficiency due to incorrect tender assumptions
 - Poor data leads to incorrect investment and decision making
 - Lack of routine maintenance undermines asset investment
 - Risk of rising prices
 - Poor management of changes to our asset inventory.

ROAD TO CERTIFICATION

10) Timetable and plans to full AMS implementation

No information available.

11) Targets and change management

- Improvements can be identified through audits
- Certain renewals projects are selected for a balanced scorecard review whereby project participants score the project, discuss positive and negative outcomes and generate an action plan which is shared with the supply chain
- Strategic change management is generally driven through the annual business plan – asset management objectives are included to drive change in asset management
- Change management at project level is managed through a gateway process.

12) Certification for entire AMS, or just for some sub-processes?

No information available.

LESSONS LEARNED

13) Quick wins

Implementation of ISO 55000 has increased the awareness of the 'softer', but very important, aspects such as leadership, skills/competency and communication.

Initially the AMS was more focused on physical assets and more technical aspects of asset management. People understand AM objectives so can make technical, procurement and R&D decisions that deliver the intended outcomes.

14) Big challenges/barriers

Challenges: Securing understanding and alignment of objectives of the teams that are involved in the end to end asset management process, from inspectors right through the contractors and on site supervisors.

15) Risks and critical success factors

Critical success factors:

- The data has been reviewed as part of the project to transition to the new IT system. Certain data gaps have been identified and plans are now being put in place as part of business as usual activity to close these gaps
- Data quality varies across different asset categories. A lot of the data has been inherited from previous agents. Where system functionality has historically been poor, data sets generally seem to be in poor states. Drainage data (repeat records) and structures (missing data) are particular issues.

BENEFITS TO ORGANISATION

16) Structuring the strategy

- Getting cross team input into the Asset Management Forward Plan and developing simple models to communicated our asset management approach
- Putting in place a Gateway sign-off approach to scheme delivery so that asset team sponsorship of schemes continues into delivery
- Work is underway to develop an Asset Data Strategy to identify the key data required (including aspects of the Decision Support Tool) and its impact on investment and decision making.

17) Design for maintenance

No available information.

18) Whole lifecycle approach

Whole life costing is used. The whole life costing approach uses duration of contract and long term hand-back tests as part of the analysis.

7. **BALFOUR BEATTY MOTT MACDONALD JV, BBMM (UK)**

CONTEXT

1) Nature of the assets

Road assets.

2) Quantities

- 1,303, 2 c-way km
- 2,223 bridges/structures
- 33,000 gullies
- 11,650 signs
- 4,971 technology assets
- 16,995 lighting columns
- 1,182km road restraint systems
- The ownership of the assets is public – Secretary of State.

3) Type of organisation

BBMM is responsible for maintenance and improvement of all physical highway assets in specific areas (Area 10). It acts as 'Asset Custodians'. The top 5 stakeholders for Area 10 are: The Trafford Centre, TfGM, Manchester Airport, Bootle Docks, Liverpool, Blackpool (although not in Area 10 still has an impact on the network), Liverpool Airport.

4) Size and 'birth' date

Organisation for Area 10: Total number of staff = 382.

Annual Turnover = £70m.

5) AMS operating in one, or several companies

One, but does not covers the entire AM process.

AM CURRENT STATUS (FORMAL, OR INFORMAL AMS)

6) Processes and documentation in place

AM Policy, AM Objectives, SAMP, AMPs and key business processes are in place, but under slightly different names.

7) Resources dedicated to AM

AM staff = 26 in core team.

Regarding Operation and maintenance, BBMM outsource to supply chain:

- Schemes (90%)
- AMOR (c.15%)
- Design (50% if incl Mott Mac).

The Contractual framework is ASC (Asset Support Contract) and MAC (Managing Agent Contractor) contract formats.

8) Existing AM IT support tools

No information available.

9) AMS maturity journey

Areas 4 and 10 are both PAS55 accredited since 2014, refreshed in 2015. It took 2 years to achieve PAS55.

BBMM operates a suite of AM IT tools to monitor asset inventory and condition and to model forward investment. They are also required to operate and keep updated Highways England AM IT tools for key asset groups such as pavements, structures, drainage, geotechnical and ITS.

The value of assets is calculated centrally by Highways England and BBMM is not aware of the current figure.

Highways England has a new emphasis on customers, and will increasingly be driven by customer perception. This overseen through Transport Focus and the Monitor (ORR). BBMM is increasing its emphasis – evidenced by appointment of new staff member overseeing key stakeholders schemes.

The view is that if ISO 55000 is adopted it would only require minor changes to BMS processes.

Resource needs and competencies are measured through staff appraisal process.

Communication about the asset management system is handled internally by holding dialogue meetings and briefings with other teams, eg concerning the forward programme and 'framework' (copy provided).

CPF (Contract Performance Framework) targets set by Highways England. Measured monthly.

ROAD TO CERTIFICATION

10) Timetable and plans to full AMS implementation

BBMM has no formal commitment currently to adopt ISO 55000, but has made a promise to that effect in the bid for next Area 4 contract.

The marginal extra cost of moving to ISO 55000 has not been calculated.

The current plan/timetable regarding the fully implementation of an Asset Management System, is to have the PAS55 project complete and successful.

11) Targets and change management

Targets:

- Area 10 to be the best performing area
- Working on behalf of the Highways England to modernise, maintain and operate the network as outlined in their strategic business plan
- BBMM takes safety seriously and embrace a zero harm culture
- Delivering a reliable network and responding to incidents effectively
- Sustainability is at the heart of the business.

12) Certification for entire AMS, or just for some sub-processes?

For all elements of PAS55 excluding policy and strategy.

LESSONS LEARNED

13) Quick wins

Benefits of PAS55:

- Overall improved delivery efficiency
- Improved team cohesion
- Client sees more added value, but little 'thanks' on record.

14) Big challenges/barriers

BBMM will work to improve the communications between BBMM and the main stakeholders, identifying where gaps exist and developing existing relationships to assist in the delivery of timely, informed and effective communications.

Because all of BBMM staff, whether out on the network or office based, are ambassadors for the work that is performed, an improved customer training will be putted in place.

Improved internal communications.

For the financial year 2016/16 BBMM is scheduled to deliver approximately 260 schemes.

Each scheme will be assessed as to develop a Communications Plan to assist in their smooth delivery.

15) Risks and critical success factors

Good communication is integral to the strategy and the success of the Area 10 service contract.

Employee engagement is key to achieving a successful outcome.

Major risks:

- Failure of a major structure
- Lack of funding/investment/resources
- Claims (and repudiating them).

‘You can have the best AMS in the world but if you don’t have the resources, it risks failing’

BENEFITS TO ORGANISATION

16) Structuring the strategy

No available information.

17) Design for maintenance

No available information.

18) Whole lifecycle approach

The organisation use in principle the concept of ‘Whole Life Cost’ for optimising its investment in the asset, but there are still ‘big gaps’ and what they do is not ‘truly’ Whole Life.

Investment still not high enough, so in most cases solutions are ‘Do Minimum’.

8. ASFINAG SERVICE GMBH – DATA COLLECTED IN MARCH 2016 (AUSTRIA)

CONTEXT

1) Nature of the assets

Highways of Austria – road assets along 2,199km network length.

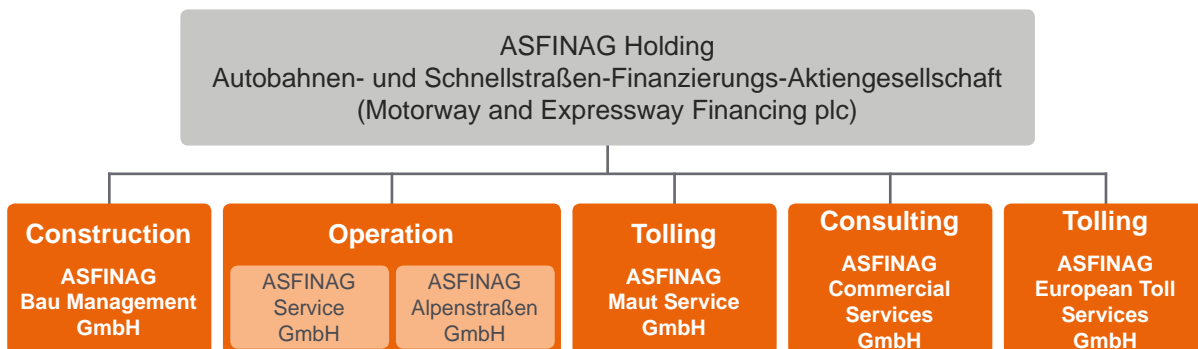
2) Quantities

- Lanes: 11,846km
- Bridges numbers: 5,175
- Bridge area: 5,713,451m²
- Tunnels: 383km; 164 un
- Noise protect barriers area: 4,200,000m²
- Connection points: 366
- Half connection points: 56
- Annexions: 38
- Motorway operation and maintenance facilities: 43
- Toll stations: 6
- Control centres: 9
- Motorway service areas: 86
- Rest areas: 47
- Parking places for HGVs: 6,600
- Parking areas: 107
- Park & Drive areas: 41.



3) Type of organisation

ASFINAG is a state-owned company that plan, finance, build, maintain, operate and collect tolls on the entire primary road network in Austria.



4) Size and 'birth' date

ASFINAG was founded in 1982 and has 2,700 employees. The annual capital expenditure (2014) on the assets are about:

- 380 Mio. EUR annual expenditure for new lanes and new roads
- 460 Mio. EUR annual maintenance and reconstruction expenditure
- 70 Mio. EUR annual Investment expenditure.

The annual maintenance expenditure is about 460 Mio. EUR. The annual revenue is 1.800 Mio. EUR.

5) AMS operating in one, or several companies

See (3).

AM CURRENT STATUS (FORMAL, OR INFORMAL AMS)**6) Processes and documentation in place**

Public tender for measurements of condition parameters of the pavement and of the inspections of objects. Framework contracts. ASFINAG has an asset management strategy which directly links to the company strategy. High level policies and/or objectives that inform or direct its implementation of asset management:

- Ratio of construction sites in our network
- Safety of construction works
- Safety of pavement (eg skid resistance)
- Cost certainty (concerning construction site)
- Annual profit.

Regarding communication:

- the needs and expectations of the road users are identified with opinion polls (road users);
- with annual reports, information to the staff, planning manuals for the suppliers and delivery partners.

There are defined roles and responsibilities in the Department for Asset Management.

7) Resources dedicated to AM

53 employees (incl. overhead and secretary).

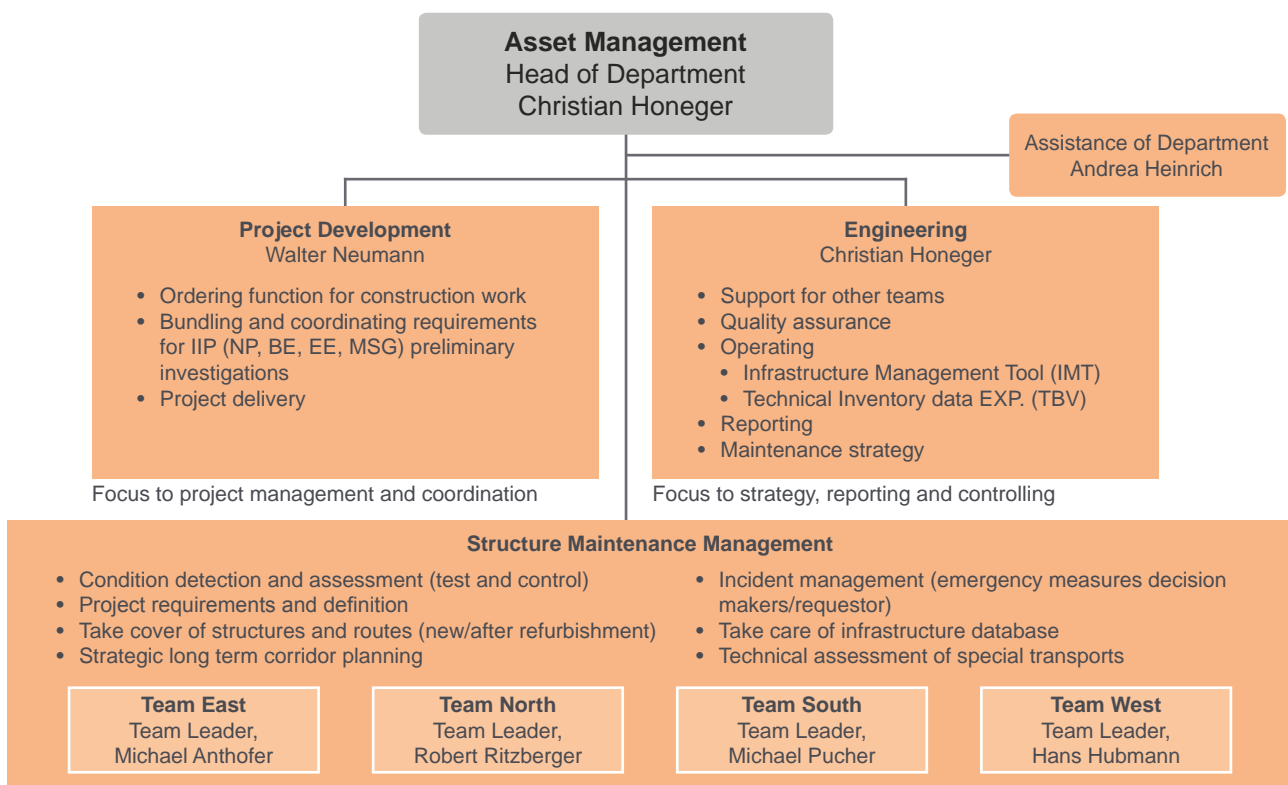
Department ASSET Management is responsible for condition survey and assessment, project development and engineering (reporting, strategy and quality assurance).

Subcontractors:

- 2.3 Mio Eur/year for period inspections and checks
- 0.5 Mio Eur/year for pavement condition scans
- 0.2 Mio Eur/year for asset management systems and software.

In house:

- 6.6 Mio Eur/year for period checks, coordination of construction measures, overhead.



8) Existing AM IT support tools

ASFINAG is currently introducing a new database system to replace the existing system.

In defined intervals the condition of objects and components, traffic data and their developments, construction data and type of objects, etc., are collected and recorded in databases. With calculated condition developments and with stored sequences of action, medium and long-term forecasts are calculated. It can be predicted depending on the default condition developments in defined annual budgets or other side by defined condition the necessary annual budgets. The software calculation model aims to minimise the lifecycle costs.

The organisation has defined the data and information required to support asset management and it is completed and updated. It has also developed in most fields, documented procedures and records management to support the implementation of asset management, which are maintained and reviewed in defined intervals.

9) AMS maturity journey

In 2014 ASFINAG determined the replacement costs of the assets, according to EU directive on road charging and the fair value.

The replacement costs are 34,389 Mio. EUR (status 2014).

The fair value is determined using the average condition and the replacement cost and in 2014 was 23,353 Mio EUR (the average condition is 2.6 (very good =1, very bad = 5).

The AM strategy is in line with ISO 55000 (although they are not certified, but they follow the main objectives of ISO 55000) and it is aligned with the organisational policies and/or strategies. The policies and/or plans for asset management were developed and are available to the most stakeholders.

The level of maturity may be about 70%. ASFINAG is currently working on a strategic road map to improve the asset management system and tools.

ROAD TO CERTIFICATION**10) Timetable and plans to full AMS implementation**

No information available.

11) Targets and change management

The organisation regularly audits the asset management system and has procedures for identifying nonconformities and consequent corrective and preventive actions. After the audits updates on the AMS are performed.

Regarding the change management process at certain time intervals, the changes are recorded in a manual, with the support of the quality management department.

12) Certification for entire AMS, or just for some sub-processes?

No information available.

LESSONS LEARNED**13) Quick wins**

Transparency and traceability of:

- Achievement of asset management and company objectives
- Budget for maintenance and refurbishment
- Effectiveness of construction measures
- Development of the condition of our network.

14) Big challenges/barriers

The main challenges were:

- To introduce a better understanding, that asset management needs a long term focus to make the right decisions now
- To have appropriate management systems and tools
- To deal with different interests (long term, short term)
- To deal with the influence of a professional Asset Management system to the company.

15) Risks and critical success factors

Dealing with different interests and responsibilities in the company.

Regarding risk and opportunity management, for example regarding Tunnel Risk Management: with long-term casualty survey data, type of tunnel equipment, type of traffic management, traffic and traffic development, etc. the probability of occurrence of a failure for every Tunnel is calculated.

The principal risks to the asset faced by the organisation are:

Physical

- Landslides and avalanches
- Extreme accidents.

Resources (People/Financial)

- Change the funding policy
- Economic crisis – fall in tolling revenue.

Environmental

- Accordance to national regulations and laws (eg noise protection, air and water protection, hazardous substances)
- Exchange of technology in cars (autonomous self-propelled cars).

Political

- Change of interests of stakeholders and owners
- New policy of the EU.

BENEFITS TO ORGANISATION**16) Structuring the strategy**

No available information.

17) Design for maintenance

No available information.

18) Whole lifecycle approach

The organisation uses the concept of 'Whole Life Cost' for optimising the investment in the asset.

9. EGIS ROAD AND TUNNEL OPERATION IRELAND (ERTO) – DUBLIN TUNNEL, DATA COLLECTED IN MARCH 2016 (IRELAND)

CONTEXT

1) Nature of the assets

ERTO manages three project areas:

1. Dublin Tunnel
2. Motorway Traffic Control Centre (MTCC)
3. Jack Lynch Tunnel.

The assets are in public ownership. Under the contract agreement, Transport Infrastructure Ireland have assumed ownership of assets (operational transfer of asset ownership).

2) Quantities

1. Dublin Tunnel

It is a twin bore tunnel of 4.5km in length with a height clearance of 4.65m. The assets are divided into the following groups:

- Tunnel and other structures
- Roads and associated infrastructure
- Ventilation systems
- Lighting systems
- Drainage system
- Fire-fighting system
- Communication system
- Traffic control and SCADA system
- Electrical and emergency power system
- Service buildings and plant rooms
- Toll collection systems.

2. Motorway Traffic Control Centre (MTCC)

There are a total of 98 MTCC assets, including servers, Emergency Roadside Telephones, monitors, PABX modules, patch panels, controllers and workstations.

3. Jack Lynch Tunnel

The tunnel is 0.61km long and has two cells, each with two traffic lanes and two footpaths, and a central bore for use in an emergency only.

The assets are divided into groups as indicated for Dublin Tunnel, with exception of toll collection systems.

3) Type of organisation

Egis Road and Tunnel Operation Ireland (ERTO) does not own assets. ERT0 manages assets on behalf of asset owner for the duration of the project (Operation and Maintenance of Tunnels and Motorway Traffic Control Centre).

4) Size and 'birth' date

ERTO employs a total of 98 staff.

The annual maintenance spend (corrective and preventative) for DT and JLT respectively is 2.2m and 1.8m. This includes all costs – staff, sub-contracts, spares, etc.

Egis Road and Tunnel Operation was established in November 2005 as Transroute Tunnel Operation Limited, part of Groupe Egis. Transroute Tunnel Operation, and later Egis Road and Tunnel Operation, have been involved in the operation and maintenance of Dublin Tunnel since 2006. The initial service period was for 60 months. In 2014, ERT0 won a tender for operation and maintenance of Dublin Tunnel, Jack Lynch Tunnel in Cork, and the Motorway Traffic Control Centre. The OMTTCC Term Service Contract commenced on the 20th February 2015 for a duration of six years with a possible extension of up to four years.

5) AMS operating in one, or several companies

One, but on the 3 projects areas.

AM CURRENT STATUS (FORMAL, OR INFORMAL AMS)**6) Processes and documentation in place**

ERTO is not responsible for any cap ex above 10k, all works under 10k are considered maintenance costs.

Above 10k ERTO propose a cap ex programme for the following 12, 24 and 36 months to be agreed with the Service Manager (the Client's representative). The cap ex for 2016 is proposed at 9,65k, 2017 is proposed at 1,025m.

Below 10k ERTO assume, ERTO look at obsolescence issues, lifecycle, degradation in service/safety/reliability and environmental factors.

Also if the maintenance required is becoming unreasonable ie what you would reasonably expect to spend on maintaining a system becomes excessive, then we present this to the client.

Outsourcing of asset management operations is carried out under a standard form contract developed by Egis and approved by the Employer (TII) as was required by our Term Service Contract. For critical systems the contracts include for call out arrangements to ensure defects are addressed timeously.

ERTO has been applying a PDCA (Plan, Do, Check and Act) approach to asset management.

The AM objectives have been incorporated into the Strategic Asset Management Plan, and backed up by a set of AM KPIs. The AM principles and goals have been incorporated into the company's Integrated Management System Policy. The Client's (asset owner's) Asset Management Policy has been incorporated in the ERTO's IMS Policy as annex.

A set of AM procedures has been developed (or the existing documents updated) and included in the project library (document control system).

The contractually-influenced AMS requires ERTO to ensure the communication with AMS stakeholders is effective, therefore a care has been taken to ensure availability of the AM documentation to the AMS stakeholders.

All documents have been included in the project library, ie the Contractor's Plan.

As per initially adopted hierarchy, the AM documents have been structured at 4 levels, ie:

- Level 1 – high level management and governance documents (ie IMS Policy, IMS Manual, SAMP)
- Level 2 – high level plans and business management procedures (ie AM Communication Plan, AM Risk Identification and Management Procedure, Asset Management Plans, Maintenance Plan, Internal Audit Procedure)
- Level 3 – operational manuals and guidelines
- Level 4 – operational procedures and forms.

The AMS documentation is available to the Client, employees, and – as far as applicable - subcontractors and other interested third parties.

ERTO has developed generic Asset Management Plans individually for each project area (Dublin Tunnel, Jack Lynch Tunnel and Motorway Traffic Control Centre). The documents provide a planning framework and address specific requirements included in the contract agreement for development of AM Plans.

Additionally, ERTO has developed, and maintain, Annual Asset Management Plans for each system/asset group, and submits them annual to the Service Manager (Client's representative) for approval.

ERTO has developed and implemented a procedure for management of documents and records, defining the principles and processes for accessing, reviewing, updating and archiving of documents.

The documents are reviewed annually, unless a need for revision is identified through internal audits, or following change in legislation, or following review of the AM risk register.

ERTO has implemented 3 management systems, ie:

- ISO 9001 Quality Management System
- ISO 14001 Environmental Management System
- OHSAS 18001 Occupational H&S Management System.

The company is in the process of implementing ISO 27001 Information Security Management System.

Ultimately, the company's portfolio of management systems, ie Integrated Management System, will include 5 ISO-compliant systems.

Communication has been an important element on the agenda throughout the implementation process. It has been planned (in the ISO 55001 implementation programme), and subsequently put in place.

Communication with the key stakeholder of ERTO AMS, ie the Client (asset owner), is planned and managed in line with the contractual requirements, and as stipulated in ERTO's Communication Plan. The regular means of communication with the client include:

- Monthly review meetings
- Workshops for review of AM Strategy and AM Objectives
- Formal communication via contract management software
- AMS Review meetings – although the Client does not participate in review meetings, the report is submitted as part of project records library.

7) Resources dedicated to AM

Direct responsibility for asset management lies with the Maintenance department (15 staff).

ERTO Maintenance department includes:

- Maintenance Manager (Asset Management Leader)
- Civil Engineer
- Reliability and Planning Engineer
- Maintenance Management Software (MMS) Administrator
- Mechanical & Electrical (M&E) Technical Services Coordinator
- M&E Technicians
- SCADA Software and Hardware Technicians.

The resources necessary for implementation of the ISO 55001 have been identified at the planning stage of the implementation project. ERTO has adopted an inter-departmental approach, ie the AM process is led by the Maintenance department, but planning, coordination and documentation is overseen by the QA Manager. The QA Manager ensures that all requirements of the ISO standard are identified and addressed, and that the PDCA approach is applied to the AMS. The process of update and review of documentation has been supported by a technical writing resource. External (corporate) experts have been providing documentation review and internal audit service.

The asset management process is also supported by the following departments:

- Finance department (3 staff)
- QESH department (5 staff)
- IT department (4 staff)
- Commercial Manager (1 staff).

The significant portion of asset management work is outsourced. There are 42 contracted parties delivering work at DT, 3 at MTCC and 46 at JLT (asset management-related).

Training matrices have been developed and are maintained by the HR department to indicate the level of training required for each individual position. The effectiveness of the training and further training needs are identified as part of the overall performance (employee and company) evaluation process.

The AM training needs have been reviewed and re-identified at the ISO 55001 implementation planning stage (as part of the implementation project programme).

A high level review of adequacy of resources is carried out at the AM review meetings, taking into account the overall effectiveness of the AMS, the level of performance, results of internal audits, etc.

8) Existing AM IT support tools

These are:

- Maximo – asset and maintenance management software (MMS)
- SIMS (Stores, Inventory Management System)
- Orion Network Performance Monitor
- Virtual Cabinet – electronic documentation control system.

9) AMS maturity journey

Under the previous contract (2006-2014, operation of Dublin Tunnel only), ERTO adjusted its AMS to the requirements of PAS55. Currently (after 2015), ERTO is in the process of implementation of ISO 55001:2014.

The AMS objectives have been developed in line with the overall business strategy of ERTO. The applicability of AMS objectives will be reviewed at annual asset management review meetings.

ERTO describe the planning and communication strategy in the Strategic Asset Management Plan. The means of communication and sources of input in terms of stakeholders' requirements and expectations have been identified separately for each key AMS stakeholder:

- The requirements and expectations of the Client (asset owner) have been documented in the contractual service catalogue (a comprehensive list of all contractual requirements linked to corresponding plan or procedure describing how this requirement is met), and in the list of contractual Key Performance Indicators.
- The requirements and expectations of tunnel and road network users are identified through external communication (enquiries and complaints), and annual customer satisfaction surveys.
- The requirements and expectations of Emergency Services are identified primarily through regular emergency response exercises and communication following significant events.
- The requirements and expectations of ERTO internal stakeholders are identified through regular inter-departmental meetings.

A number of communication channels have been utilised to ensure adequate level of staff awareness. These have been described in the company's Communication Plan and include:

- Internal training (level of training adjusted to the level of involvement in the AMS)
- External training (for the staff directly involved in the implementation/maintenance of the AMS)
- Update of staff induction to include introduction to ISO 55001
- Posters and electronic notice board messages
- Internal workshops
- Internal memos and communication
- Inter-departmental meetings.

The subcontractors have received individual notifications about the AMS (via e-mail). Information about the AMS is also included in subcontractors' inductions.

The level of awareness of both staff and subcontractors is subsequently verified through internal audits.

The roles and responsibilities for the implementation and support of asset management have been defined within the Strategic Asset Management Plan and in a dedicated document – ERTO Descriptions of Functions.

The completeness of information is monitored monthly under specific KPIs.

ROAD TO CERTIFICATION

10) Timetable and plans to full AMS implementation

The certification has been planned for 2016 (Stage 1 audit scheduled for September 2016, Stage 2 audit scheduled for November 2016).

11) Targets and change management

The scope of ERTO's AMS includes physical assets only. However, information as an asset is controlled under a separate management system, ie ISO 27001 Information Security, which ERTO has been implementing in parallel to ISO 55001. This 'overlap' of systems and controls has been recognised and reflected in ERTO's AMS documentation.

ERTO regularly audit its asset management system and has defined and implemented an annual audit schedule for all 3 project areas. The AM processes are audited at least once a year within each project area.

ERTO has implemented a Corrective Action procedure and Preventive Action procedure, supported by a Continual Improvement procedure.

As ERTO is at the beginning of its AM journey, it cannot really confirm the effectiveness of the continual improvement process with regards to AM.

However, based on the principles adopted for the other management systems, the primary sources of improvements are:

- Feedback from the Client
- Feedback from road and tunnel users
- Results of internal audits
- Supplier (subcontractor) audits
- Third party audits
- Analysis of trends in the level of performance (measured with KPIs)
- Incidents
- ERTTO recognises several levels/types of change to be controlled:
- Engineering changes, both planned and emergency, temporary or permanent – these are controlled under a specific ERTTO Change Control Procedure (change request submitted on a dedicated form; reviewed, evaluated in terms of risk and approved by Change Control Committee)
- Business management changes – these are reviewed at regular progress review meetings, and, at a high level, at the annual management review meeting. The review includes evaluation of impact on the AMS;
- Changes in applicable legislation, regulatory requirements and standards – these are controlled under a dedicated legislation compliance procedure;
- Changes in AMS risk – these are controlled under a dedicated AMS Risk Identification and Management procedure;
- Changes to the AMS Strategy and Objectives – if there are any; these are reviewed at annual review meetings with the Client.

12) Certification for entire AMS, or just for some sub-processes?

For the entire AMS.

LESSONS LEARNED

13) Quick wins

The key, high-level benefits for ERTTO result from a clearer definition and improved organisation of asset management processes.

This in turn enables ERTTO to implement the requirements of the contract in a more structured, cost-effective, timely and safe manner. The risk-based approach adopted under the ISO 55001 helps to prioritise decisions.

14) Big challenges/barriers

The main challenge has been to ensure that ERTTO's AMS conforms both to the requirements of the ISO 55001 standard, and the requirements of the contract agreement. The contract initially required implementation of PAS55, rather than ISO 55001, and the transition to the ISO standard required full analysis, formal approval by the client and processing of contractual amendments.

The obvious challenge has been the ownership of assets and the AM roles and responsibilities already defined under the contract (asset owner [the Client] vs asset manager [ERTTO]). Taking this into account, it has been difficult for ERTTO to design the AMS in such a way that the system addresses the requirements of the standard, reflects the key AM principles and remains in line with the contract.

Having a set and tight contractual timeframe for implementation of the system has also been challenging, and has required a strict regime for planning, decision-making and decision execution.

The level of necessary implementation expertise had to be efficiently increased (intensive training).

15) Risks and critical success factors

The critical success factors cannot be fully determined as ERTTO is still in the implementation phase, and the system is yet to be externally verified for compliance and effectiveness.

Regarding risks and opportunity management, the AM risks identified by ERTTO fall into the following categories:

- Strategic risks: risks that are created by ERTTO's business strategy and strategic objectives
- Operational risks: risks that occur due to day to day operations
- Asset risks: risks that are associated with the effective and efficient delivery of operational asset management objectives and the asset's lifecycle
- Programme risks: risks that arise due to changes in strategic plans and procedures.

→ Project risks: risks associated with the implementation of new projects and programmes.

The majority of risks identified by ERTO can be classified as physical and environmental.

Risk priority has been defined on 4 levels:

- High risk – immediate action required
- Medium risk – action to be applied within next month
- Low risk – action to be reviewed annually
- Very low – action to be reviewed annually

Risks that are deemed by ERTO not to have an adequate control measure in place are given an 'Open' status. Such risks are prioritised and given most attention in order to close them out, and implement mitigation measures.

Currently, the ERTO risk register contains 135 no. of risks within 13 system/asset group categories.

BENEFITS TO ORGANISATION

16) Structuring the strategy

ERTO's criteria for asset management decision-making include (among others):

- Client and stakeholder requirements – primarily defined within the contract (contractual compliance matrix)
- Obsolescence
- Enhanced maintenance requirements, above what would normally be expected or experienced
- End of life and premature failure
- Changes in legislative requirements and international standards
- Changes to maintenance and operational requirements
- Lifecycle value realisation
- AMS Policy
- Risk management data
- Results of AM internal and external audits.

The data and information required to support asset management have been identified in the ISO implementation planning phase.

17) Design for maintenance

No available information.

18) Whole lifecycle approach

Due to the contract duration being less than some system life span, optimising full lifecycle costs is difficult.

ERTO propose to maintain the asset for as long as reasonably practical and then when reliability/safety deteriorates to a level that affects the service of the system we propose cap ex works.

10. SUPPLEMENTARY INFORMATION OBTAINED FROM DURHAM COUNTY COUNCIL (UK) IN JULY 2016

- Durham County Council (DCC) is responsible for 3778km of road, 486 road bridges and 82,144 street lighting columns.
- DCC has a role as asset owner, asset manager and also runs an in-house asset operational department with some 250 staff. It describes itself as running a 'mixed public/private sector economy' and around 50% of maintenance work is sub-contracted out to the private sector.
- When a decision was taken to adopt the ISO 55000 standard in early 2015, DCC was already working to an informal asset management system and had prepared a draft Transport Asset Management Plan (TAMP). Information Systems were seen as key, and DCC had a mature road management system based on UKPMS.
- At that time, the authority was already accredited to BS ISO 9001, BS ISO 14001 and BS ISO 18001, and it was seen as a logical extension to seek BS 11000 (Collaborative Business Relationships) and BS ISO 55001 (Asset Management).
- A business case was drawn up; as the AMS was already working, the marginal extra costs of ISO 55001 were seen as mainly the fees of employing outside audit and accreditation services, and staff time in documenting processes and case studies. The ongoing extra audit costs are expected to be marginal, given that the work will be combined with the other existing ISO audits.
- A dry run audit in July 2015 was used to establish the gap analysis of requirements to be fulfilled in order to achieve level 3 competence.
- At a final audit in January 2016 DCC successfully met the requirements and were certified to ISO 55001.
- The benefits of accreditation were immediately apparent:
 - DCC achieved a ranking in the top two out of 119 Highway Authorities in the government's efficiency rating questionnaire. This is hoped will improve the likelihood of enhanced central government support and funding in future.
 - DCC report that staff engagement in asset management has greatly improved.
 - Political support through the Council Portfolio Holder has also improved and funding secured and enhanced based on more rational lifecycle modelling criteria.

APPENDIX 2

COST BENEFIT ANALYSIS

DESIGN OF COST BENEFIT ANALYSIS

One of the principal objectives of the CEDR ARISE study was to attempt to identify both the likely costs and benefits of implementing an asset management system – ISO 55001 compliant systems in particular – based on the experience of organisations that had been through the process, in order to inform those considering such an implementation.

The design of the Cost Benefit Analysis (CBA) was directed and constrained by the fact that the data would only be obtained from the consultation exercise for WP1, with the expectation that no more than 10 case studies would be completed from a range of organisations. This informed:

- The potential quantity of data to be obtained
- The reasonableness of granularity/detail of data to be requested
- The likely availability of quantified/monetised information
- The likely variability in the range of responses
- How representative the responses would be of the overall highway authority community

Consideration was also given to the likely availability of information on costs and benefits, as well as how it could be analysed and presented. From this assessment two key principles were established:

- The request for data should align with the structure of ISO 55000 in order to facilitate analysis and integration with the other work packages in the study
- The data requested should be capable of being quantified/monetised

The structure of ISO 55000 is presented in Appendix 3. Evaluation of each of the elements in the context of ISO 55001 indicated that 'Support' (element 7) is the principal heading under which costs would be incurred and/or benefits accrued in contributing to activities under the remaining elements.

Potential sources of cost and/or benefit that could most readily be quantified/monetised were then considered and rationalised as follows:

- Time
- Expenditure
- Risk exposure/mitigation

Thus, costs were defined to include time, expenditure or increased risk, while benefits included savings in time or expenditure or mitigation of risk.

As the likely availability of quantified information was considered to be low, and also to facilitate assimilation of data between organisations of different scales, the magnitude of costs and benefits were requested on a simple, ranked scale:

- 0 = None
- 1 = Low
- 2 = Medium
- 3 = High

In order to achieve a manageable scale of data request, both for completion by respondees to the information gathering and subsequent analysis, the CBA data schedule was limited to the principal element headings of ISO 55000 which, with further rationalisation and interpretation, resulted in the framework presented in Table A2.1.

In order to capture the wider benefits and associated costs, beyond the immediate scope of ISO 55000, of implementing an asset management system, the following general questions were also included:

1. What are/were your baseline costs for managing your assets prior to implementing your asset management system?
2. What is the overall estimated cost of implementing your asset management system?
3. What are overall savings are you expecting to achieve from implementing your asset management system?
4. What is your expected payback period?

RESULTS OF COST BENEFIT ANALYSIS

Only four organisations provided information for the cost benefit analysis. The results of the analysis of the responses in terms of:

1. Costs
2. Benefits
3. Benefit-Cost Ratio

are presented in Tables A2.2 to A2.4.

Tables A2.2 and A2.3 show, respectively, the relative costs and benefits to the organisation of implementing the various asset management elements that constitute ISO 55001, based on the aggregated scores from the three participating organisations. The scores reflect the organisations' subjective assessment of the comparative cost and benefit associated with each element.

Table A2.4 shows the combined costs and benefits of implementing the various elements of ISO 55001 to indicate which elements are likely to provide the greatest return on an organisation's investment of time, effort or resources compared to unity.

Table A2.1 Cost Benefit Analysis Framework

CEDR ARISE Cost Benefit Analysis – Data Collection Framework

Name of Organisation:

Implementation of ISO 55000 or equivalent?

Notes for Respondees

1. The purpose of this framework is to collect comparative costs and benefits associated with the implementation of asset management systems.
2. Respondees should complete the table to provide an indicative value for the costs incurred or benefits realised on the following scale: 0 = None 1 = Low 2 = Medium 3 = High
3. Costs may include time, expenditure or increased risk. Benefits may include savings in time or expenditure or mitigation of risk.
4. The framework has been structured around the asset management elements set out in ISO 55000, and looks at the various areas of Support (Section 7) required by each of the other six elements.
5. Organisations that have implemented ISO 55000 - or other formal asset management systems - are asked to provide an indication of the incremental costs and benefits of doing so.
6. Organisations that have not implemented a formal asset management system are asked to provide an indication of the costs and benefits associated with their ongoing asset management processes.

General Questions

- What are/were your baseline costs for managing your assets prior to implementing your asset management system?
- What is the overall estimated cost of implementing your asset management system?
- What are overall savings are you expecting to achieve from implementing your asset management system?
- What is your expected payback period?

Support (7)		Resources		Competence		Awareness/Comms		Information		Documentation	
	Asset Management Elements (ISO 55000)	Human and non-human resources including tools		Competence, skills, experience, training, training management		Awareness of policy and practices; internal and external communication		Information management, information needs, information systems		Documented information, document control and management	
		Costs	Benefits	Costs	Benefits	Costs	Benefits	Costs	Benefits	Costs	Benefits
Context (4)	Align asset management with organisational objectives and context; Understand and respond to stakeholder needs and expectations; Define the scope of the asset management system; Plan the implementation of asset management system, produce SAMP.										
Leadership (5)	Provide asset management leadership and ensure Top Management commitment; Produce and Asset Management Policy; Define and establish organisational roles, responsibilities and authorities for asset management.										
Planning (6)	Identify and manage actions to implement the asset management system, including risks and opportunity; Define asset management objectives and produce plans for specific assets or asset types to meet those objectives.										
Operation (8)	Establishing and implement operational planning and control processes; Establishing and implement change management processes; Ensure outsourced services are integrated within overall asset management system.										
Performance Evaluation (9)	Develop and implement processes for monitoring, measurement, analysis and evaluation of performance; Undertake internal audits; Undertake high-level management reviews.										
Improvement (10)	Establish and implement process for investigating nonconformities and implementing corrective actions; Establish and implement process for initiating preventative actions; Establish and implement process to continually identify, assess and implement improvements.										

Table A2.2 ISO 55001 element costs from aggregated returns

		Support (7)					TOTAL
		Resources	Competence	Awareness/ Comms	Information	Documentation	
Asset Management Elements (ISO 55000)		Human and non-human resources including tools	Competence, skills, experience, training, management	Awareness of policy and practices, internal and external communication	Information management, information needs, information systems	Documented information, document control and management	Costs
Context (4)	Align asset management with organisational objectives and context; Understand and respond to stakeholder needs and expectations; Define the scope of the asset management system; Plan the implementation of asset management system, produce SAMP.	8	9	4	6	5	32
Leadership (5)	Provide asset management leadership and ensure Top Management commitment; Produce and Asset Management Policy; Define and establish organisational roles, responsibilities and authorities for asset management.	3	2	2	3	3	13
Planning (6)	Identify and manage actions to implement the asset management system, including risks and opportunity; Define asset management objectives and produce plans for specific assets or asset types to meet those objectives.	8	7	6	9	5	35
Operation (8)	Establishing and implement operational planning and control processes; Establishing and implement change management processes; Ensure outsourced services are integrated within overall asset management system.	9	7	6	8	4	34
Performance Evaluation (9)	Develop and implement processes for monitoring, measurement, analysis and evaluation of performance; Undertake internal audits; Undertake high-level management reviews.	5	3	3	6	4	21
Improvement (10)	Establish and implement process for investigating nonconformities and implementing corrective actions; Establish and implement process for initiating preventative actions; Establish and implement process to continually identify, assess and implement improvements.	6	6	5	5	5	27
TOTAL		39	34	26	37	26	

COSTS

The results show that implementing the following asset management elements are likely to incur the greatest relative cost⁹:

- Planning (35/60), eg implement the asset management system, define asset management objectives, produce individual asset plans to meet those objectives.
- Operation (34/60), eg establishing and implementing operational planning and control processes, and change management processes, integrating outsourced services into overall asset management system.
- Context (32/60), eg aligning asset management with organisational objectives, defining stakeholder needs and objectives, defining and planning the asset management system, producing the strategic asset management plan (SAMP).

Meanwhile, the following asset management elements are likely to incur a relatively low cost:

- Improvement (27/60), eg establishing processes for investigating and correcting non-conformities, and initiating preventative actions and improvements.
- Performance Evaluation (21/60), eg establishing performance management processes, undertaking audits and reviews.
- Leadership (13/60), eg ensuring Senior Management commitment, produce asset management policies, define and establish roles and responsibilities.

The costs associated with implementing these asset management elements arise primarily from the following:

- Resources (39/72), eg staff time, additional resources.
- Information (37/72), eg development of information management systems and collection and management of associated data.
- Competence (34/72), eg training management and provision of training.

The following Support activities are likely to require the lowest relative investment:

- Awareness/Communications (26/72), eg internal and external communication to raise and embed awareness of policy and practices.
- Documentation (26/72), eg production of documentation, establishment of document management procedures and systems.

⁹ The numbers in parenthesis show the aggregated cost out of the maximum possible value.

Table A2.3 ISO 55001 element benefits from aggregated returns

Asset Management Elements (ISO 55000)		Support (7)					
		Resources	Competence	Awareness/ Comms	Information	Documentation	
		Human and non-human resources including tools	Competence, skills, experience, training, management	Awareness of policy and practices, internal and external communication	Information management, information needs, information systems	Documented information control and management	
Context (4)	Align asset management with organisational objectives and context; Understand and respond to stakeholder needs and expectations; Define the scope of the asset management system; Plan the implementation of asset management system, produce SAMP.	9	10	11	6	10	TOTAL 46
		11	8	8	4	6	
Leadership (5)	Provide asset management leadership and ensure Top Management commitment; Produce and Asset Management Policy; Define and establish organisational roles, responsibilities and authorities for asset management.	11	8	8	11	11	49
Operation (8)	Establishing and implement operational planning and control processes; Establishing and implement change management processes; Ensure outsourced services are integrated within overall asset management system.	9	8	5	9	9	40
Performance Evaluation (9)	Develop and implement processes for monitoring, measurement, analysis and evaluation of performance; Undertake internal audits; Undertake high-level management reviews.	7	5	4	8	7	31
Improvement (10)	Establish and implement process for investigating nonconformities and implementing corrective actions; Establish and implement process for initiating preventative actions; Establish and implement process to continually identify, assess and implement improvements.	7	8	6	7	7	35
	TOTAL	54	47	42	45	50	

BENEFITS

Table A2.3 shows the relative benefit of the various elements that constitute ISO 55000 based on the consolidated results from the three participating organisations. Benefits are defined as savings in time and expenditure and/or reductions in risk exposure using the same comparative scale as for costs.

The results show that implementing the following asset management elements are likely to provide the greatest relative benefit to the organisation¹⁰:

- Planning (49/60), eg implementing the asset management system, and producing asset management plans for individual assets
- Context (46/60), eg effective alignment of asset management system with organisational objectives, defining and planning implementation of the asset management system, developing a strategic asset management plan (SAMP).
- Operation (40/60), eg establishing and implementing operational planning and control processes, and change management processes, integrating outsourced services into overall asset management system
- Leadership (37/60), eg ensuring Senior Management commitment, developing asset management policies, establishing effective organisational structure including roles and responsibilities.

Meanwhile, the following asset management elements are likely to provide the lower relative benefits:

- Improvement (35/60), eg establishing processes for investigating and correcting non-conformities, and initiating preventative actions and improvements.
- Performance Evaluation (31/60), eg establishing performance management processes, undertaking audits and reviews.

The greatest benefits associated with the implementation of these elements of the asset management system are:

- Resources (54/72), eg increased maintenance budgets, availability of additional resources.

However, benefits are likely to be derived across all remaining Support activities:

- Documentation (50/72), eg more fully documented information, better document control and management.
- Competence (47/72), eg enhanced skills and knowledge, more competent staff.
- Information (45/72), eg better information management supporting better informed decision-making.
- Awareness/Communication (42/72), eg greater awareness of asset management policy, improved consistency and conformity.

¹⁰ The numbers in parenthesis show the aggregated benefit score out of the maximum possible value value

Table A2.4 ISO 55001 element benefit – cost ratios from analysis of returns

Asset Management Elements (ISO 55000)		Support (7)					TOTAL
		Resources	Competence	Awareness/ Comms	Information	Documentation	
		Human and non- human resources including tools	Competence, skills, experience, training, management	Awareness of policy and practices, internal and external communication	Information management, information needs, information systems	Documented information, document control and management	
Context (4)	Align asset management with organisational objectives and context; Understand and respond to stakeholder needs and expectations; Define the scope of the asset management system; Plan the implementation of asset management system, produce SAMP.	BCR +1	BCR +1	BCR +2	BCR +0	BCR +1	+5
Leadership (5)	Provide asset management leadership and ensure Top Management commitment; Produce and Asset Management Policy; Define and establish organisational roles, responsibilities and authorities for asset management.	+3	+3	+3	+1	+1	+11
Planning (6)	Identify and manage actions to implement the asset management system, including risks and opportunity; Define asset management objectives and produce plans for specific assets or asset types to meet those objectives.	+1	+1	+1	+1	+2	+6
Operation (8)	Establishing and implement operational planning and control processes; Establishing and implement change management processes; Ensure outsourced services are integrated within overall asset management system.	+0	+1	-1	+1	+2	+3
Performance Evaluation (9)	Develop and implement processes for monitoring, measurement, analysis and evaluation of performance; Undertake internal audits; Undertake high-level management reviews.	+1	+1	+1	+1	+1	+5
Improvement (10)	Establish and implement process for investigating nonconformities and implementing corrective actions; Establish and implement process for initiating preventative actions; Establish and implement process to continually identify, assess and implement improvements.	+1	+1	+1	+1	+1	+5
TOTAL		+7	+8	+7	+5	+8	

BENEFIT COST RATIO

Table A2.4 considers the combined costs and benefits of implementing the various elements of an asset management system to indicate which elements are likely to provide the greatest return on an organisation's investment of time, effort or resources. Given that the figures are based on relative rankings provided by a small sample of organisations, the relative importance – represented by the shading and values¹¹ in the table – is considered to be more meaningful than the absolute Benefit:Cost Ratio (BCR).

The results show that the implementation of each element of ISO 55000 is likely to provide a positive return on investment, with the Leadership element providing by far the greatest (+11). Leadership includes:

- The provision of asset management leadership and ensuring Senior Management commitment to asset management
- Producing an Asset Management Policy
- Defining and implementing an effective asset management organisational structure including roles and responsibilities.

Within this element, Resources (+3), Competence (+3) and Awareness/Communication (+3) make the greatest contribution, underlining the value of investing in appropriate resources, providing appropriate training and ensuring awareness through effective communication.

Operation, eg establishing and operating asset management processes and procedures, provides the lowest return of the six elements (+3). However, within this element, only Awareness/Communication has a relative BCR less than one; the lowest result and only value less than one.

Considering individual Support activities, Competence and Documentation provide the greatest return on investment (both +8), ahead of Resources and Awareness/Communication (both +7).

The responses from the four participating organisations to the general questions are given in table A2.5.

¹¹ The numbers in the table show the relative value of the benefit:cost ratio to unity

Table A2.5: General costs and benefits of implementing an asset management system

Question	Respondent			
	1	2	3	4
What are/were your baseline costs for managing your assets prior to implementing your asset management system?	Not assessed/calculated	We were already working in an asset management system organisation and had rather well defined asset management processes and procedures. So the introduction of PAS55 was related to find scopes for further improvement.	Unknown	circa £800m pa
What is the overall estimated cost of implementing your asset management system?	These costs were not collected	There was not a big smash hit change for us. The introduction of asset management was smoothening that happened through a long term evolution (not a top management decision for a revolution). So we started making changes during late 1990's to processes and procedures that did not work and around 2005 had we become an asset management organisation.	Circa £1m pa (ie 10 staff)	circa £2m pa since 2011 (ie £10m)
What are overall savings are you expecting to achieve from implementing your asset management system?	Not considered. The driver was providing an improved asset management system to meet client requirements	This has never been measured and can also be very difficult to measure since there where during this evolution period also numerous other improvement programs running.	Circa 20% efficiency saving in capital maintenance costs (ie £30m – £40m)	circa £84m pa
What is your expected payback period?	Not calculated	Not applicable	Start-up costs paid back in < 1 year	< 1 year after full implementation

APPENDIX 3

CROSS REFERENCING ISO 55001 & ISO 55002 IN A HIGHWAYS CONTEX

4. CONTEXT OF THE ORGANISATION			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
4.1. Understanding the organisation and its context			
<p>The organisation shall determine relevant external and internal issues that affect the organisations ability to achieve the intended outcomes of the asset management system.</p> <p>Asset management objectives shall be aligned to, and consistent with, the organisation's objectives.</p>	<p>Organisational objectives and organisational plan</p>	<p>Asset management system has a prescribed structure and should fit in and result from:</p> <p>Organisational objectives</p> <p>Organisational plan</p> <p>AMS includes:</p> <ul style="list-style-type: none">→ Policy→ AM Objectives→ SAMP→ AMPs (guided by SAMP)	<p>For a road administration, this should be the organisation's highest-level plan and objectives that defines the purpose of the organisation.</p> <p>These should reflect the administration's position within the overall governance structure. For example, the administration's objectives and plan might be set by the overarching Government Ministry or Department to which it reports or may be defined in the commercial agreement where the road administration operates in a more commercial capacity.</p> <p>For highways this could reflect different organisations being asset owner & operator, and that these arrangements might change during asset lifecycle.</p>
	<p>Internal and external context</p>	<p>Ensure approach to asset management system is consistent and aligned with the external and internal contexts of the organisation</p> <p>Assess the ability of the asset management system to achieve the organisational objectives</p>	<p>The external context of a road administration is likely to include, but not be limited to:</p> <p>Political, legal, regulatory, commercial, environmental, social and technological considerations at a local, regional, national and international level:</p>

4. CONTEXT OF THE ORGANISATION		
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context
		<p>Key drivers and trends having impacts on the objectives of the organisation, for example political or social trends, technological developments, etc.</p> <p>Relationships with, perceptions and values of external stakeholders (see section on stakeholders below).</p> <p>The internal context of the road administration is likely to include but not be limited to:</p> <p>Governance requirements (including the reporting needs of overseeing ministries, departments, regulators, etc.)</p> <p>Organisational structure, roles, accountabilities and authorities</p> <p>Policies, objectives and strategies</p> <p>Capabilities</p> <p>Information systems, information flows and decision-making processes</p> <p>Relationships with, and perceptions and values of internal stakeholders (see below)</p> <p>Culture of the organisation</p> <p>Standards and guidance</p> <p>Contractual relationships, including with third-party service providers and contractors</p> <p>Risk management approach</p>

4. CONTEXT OF THE ORGANISATION			
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context	
		Asset management practices and other management systems such as environmental or quality management systems Integrity and performance of the road assets and asset systems Feedback from any previous failures, incidents, accidents and emergencies Feedback from previous self-assessments, internal audits, and reviews	
4.1. Understanding the needs and expectations of stakeholders			
The organisation shall determine: Stakeholders that are relevant to the asset management system Requirements and expectations of these stakeholders with respect to asset management Criteria for asset management decision making Requirements for recording financial and non-financial information relevant to asset management and reporting on it internally and externally	Stakeholder requirements	This should include both internal and external stakeholders. Stakeholder needs and expectations should be documented and communicated. (These can be captured by a statement of needs within the SAMP). Needs include identification of required levels of service that the assets should deliver to meet stakeholder expectations. Criteria for decision making is also driven by stakeholder needs.	For road administrations, internal stakeholders will typically include employees and functional groups within the organisation External stakeholders will typically include: Governmental organisations (including overseeing Ministries and Central Departments), regulatory authorities and politicians as well as tax payers: Road users (including freight operators, public transport providers as well as private car users) Local communities, ie people and businesses who are affected by the road network Operators, service providers and other contractors operating on behalf of the road administration and their supply chain (including materials suppliers, etc.)

4. CONTEXT OF THE ORGANISATION			
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context	
		<p>Local authorities</p> <p>Utility companies</p> <p>Other transport operators</p> <p>Media (national, local)</p> <p>Automobile clubs and other interest groups (eg social, environmental).</p> <p>The road administration should determine the needs of these stakeholders (for example the expected levels of service) and determine how to use them to inform decision making, noting that these needs may, in some cases, be mutually exclusive.</p>	
4.3 Determining the scope of the asset management system			
<p>The organisation shall determine the boundaries and applicability of the asset management system to establish its scope</p> <p>The scope shall be aligned with the SAMP and the asset management policy</p> <p>When determining the scope, the organisation shall consider:</p> <p>External and internal factors referred to in Element 4.1</p> <p>Stakeholder requirements referred to in Element 4.2</p>	<p>Scope of asset management system</p>	<p>Asset management system includes:</p> <p>Asset management policy</p> <p>Asset management objectives</p> <p>Strategic Asset Management Plan (SAMP)</p> <p>Individual asset management plan(s)</p> <p>The scope of the asset management system may expand as its maturity increases. Initially, an organisation might wish to limit the scope to the key or business critical assets. (But it must include those which align to organisational objectives).</p>	<p>For road administrations, the scope of the asset management system may include:</p> <p>→ The assets, or asset portfolios managed by the organisation and their interrelationships, and the level of granularity at which they are managed (but noting that road assets interact so closely that it is very unlikely that 'cherry picking' which assets to include would be a compliant approach)</p>

4. CONTEXT OF THE ORGANISATION			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
<p>Interaction with other management systems</p> <p>The organisation shall define the asset portfolio covered by the scope of the asset management system.</p> <p>The scope shall be available as documented information.</p>			<p>→ The business processes and asset management activities that fall within the scope of the asset management system, or that interface with it (for example quality management systems, financial management processes, procurement and contract management processes may be out of scope of the asset management system but will have an interrelationship with it).</p> <p>Similarly, the parts of the organisation that are involved in asset management or that interact with it, including service providers and contractors</p>
4.4 Asset management system			
<p>The organisation shall establish, implement, maintain and continually improve an asset management system, including the processes needed and their interaction, in accordance with the requirements of ISO 55001.</p>	<p>Implementation of asset management system</p>	<p>In the initial development of the asset management system, the organisation should outline how it intends to establish, implement, maintain and improve the system.</p> <p>Reviewing the current processes against the requirements of ISO 55001 will determine the areas in need of development.</p> <p>Asset management processes, activities and data should be integrated with those of other parts of the organisation. Where possible, existing business processes should be leveraged to avoid unnecessary or duplicate work.</p>	<p>A road administration embarking on the implementation of an asset management system, should follow the following steps:</p> <p>Once the scope of the asset management system has been established, carry out a gap analysis of the current asset management system against the requirements of ISO 55001 to determine the improvements that are needed</p> <p>Systematically prioritise these improvements based on importance (ie are they key enablers for the asset management system as a whole), risk (are they preventing the organisation from meeting its asset management objectives).</p>

4. CONTEXT OF THE ORGANISATION			
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context	
	<p>The review should result in a prioritised plan to implement the asset management system within available resources.</p> <p>A useful starting point is the establishment of the asset management policy – which may provide a focus – followed by the development of the SAMP.</p>	Develop a realistic implementation plan that reflects resource availability and which includes interim delivery milestones to enable progress to be managed.	
The organisation shall develop a SAMP which includes documentation of the role of the asset management system in supporting achievement of the asset management objectives.	<p>Strategic Asset Management Plan (SAMP)</p> <p>The SAMP may be contained in, or may be a subsidiary plan of the organisational plan. It consists of documented information which specifies: How organisational objectives are converted into AM objectives; The Approach for developing AM Plans and The Role of the AMS in supporting achievement of AM objectives. 1.</p> <p>In developing the SAMP, the organisation should:</p> <p>Consider the needs and expectations of stakeholders</p> <p>Consider activities that could extend beyond the normal planning timeframe</p> <p>Clearly document the processes to establish its asset-related decision-making criteria</p>	<p>For a road administration, the SAMP should be a high-level plan that:</p> <p>Describes the asset management objectives of the road administration</p> <p>Sets out, at a high-level, how the organisation will achieve these objectives</p> <p>Provides a framework for the development of asset management plans for individual assets, or groups of assets.</p> <p>In developing the SAMP, the road administration should consider activities such as the long-term maintenance, renewal, replacement and/or disposal of assets with long lives (eg bridges and structures).</p>	

5. LEADERSHIP			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
5.1 Leadership and commitment			
<p>Top management shall demonstrate leadership and commitment with respect to the asset management system by:</p> <p>Ensuring that the asset management policy, the SAMP and asset management objectives are established and are compatible with the organisational objectives</p> <p>Ensuring the integration of the asset management system requirements into the organisation's business processes</p> <p>Ensuring that the resources for the asset management system are available</p> <p>Communicating the importance of effective asset management and of conforming to the asset management system requirements</p> <p>Ensuring that the asset management system achieves its intended outcome(s)</p>	<p>Leadership and commitment</p>	<p>Asset management leadership can be demonstrated by top management through positively influencing the organisation by:</p> <p>Making reference to asset management principles in communication</p> <p>Engagement in setting objectives and measures of success for the people responsible for the asset management</p> <p>Establishing a work culture that is focused on delivering the asset management objectives</p> <p>Using asset management related decision-making criteria for capital expenditures and other decisions</p> <p>Supporting asset management related improvement activities</p> <p>Supporting a management-development track that encourages and rewards time spent in roles associated with asset management and operation of the asset management system</p>	<p>Securing buy-in and commitment at the most senior levels of management within the road administration is essential for successful implementation an establishment of the asset management system.</p> <p>Leadership includes:</p> <p>The provision of asset management leadership and ensuring Senior Management commitment to asset management, and ISO 5000 implementation in particular</p> <p>Producing an Asset Management Policy to support the context of the organisation and establish 'line of sight' through the organisation's AM operations and delivery</p> <p>Defining and implementing an effective asset management organisational structure including roles and responsibilities</p> <p>Securing necessary resources (staff and budget) and removing barriers to the successful implementation of the asset management system.</p>

5. LEADERSHIP			Highways Context
ISO 55001 Requirements	General Guidance (based on ISO 55002)		
<p>Directing and supporting persons to contribute to the effectiveness of the asset management system:</p> <p>Promoting cross-functional collaboration within the organisation</p> <p>Promoting continual improvement</p> <p>Supporting other relevant management roles to demonstrate their leadership as it applies to their areas of responsibility</p> <p>Ensuring that the approach used for managing risk in asset management is aligned with the organisation's approach for managing risk.</p>	<p>Monitoring the asset management system performance and ensuring corrective or preventative actions are carried out</p> <p>Monitoring the asset management system performance and ensuring corrective or preventative actions are carried out</p> <p>Assuring that asset management is considered at the same level of importance as safety, quality, environment, etc</p> <p>Addressing asset related risks and incorporating them into the organisation's risk management processes</p> <p>Aligning asset management and the asset management system to other organisational functions, practices and management systems.</p> <p>Top management may appoint an individual to oversee the development, implementation, operation and continual improvement of the asset management system but overall ownership and accountability must remain at the top management level.</p>		

5. LEADERSHIP			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
5.2 Policy			
<p>Top management shall establish an asset management policy that:</p> <p>Is appropriate to the purpose of the organisation</p> <p>Provides a framework for setting asset management objectives</p> <p>Includes a commitment to satisfy applicable requirements</p> <p>Includes a commitment to continual improvement of the asset management system.</p> <p>The asset management policy shall:</p> <p>Be consistent with the organisational plan</p> <p>Be consistent with other relevant organisational policies</p> <p>Be appropriate to the nature and scale of the organisation's assets and operations</p> <p>Be available as documented information</p> <p>Be communicated within the organisation</p>	<p>Asset management policy</p>	<p>The asset management policy should be a short statement that sets out the principles by which the organisation intends to apply asset management to achieve its organisational objectives and should be authorised by top management:</p> <p>The policy should set out the organisation's commitments and expectations for decisions, activities and behaviour concerning asset management. It should be aligned to and demonstrate support for the organisational objectives</p> <p>It is not necessary for the policy to be captured in a discrete document (it could be included in the SAMP for example) but it must be demonstrably communicable to the organisation</p> <p>There should be a process in place to review and update the asset management policy, and to ensure that if the organisation's internal or external context changes, the actions necessary to update the policy are also triggered.</p>	<p>In the roads context, where the owner is most likely a public road administration, the asset management policy and principles will usually be set by the owner, even if the asset management delivery is outsourced. This could, for example, include:</p> <p>Guiding principles for asset management activities (eg safety of road users and road workers is paramount, investment decisions will be based on minimising life-cycle costs, minimising impact on environment)</p> <p>Long-term objectives, sustainable outcomes and stakeholder requirements</p> <p>Provision of sufficient resources, within an appropriate organisational structure, to deliver the asset management objectives</p> <p>Decision-making criteria to be used, eg asset management decisions are to be based on evaluations of alternatives that take into account lifecycle costs, benefits and risks</p> <p>Reporting on asset and asset management performance</p> <p>Continual improvement of the asset management system.</p>

5. LEADERSHIP			
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context	
Be available to stakeholders, as appropriate Be implemented and be periodically reviewed and, if required, updated.			
5.3 Organisational roles, responsibilities and authorities			
<p>Top management shall ensure that the responsibilities and authorities for relevant roles are assigned and communicated within the organisation.</p> <p>Top management shall assign the responsibility and authority for:</p> <p>a) Establishing and updating the SAMP, including asset management objectives</p> <p>Ensuring that the asset management system supports delivery of the SAMP</p> <p>Ensuring that the asset management system conforms to the requirements of ISO 55001</p>	<p>Roles, responsibilities and authorities</p>	<p>The responsibilities and authorities of key functions should be defined, as well as interfaces between organisational functions both internally and externally</p> <p>It should be clear which role is responsible for which activity</p> <p>When assigning internal roles, consideration should be given to:</p> <p>An individual's experience and competence</p> <p>Support for the role through training and mentoring</p> <p>Other workload requirements and their variability, which could impact on the individual's ability to deliver on asset management related objectives</p>	<p>In a road administration where certain asset management activities may be outsourced, this should include both internal and outsourced roles and responsibilities, as well as the interfaces between them. The responsibilities of the contractors and external service providers, and the competence required, should form part of the contractual requirements.</p>

5. LEADERSHIP			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
<p>Ensuing the suitability, adequacy and effectiveness of the asset management system</p> <p>Establishing and updating the asset management plan(s)</p> <p>Reporting on the performance of the asset management system to top management.</p>		<p>The individual being able to demonstrate an understanding of what the responsibilities mean in the context of their role.</p> <p>In small or medium-sized organisations, multiple asset management functions may be assigned to one individual. This does not change the need to communicate this to other stakeholders, or to clarify the responsibilities of the individual.</p>	

6. PLANNING			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
6.1 Actions to address risks and opportunities for the asset management system			
<p>When planning for the asset management system, the organisation shall consider the issues referred to in 4.1 and the requirements referred to in 4.2 and determine the risks and opportunities that need to be addressed to:</p> <p>Give assurance that the asset management system can achieve its intended outcome(s)</p> <p>Prevent, or reduce undesired effects</p> <p>Achieve continual improvement.</p> <p>The organisation shall plan:</p> <p>a) Actions to address these risks and opportunities, taking into account how these risks and opportunities can change with time</p> <p>How to:</p> <p>Integrate and implement the actions into its asset management system processes</p> <p>Evaluate the effectiveness of these actions.</p>	<p>Addressing risks and opportunities</p>	<p>The organisation should determine the actions that are necessary for addressing risks when planning for its asset management system. In ISO 55001, it is assumed that the term 'risk' also includes opportunities.</p> <p>The overall purpose is to understand the cause, effect and likelihood of adverse events occurring, to manage such risks to an acceptable level, and to provide an audit trail for the management of risks. When addressing risks in the asset management system, the organisation should determine the risk assessment criteria.</p> <p>The approach of managing risks associated with the asset management system should be aligned with the organisation's overall risk management approach and should be related to other risk management processes.</p> <p>The organisation should determine and plan actions, and provide adequate resources, to address its asset management system risks.</p>	<p>With respect to road administrations, these requirements relate to risks to the successful implementation and ongoing operation of the asset management system rather than risks related to the assets themselves.</p> <p>The intent is for the road administration to ensure that the asset management system achieves its objectives, prevents or reduces undesired effects, identifies opportunities, and achieves continual improvement.</p> <p>The actions to address these risks should be incorporated into the implementation plan for the asset management system.</p>

6. PLANNING			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
		The organisation should be able to demonstrate how it has evaluated the effectiveness of the actions that it has taken to manage the risks identified.	
6.1 Actions to address risks and opportunities for the asset management system			
6.2.1 Asset management objectives			
The organisation shall establish asset management objectives at relevant functions and levels. When establishing its asset management objectives, the organisation shall consider the requirements of relevant stakeholders and of other financial, technical, legal, regulatory and organisational requirements in the asset management planning process. The asset management objectives shall: Be consistent and aligned with the organisational objectives Be consistent with the asset management policy Be established and updated using asset management decision-making criteria (see 4.2)	Asset management objectives – overview	The asset management objectives, derived as part of the SAMP, provide the essential link between the organisational objectives and the asset management plan(s) that describe how those objectives are going to be achieved. The asset management objectives transform the required outcomes (product or service) to be provided by the assets, into activities typically described in the asset management plan(s). Asset management objectives should be specific, measurable, achievable, realistic and time-bound (ie 'SMART' objectives). They can be both quantitative measurements (eg mean time between failures) and qualitative measurements (eg customer satisfaction).	For a road administration, the asset management objectives should be aligned with the organisation's overall objectives and may cover aspects such as: Improving network safety Improving network and/or asset condition Minimising disruption to road users Minimising environmental impact Improving user satisfaction Achieving cost efficiencies Etc. It may be appropriate to define objectives at different levels of aggregation ie at an asset, portfolio, regional or organisation level. Care should be taken to ensure that objectives that reinforce desired behaviours and don't lead to unexpected, perverse incentives.

6. PLANNING			Highways Context
ISO 55001 Requirements	General Guidance (based on ISO 55002)		
<p>Be established and updated as part of the SAMP:</p> <p>Be measurable (if practicable)</p> <p>Take into account applicable requirements</p> <p>Be monitored</p> <p>Be communicated to relevant stakeholders</p> <p>Be reviewed and updated as appropriate.</p> <p>The organisation shall retain documented information on the asset management objectives.</p>		<p>The organisation should consider the monitoring, measuring, analysing and evaluating needed to drive and support its decision making on improvement actions.</p> <p>The asset management objectives should be aligned to the organisational objectives and should promote collaboration with stakeholders.</p>	
	Developing asset management objectives	<p>During the development of its asset management objectives, the organisation should:</p> <p>a) Review risks, including impact of potential failure</p> <p>b) Review the importance of assets related to their intended outcomes, objectives and product or service requirements</p> <p>Check the applicability of the asset management objectives during the asset management planning process.</p>	

6. PLANNING			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
	Issues addressed by asset management objectives	<p>The organisation should consider the typical issues that are addressed by the objectives include the following:</p> <p>For large or complex asset management systems, the organisation might also need to establish objectives for the asset management system itself.</p>	<p>For a road administration, typical issues that are addressed by the asset management objectives may include:</p> <p>a) At an organisational/network level</p> <p>Customer satisfaction scores; Society or reputation survey results; Environmental impact, eg carbon costs; Level of service; Safety; Asset valuation.</p> <p>For assets: Asset condition/performance; Lifecycle costs; Asset valuation; Asset energy performance.</p> <p>For asset management system itself: Performance against plan; Certification or assessment of maturity (by benchmarking); Cost-benefit ratio, return on investment.</p>
	Monitoring performance against asset management objectives	<p>Monitoring the performance of the organisation's asset management, in terms of how well the asset management objectives and hence the organisational objectives are being met, is an important part of the asset management system (see 9.1).</p> <p>Deviations in performance should be used as inputs to revise the asset management objectives.</p> <p>Asset management objectives should be subject to regular management review (see 9.3) and such reviews should inform the continuous improvement process (see 10.3).</p>	

6. PLANNING			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
6.2.2 Planning to achieve asset management objectives			
<p>The organisation shall integrate the planning to achieve asset management objectives with other organisational planning activities, including financial, human resources and other support functions.</p> <p>The organisation shall establish, document and maintain asset management plan(s) to achieve the asset management objectives. These asset management plan(s) shall be aligned with the asset management policy and the SAMP.</p> <p>The organisation shall ensure that the asset management plan(s) take(s) into account relevant requirements coming from outside the asset management system.</p>	<p>Asset management plan overview</p> <p>The organisation should develop an asset management plan(s) which is aligned across the organisation and in particular with the AM policy & SAMP. In order to define the activities that will be implemented and the resources that will be applied to meet the asset management objectives and consequently the organisational objectives. An asset management plan(s) provides the direction to, and expectations for, an individual asset or for a portfolio, group or class of assets.</p> <p>An asset management plan(s) should be documented at a level that is appropriate to the organisation and the degree of sophistication in its asset management approach.</p> <p>For some organisations, this may be captured in a single document, while for other organisations, multiple asset management plans may be appropriate.</p> <p>Asset management plan(s) should be developed to appropriate time horizons for the organisation.</p>	<p>There is no set formula for what should be included in the asset management plan or how it should be structured, however, for a road administration, a typical asset management plan will include:</p> <p>Introduction – explaining how that asset management plan(s) support the overall asset management policy and SAMP</p> <p>Performance Management – description of the performance measures in order to monitor the performance of the asset against the asset management objectives</p> <p>Asset Information – a summary of the assets included within the plan, by type, group, subgroup and components, including construction or renewal dates and other important information. This section should also describe the approach for collecting and managing inventory and condition data</p> <p>Lifecycle planning – The approach adopted for lifecycle planning should be documented. It should include; the assumptions made, performance requirements, maintenance needs, the decision-making process, and the proposed maintenance and treatment strategy, and the timing of interventions</p> <p>Investment Strategy – Details of the funding required to deliver the lifecycle plan, including planned, cyclic and reactive maintenance, and to sustain the desired level of performance</p> <p>Work Programming – Work required to manage and operate the network at the required performance levels. The section should summarise how the works programme was developed as well as describing the programme itself.</p>	

6. PLANNING		
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context
<p>When planning how to achieve its asset management objectives, the organisation shall determine and document:</p> <p>a) The method and criteria for decision making and prioritising of the activities and resources to achieve its asset management plan(s) and asset management objectives:</p> <p>The processes and methods to be employed in managing its assets over their lifecycles</p> <p>What will be done</p> <p>What resources will be required</p> <p>Who will be responsible</p> <p>When it will be completed</p> <p>How the results will be evaluated</p> <p>The appropriate time horizon(s) for the asset management plan(s)</p> <p>The financial and non-financial implications of the asset management plan(s)</p> <p>The review period for the asset management plan(s) (see 9.1)</p>	<p>There can be benefits in developing the first asset management plan(s) as an interim plan as quickly as possible, using existing information. It helps the organisation to understand the strengths and weaknesses of current asset management practices and to identify priorities for the development of future plan(s). It can also help avoid embarking on ambitious data collection exercises before needs are fully understood.</p> <p>It is important for the organisation to commit the resources that are identified in the asset management plan(s) as being necessary, in order to achieve its planned objectives.</p> <p>Asset management plan(s) should be reviewed periodically to ensure continual alignment with the asset management objectives.</p> <p>There should be a regular assessment of the ability of the SAMP to support the achievement of the asset management objectives. This analysis should be used as input to management review and to an improvement process for the asset management system.</p>	<p>Risks – Details of the risks in managing highway infrastructure assets.</p> <p>Performance Monitoring – Details of how asset performance will be monitored and the results fed back into the planning process.</p> <p>The level of detail within the asset management plan should be proportionate to the size and complexity of the highway network being managed.</p> <p>The time horizons should take account of the organisation's period of responsibility and the life of its assets (for example, where responsibility for management of all or part of the highway network activities has been outsourced for a period of time).</p>

6. PLANNING			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
<p>Actions to address risks and opportunities associated with managing the assets, taking into account how these risks and opportunities can change with time, by establishing processes for:</p> <ul style="list-style-type: none"> → Identification of risks and opportunities → Assessment of risks and opportunities → Determining the significance of assets in achieving asset management objectives → Implementation of the appropriate treatment, and monitoring, of risks and opportunities. <p>The organisation shall ensure that its asset management related risks are considered in the organisation's risk management approach including contingency planning.</p>	<p>A risk ranking process can determine which assets have a significant potential to impact on the achievement of the asset management objectives, ie which are the critical assets.</p>	<p>When developing or reviewing asset management plan(s), the organisation should consider:</p> <p>a) Who should be responsible for developing and implementing the asset management plan(s) and their continual improvement</p> <p>Who will read the asset management plan(s), what they will want to know and need to know</p> <p>The environments in which the assets are operating or are intended to operate and the activities that are being performed either on individual assets, or where there are interdependencies between multiple assets</p> <p>Activity program requirements, which will typically also involve operational planning activities and implementation (see Clause 8)</p>	<p>In developing their asset management plan(s), road administrations should consider:</p> <p>Whether they have suitable internal resources available or whether they should external resources and, if the latter, how to retain the knowledge within the organisation</p> <p>Who the target audience is for the asset management plan(s) and what they need to know. For example, the information needs of senior managers, operational staff, service providers and external stakeholders will all be different</p> <p>Scheduling of maintenance activities across different assets to deliver efficiencies and reduce disruptions to road users – particularly where different assets are supported by different parts of the organisation and/or have their own individual asset management plans</p> <p>Where some or all asset management activities have been outsourced, the asset management plans must be consistent with the contracts under which the service providers operate and, crucially, service provider contracts must be in full alignment with the asset management plan(s) and the road administrations asset management objectives.</p>

6. PLANNING			
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context	
	<p>The performance of the assets and the intended outcomes expected from implementation of asset management plan(s) in enabling the organisation to achieve its asset management objectives.</p> <p>Whether appropriate resources and funding is available.</p> <p>Applicable standards.</p>		
	<p>Management of risks to achieving asset management objectives</p>	<p>The organisation should ensure that its assets are capable of delivering the required products or services and achieving its organisational objectives.</p> <p>The organisation should be able to create and demonstrate a link between the actions that address the risks and the organisation's approach to risk management and business continuity planning.</p> <p>When planning processes to manage risk in the asset management system, the organisation should consider adopting a structured method for identifying, analysing and evaluating risk (see 6.1). An example method is provided below.</p>	

6. PLANNING		
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context
	<p>a) Classify assets and define the scope: prepare a list of asset systems and their constituent assets, and gather information about them, including the management and control activities which affect the assets' performance; define the scope and limits of the individual asset risk assessments (see 4.3).</p> <p>b) Identify risks: create a table of potential events and their causes, ensuring that the identification process includes risks to the delivery of the organisational objectives.</p> <p>c) Identify risk controls that exist (or are proposed for planned assets and planned activities).</p> <p>d) Analyse risks using appropriate process.</p> <p>e) Evaluate the level of risk: estimate the likelihood and consequences for each potential event, based on the asset management decision-making criteria (see 4.2) and the risk management criteria (see 6.1). The effectiveness of any existing risk controls, and the likelihood and consequences of their failure, should also be considered.</p>	

6. PLANNING			
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context	
	<p>f) Evaluate the level of risk over time: where appropriate, establish whether the identified risks will change over time, and how this will affect their consequences.</p> <p>g) Evaluate the tolerability of the risks: decide whether planned or existing controls (if any) are sufficient to keep the risks under control and to meet any legal, statutory and other asset management requirements.</p> <p>Determine the treatment of the risks: establish whether the risks will be treated by addressing them directly, avoiding, reducing, tolerating or transferring them.</p>		
	Management of risk in asset management planning	<p>The organisation's method to identify, analyse and evaluate risk in the asset management system should be documented appropriately (see 7.6):</p> <p>The organisation should document the risks associated with asset management and incorporate risks critical to the achievement of the asset management objectives in its risk register.</p>	<p>Road administrations would ensure that their risk management approach considers very low probability/high consequence events that may occur on the road network, for example, extreme weather events, catastrophic asset failure etc, and ensure that they are adequately prepared.</p> <p>Given the importance of the highway network to the national economy, road administrations should apply a common methodology for determining the financial/economic implications of the asset management plan(s) such as the economic cost of road traffic accidents, rolling resistance and traffic delays:</p>

6. PLANNING		
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context
	<p>The organisation should establish governance arrangements for risk management in the asset management system (see 6.1). This includes audit of the risk management approach (see 9.2), and the review of risks by top management (see 9.3).</p> <p>Where asset lifecycle activities or asset management activities are outsourced, the organisation should ensure that the asset management system includes appropriate control and management of risk (see 8.3).</p> <p>Asset management plan(s) should consider the risks during the organisation's period of responsibility, including any residual liabilities beyond the period of operation or use of the asset.</p> <p>In the process of continual improvement, the organisation should consider the risks that can change with time and how these could impact the asset management system in the future.</p> <p>It is important that risk analysis includes the capability of the asset system to monitor and continually assess the probability of rare, but potentially catastrophic, events.</p>	<p>Where asset lifecycle activities or asset management activities are outsourced, the road administration should ensure that the asset management system includes appropriate control and management of risk across the organisational boundaries.</p>

6. PLANNING			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
		<p>The organisation should apply a common methodology for determining the financial/economic implications of the asset management plan(s).</p> <p>Lifecycle cost, which may include capital expenditure, financing and operational costs, should be considered in the decision-making process (see 4.2).</p>	

7. SUPPORT			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
7.1 Resources			
<p>The organisation shall determine and provide the resources needed for the establishment, implementation, maintenance and continual improvement of the asset management system.</p> <p>The organisation shall provide the resources required for meeting the asset management objectives and for implementing the activities specified in the asset management plan(s).</p>	<p>Asset management resource requirements</p>	<p>During the development and implementation of the asset management system, the organisation should determine the resources required. This should include both internal and external, and human and non-human resources.</p> <p>Where funding or resourcing constraints mean that not all proposed asset management activities can be resourced as proposed. An iterative process to reconcile proposed activities with available resources should be used, and the criteria and processes for prioritising asset management activities defined.</p> <p>In some organisations, these activities can require that other parts of the organisation provide additional resources in order to support the primary asset management activity (eg additional staff).</p> <p>Any tools, facilities or equipment that are required for the delivery and control of asset management activities should be defined and managed as assets, at a level of detail appropriate to their function and purpose.</p>	<p>All data and information necessary for the management of the highway asset – including inventory, condition and performance data – should also be defined and managed as assets at an appropriate level of detail.</p>

7. SUPPORT			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
7.2 Competence			
<p>The organisation shall:</p> <p>Determine the necessary competence of person(s) doing work under its control that affects its asset performance, asset management performance and asset management system performance</p> <p>Ensure that these persons are competent on the basis of appropriate education, training, or experience</p> <p>Where applicable, take actions to acquire the necessary competence, and evaluate the effectiveness of the actions taken</p> <p>Retain appropriate documented information as evidence of competence</p> <p>Periodically review current and future competency needs and requirements.</p>	<p>Asset management competency overview</p>	<p>In asset management competence is defined as 'the ability to apply knowledge and skills to achieve intended results'. To meet this definition management should all levels of the organisation in a way that ensures alignment between roles and levels and not just for those considered to be asset managers.</p> <p>For example, a competent trades person should be able to demonstrate clear competency in specific asset management related tasks (eg condition rating) and also have an understanding of the relationship of what they do to the asset management activities others undertake (eg the input of the condition rating activity into the determination of remaining useful asset life).</p>	<p>Road administrations that outsource asset management activities should ensure that appropriate competency requirements form part of their contract with external service providers and contractors.</p> <p>Asset management competence should also include an understanding of how an individual's activities support the wider asset management objectives of the road administration as well as an understanding of how to complete the specific activities themselves.</p>

7. SUPPORT		
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context
	<p>Competency gap analysis</p> <p>The organisation should determine the competences required for all asset management roles and responsibilities, and the awareness, knowledge, understanding, skills and experience needed to fulfil them. The organisation should map its current competences to its required competences to determine any gaps. This gap analysis can be used to develop asset management competency improvement and training plans, and enable the organisation to incorporate specific asset management competences into its organisational competency framework, as considered appropriate.</p> <p>All persons assigned roles and accountabilities within the organisation that can have an impact on the asset management system should have those roles and accountabilities communicated to them, be provided with the training, education, development and other support needed to perform their role, and be able to demonstrate the competences required.</p>	

7. SUPPORT			
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context	
	<p>Competency and organisational design</p> <p>There is clearly an interdependency between an organisations asset management competences, its organisational design and business processes. When undertaking a competency gap analysis, it should also consider undertaking a gap analysis of its organisational design and business processes and develop appropriate improvement plans, as necessary.</p> <p>In the event that the organisation decides to outsource any aspect of the asset management system, the organisation should ensure that the external resource providers can demonstrate competency against the required activities. The organisation should, depending on the criticality of the activity, validate claims of competency, and have a process to ensure that any third party resource provider continues to provide competent resources.</p>	<p>If a road administration were to discover that the majority of its asset management competences existed within one individual, with no effective succession and knowledge management plans, this this would represent a significant risk that required urgent remedial action).</p> <p>Where a road administration has outsourced some or all of its asset management activities, then it should ensure that it validates claims of competency, and has a process in place to ensure that any third party resource provider continues to provide competent resources.</p>	

7. SUPPORT			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
7.3 Awareness			
<p>Persons doing work under the organisation's control, who can have an impact on the achievement of the asset management objectives, shall be aware of:</p> <p>the asset management policy</p> <p>their contribution to the effectiveness of the asset management system, including the benefits of improved asset management performance</p> <p>their work activities, the associated risks and opportunities and how they relate to each other</p> <p>the implications of not conforming to the asset management system requirements.</p>	<p>Asset management awareness</p>	<p>Persons working under the organisation's control should have appropriate awareness of the organisation's asset management system and activities. They should be aware of the asset management policy and the following:</p> <p>a) Why asset management is important to the organisation</p> <p>b) The implications of changes in the operation of the organisation</p> <p>c) Their contribution to the effectiveness of the asset management system</p> <p>d) Asset management related risk consequences of their work activities, their behaviour, and the asset management benefits of improved personal performance and how they relate to each other</p> <p>e) Their roles, responsibilities and authorities as well as the importance of their contribution in meeting the requirements of the asset management policy and the asset management system</p>	<p>For a road administration, this may include staff, contractors, internal or external service providers, and suppliers.</p>

7. SUPPORT			
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context	
	<p>f) How well the organisation is performing in meeting its objectives.</p> <p>The specific awareness needs of any stakeholder should be determined by their role and its relationship to the organisation meeting its asset management objectives.</p>		
	<p>Improving organisational awareness</p>	<p>The level of organisational awareness can be improved, for example, by the following:</p> <ul style="list-style-type: none"> a) A consultation process with staff throughout the organisation concerning the establishment, operation, improvement and changes to the asset management system b) Discussion of asset management in the organisation's newsletters, briefings, introduction programme or journals (including new employee orientation) c) Inclusion of asset management articles on relevant web pages d) Inclusion of asset management as a topic in staff and management team meetings e) Briefings for top management f) Briefing key suppliers and distributors on the organisation's asset management arrangements. 	

7. SUPPORT			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
7.4 Communication			
The organisation shall determine the need for internal and external communications relevant to assets, asset management and the asset management system including: On what it will communicate When to communicate With whom to communicate How to communicate.	Communication overview	Asset management activities carried out by the organisation should be communicated to relevant stakeholders periodically, in a coordinated way, as an integral part of the organisation's asset management activity and asset management system.	For road administrations, the communication plan should cover external stakeholders, including, potentially, local authorities, utility companies and other transport providers, as well service providers and contractors.
	Developing a communication plan	The organisation should develop communication plan(s) with consideration of: a) Building awareness of the asset management requirements and expectations b) Developing an understanding of how the implementation of the asset management system can impact stakeholders c) Promoting engagement with stakeholders to embrace transparency and create accountability for the asset management system d) Managing, informing and influencing stakeholders who can directly impact the asset management plans and the achievement of the asset management objectives.	

7. SUPPORT			
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context	
	<p>Communication plan content</p> <p>The content of the communication plan(s) may include the following:</p> <ul style="list-style-type: none"> a) The benefits of implementing an activity, project, programme, or asset modification or augmentation, and how these improvements are expected to collectively or individually impact stakeholders and the organisation: b) Any improvement schedules, including key milestones, who will be involved, and for how long c) Any resource specific communications, including statements of the asset management system expectations d) The who, why, when and what of communicating, including how well the organisation is performing against its organisational objectives and the contribution asset management is making to this performance e) If appropriate, what external and internal knowledge is needed for the stakeholders to make informed contributions or decisions, or provide informed feedback 		

7. SUPPORT			Highways Context
ISO 55001 Requirements	General Guidance (based on ISO 55002)		
		<p>f) The representative who is best suited to deliver specific communications</p> <p>g) The format to be used for the communications</p> <p>h) The feedback and reporting processes.</p>	
7.5 Information requirements			
<p>The organisation shall determine its information requirements to support its assets, asset management, asset management system and the achievement of its organisational objectives. In doing this:</p> <p>a) The organisation shall include consideration of:</p> <ul style="list-style-type: none"> → The significance of the identified risks → The roles and responsibilities for asset management → The asset management processes, procedures and activities 	Information requirements overview	<p>The organisation should determine the information needs related to its assets, asset management and its asset management system.</p> <p>The organisation should use a systematic approach to identify the necessary asset information and establish the appropriate information repositories. For example, the organisation should undertake a needs analysis, establish priorities, review system development options and data collection strategies, plan the creation of information repositories and data collection, then implement as appropriate.</p>	

7. SUPPORT			
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context	
<p>→ The exchange of information with its stakeholders, including service providers</p> <p>→ The impact of quality, availability and management of information on organisational decision making.</p> <p>The organisation shall determine:</p> <p>→ The attribute requirements of identified information</p> <p>→ The quality requirements of identified information</p> <p>→ How and when information is to be collected, analysed and evaluated.</p> <p>The organisation shall specify, implement and maintain processes for managing its information</p> <p>The organisation shall determine the requirements for alignment of financial and non-financial terminology relevant to asset management throughout the organisation</p>	<p>Assessing information requirements</p> <p>In general, the organisation should consider its asset information requirements related to the following areas:</p> <p>a) Strategy and planning</p> <p>Process</p> <p>Technical and asset physical properties</p> <p>Service delivery and operations</p> <p>Maintenance management</p> <p>Performance management and reporting</p> <p>Financial and resource management</p> <p>Risk management</p> <p>Contingency and continuity planning</p> <p>Contract management.</p>	<p>For a road administration, the asset information requirements are likely to cover, the following categories:</p> <p>Construction (including age since construction/last major maintenance as well as construction details)</p> <p>Inventory (physical characteristics of the asset)</p> <p>Condition (indication of immediate or future need for maintenance)</p> <p>Performance (level of service being provided by the asset)</p> <p>Operational (operational factors such as traffic sensitivity etc.)</p> <p>Financial (maintenance costs, asset valuation, contractor performance)</p> <p>Environmental (carbon, energy consumption, hazardous materials, etc.)</p> <p>Underpinning the asset information requirements will be an appropriate location referencing model which is likely to be geospatial and/or based on a linear network.</p> <p>Various data items will be required to be held under each of these categories and each of these data items will have a number of attributes. This should ideally be represented in a systematic way in a data dictionary.</p>	

7. SUPPORT

ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context
<p>The organisation shall ensure that there is consistency and traceability between the financial and technical data and other relevant non-financial data, to the extent required to meet its legal and regulatory requirements while considering its stakeholders' requirements and organisational objectives.</p>	<p>Information requirements – points for consideration</p> <p>When determining its information requirements the organisation should consider:</p> <ul style="list-style-type: none"> a) The value of the information to enable decision making and its quality relative to the cost and complexity of collecting, processing, managing and sustaining the information b) The need to align its information requirements to suit the level of risk that an asset, or managing it, poses c) The participation of relevant stakeholders to determine the types of information required to support decision making as well as to ensure the completeness, accuracy and integrity of the necessary information d) The establishment and continual improvement of controls, specifications and level of accuracy for data e) The determination, assignment and periodic review of accountabilities for the stewardship of specific information 	<p>Road administrations should consider the total cost of ownership of data versus its value when determining their information needs and should ensure that, as far as possible, data is collected once and used for many purposes.</p> <p>Effective data management and governance are important factors in ensuring that asset information meets the needs of the road administration.</p> <p>The road administration should consider the quality criteria as well as the information requirements. Data quality is generally expressed in terms of:</p> <ul style="list-style-type: none"> Accuracy – the record is correct in all details and is a true record of the entity it represents Completeness – the record has all or the necessary attribute values relative to its intended purpose Validity – data conforms to all standards expected Consistency – an entity that is represented in more than one data store can easily be matched Uniqueness – a single representation exists for each physical entity; and Timeliness – data is easily accessed when required and is up to date. <p>Where external service providers and contractors are responsible for the collection and provision of asset information, then this must be clearly defined within their contract along with appropriate quality criteria.</p>

7. SUPPORT		
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context
	<p>f) The establishment of competences required to collect, interpret, utilise and report information</p> <p>g) The alignment of information requirements for different levels and functions within the organisation</p> <p>h) The alignment of financial and non-financial</p> <p>i) The need for financial information regarding assets to be appropriate, consistent and traceable, and to reflect the technical and operational reality of the assets</p> <p>j) The establishment of data collection processes from internal and external stakeholders (including contracted service providers)</p> <p>k) The data flow and integration of information sources to planning, operational and reporting technology systems, appropriate for the size, complexity and capability of the</p> <p>l) Its ability to maintain the appropriate quality and timeliness of the information (as the collection of data can be costly, the organisation should prioritise data that is identified as strategically or operationally important).</p>	

7. SUPPORT			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
7.6 Documented information			
The organisation's asset management system shall include: Documented information as required by this International Standard Documented information for applicable legal and regulatory requirements Documented information determined by the organisation as being necessary for the effectiveness of the asset management system, as specified in 7.5.	Documentation General (7.6.1)	<p>This clause sets out the three general requirements for documented information under the Standard:</p> <ul style="list-style-type: none">→ information required by the Standard→ information for applicable legal and regulatory requirements→ information required by the organisation necessary for effectiveness of the AMS. <p>In establishing its documented information needs, the organisation should consider the identification and definition of documented information that will be managed and maintained over the lifecycle, taking into account its period of responsibility for the assets. The organisation should also consider the requirement to maintain this documented information for any defined period beyond the disposal of the assets, in accordance with its business, legal and regulatory requirements. The controls put in place should be adequate for the type of information in supporting the asset management activity.</p>	For road administrations, documented information at the operational level is likely to include, but not be limited to: Business processes and quality standards Contract documentation Data standards Engineering standards and specifications Design, materials, etc. Construction, maintenance and operational procedures As-built drawings Health and safety files Photographs (defects) Survey/investigation reports Correspondence The production and ongoing maintenance of robustly documented and comprehensive procedures can be demanding of resources and time. However, if an organisation has implemented other management systems (ISO 9001, 14001 etc.) then the additional work required to implement ISO 55000 may be more straightforward.
	Creating and updating (7.6.2)		

7. SUPPORT			Highways Context
ISO 55001 Requirements	General Guidance (based on ISO 55002)		
<p>Documented information required by the asset management system and by this International Standard shall be controlled to ensure:</p> <p>a) It is available and suitable for use, where and when it is needed</p> <p>b) It is adequately protected (eg from loss of confidentiality, improper use, or loss of integrity).</p> <p>For the control of documented information, the organisation shall address the following activities, as applicable:</p> <p>Distribution, access, retrieval and use</p> <p>Storage and preservation, including preservation of legibility</p> <p>Control of changes (eg version control)</p> <p>Retention and disposition.</p> <p>Documented information of external origin determined by the organisation to be necessary for the planning and operation of the asset management system shall be identified, as appropriate, and controlled.</p>	<p>The organisation should determine the documented information required to ensure effectiveness of its asset management system and asset management activity. Different types of documented information can address elements of the asset management system, asset management or a specific asset. The information required can differ from one organisation to another and should be proportional to the complexity of the assets and the asset management activity.</p> <p>When creating and updating documented information, an organisation should determine if appropriate controls are in place to ensure that the information is appropriate; these controls are necessary to ensure that the personnel supporting the asset management activity are using the approved, accurate, most up to date information.</p>		

8. OPERATION				
ISO 55001 Requirements		General Guidance (based on ISO 55002)		Highways Context
8.1 Operational planning and control				
The organisation shall plan, implement and control the processes needed to meet requirements, and to implement the actions determined in 6.1, the asset management plan(s) determined in 6.2, and the corrective and preventive actions determined in 10.1 and 10.2 by: Establishing criteria for the required processes Implementing the control of the processes in accordance with the criteria Keeping documented information to the extent necessary to have confidence and evidence that the processes have been carried out as planned Treating and monitoring risks using the approach described in 6.2.2.	Establishing operational planning and control processes	The organisation should establish operational planning and control processes in order to support the effective delivery of the activities contained within the asset management plan(s). The processes should identify who is responsible for the planning and how the defined activities will be executed, including how risks arising during the planning and execution will be managed and controlled.	The road administration should consider how to establish and implement the asset management system so that it becomes part of the 'business-as-usual' operations of the organisation, including effective planning and control processes. Operation and maintenance practice should align with the asset management policy. Therefore, policy and strategy must support a considered, practical engineering approach so that, for example, the selection of maintenance solutions is based on criteria that reflect the overall asset management objectives.	
	Implementing the planning and control processes	In implementing the processes and actions, the following criteria, amongst others, should be considered: a) Roles and responsibilities b) Procedures c) Resource allocation d) Competency development.		
	Control mechanisms	Control mechanisms for the processes and actions can include elements such as the following: a) Process performance measures b) Internal audit criteria and schedules.		

8. OPERATION			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
		The implementation of the processes and actions should produce documentation to enable verification that the process steps were followed as designed and the expected output of the process is achieved.	
8.2 Operational planning and control			
<p>Risks associated with any planned change, permanent or temporary that can have an impact on achieving the asset management objectives, shall be assessed before the change is implemented.</p> <p>The organisation shall ensure that such risks are managed in accordance with 6.1 and 6.2.2.</p> <p>The organisation shall control planned changes and review the unintended consequences of changes, taking action to mitigate any adverse effects, as necessary.</p>	Changes overview	Internal or external changes affecting assets, asset management or the asset management system can impact on the organisation's ability to achieve its asset management objectives. These changes should be evaluated and mitigating actions should be taken prior to implementation. The organisation should review the consequences associated with both planned and unplanned changes and take the necessary action to mitigate any foreseen adverse effects.	
	Scope of potential changes	<p>The organisation's considerations should address changes that include, but are not limited to, the following:</p> <ul style="list-style-type: none"> a) Organisational structures, roles or responsibilities b) Asset management policy, objectives or plans 	Changes affecting road administrations may also arise from external factors such as: <ul style="list-style-type: none"> political changes, changes to policies and strategies, budgetary changes responses to incidents and events, etc.

8. OPERATION			
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context	
	<p>c) Process(es) or procedure(s) for asset management activities</p> <p>d) New assets, asset systems or technology (including obsolescence)</p> <p>e) Factors external to the organisation (including new legal and regulatory requirements)</p> <p>f) Supply chain constraints</p> <p>g) Demands for products and services, contractors or suppliers</p> <p>h) Demands on resources, including competing demands.</p>		
	Making decisions on changes	<p>The organisation should have the capability to make evidence-based decisions on proposed changes and the ability to consider scenarios systematically across the entire organisation.</p> <p>Risks associated with a change should be considered in relation to their impact on asset management and the asset management system. This should include unintentional consequences that occur to other parts of the organisation, as a result of a change, eg the impact of resource constraints due to changes in service delivery requirements.</p>	<p>Effective lifecycle planning based on reliable asset information and appropriate models will enable road administrations to assess the impact of different funding scenarios on the condition and performance of the asset.</p>

8. OPERATION				
ISO 55001 Requirements		General Guidance (based on ISO 55002)		Highways Context
8.3 Outsourcing				
<p>When the organisation outsources any activities that can have an impact on the achievement of its asset management objectives, it shall assess the associated risks. The organisation shall ensure that outsourced processes and activities are controlled.</p> <p>The organisation shall determine and document how these activities will be controlled and integrated into the organisation's asset management system. The organisation shall determine:</p> <p>a) The processes and activities that are to be outsourced (including the scope and boundaries of the outsourced processes and activities and their interfaces with the organisation's own processes and activities)</p> <p>b) The responsibilities and authorities within the organisation for managing the outsourced processes and activities</p>	<p>Outsourcing overview</p>	<p>Outsourcing is a common method for an organisation that prefers to perform certain asset management activities not by itself, but by an external or internal service provider. When these activities influence the achievement of the asset management objectives, these should be part of the asset management system, and should be documented.</p> <p>The organisation should formalise the relationship (eg through a contract, service level agreement or other appropriate commercial mechanism) for:</p> <p>a) The governance of the outsourced activities, including responsibilities and authorities within the organisation for managing the outsourced asset management processes and activities</p> <p>b) The processes and activities that are outsourced, with a description of the scope and boundaries, their interfaces with the organisation and its control, quality, timelines, consultation requirements, financing, feedback and improvement opportunities</p>	<p>Many road administrations make use of outsourcing in the management of their assets. There are a range of scenarios with degrees of responsibility – and therefore risk – transferred from the road administration to the service provider:</p> <p>a) Outsourcing the responsibility for all stages of part of the asset including its construction or upgrading to a service provider (eg such as DBFO or PPP/PFI projects which typically have a significant initial investment followed by to long-term operation and maintenance phase). In these scenarios the road administration will retain overall ownership but all asset management responsibilities will be transferred to the service provider.</p> <p>Outsourcing operation and maintenance of part of the asset to a service provider for a fixed period of time. In this scenario, the road administration will retain overall ownership and is also likely to retain responsibility for investment decision making. The service provider will be responsible for day-to-day operations on the network and routine and reactive maintenance.</p> <p>Outsourcing delivery of maintenance to a service provider/contractor. In this scenario, the road administration retains responsibility for operations and maintenance planning but uses external contractors to delivery specific maintenance activities.</p> <p>Where asset management activities have been outsourced, then any proposed changes will need to be considered within the context of the contractual agreement with the external contractor or service provider and may incur additional costs to the road administration.</p>	
	<p>Formalising the outsourcing relationship</p>			

8. OPERATION			Highways Context
ISO 55001 Requirements	General Guidance (based on ISO 55002)		
<p>c) The processes and scope for the sharing of knowledge and information between the organisation and its contracted service provider(s)</p> <p>When outsourcing any activities, the organisation shall ensure that:</p> <p>The outsourced resources meet the requirements of 7.2, 7.3 and 7.6</p> <p>The performance of the outsourced activities is monitored in accordance with 9.1.</p>		<p>c) The processes for the (bidirectional) exchange of information, knowledge, people, processes and technology at the start of the agreed period</p> <p>d) The processes for monitoring the activities of the assigned service provider(s)</p> <p>e) The processes for sharing of knowledge, information and data, between the organisation and its service provider(s)</p> <p>f) The process of handing back the asset management activity from the service provider(s), including the required state of the asset and associated information.</p>	
	Exercising control	Any asset management objectives, processes and activities that are outsourced should be controlled by the organisation to provide assurance that performance is as planned. The performance of outsourced activities should be subject to a regular management reviews to ensure that they are adequately controlled. The more extensively an organisation chooses to outsource the delivery of its asset management,	

8. OPERATION			Highways Context
ISO 55001 Requirements		General Guidance (based on ISO 55002)	
			that it will need to exert over the service provider(s), in order to give assurance that delivery of the SAMP will be achieved. The extent of outsourcing could require a service provider to establish its own asset management system that is aligned with the organisation's asset management objectives.
	Ownership, intellectual property and corporate knowledge		The organisation should consider the ownership and protection of intellectual property and corporate knowledge (including that generated during the outsourcing) when outsourcing asset management activities.
	Outsourcing and management of risk		When outsourcing any lifecycle activities and asset management activities, the organisation should consider the risks and impacts on its assets, asset management and asset management system. The organisation should consider what potential risks cannot be transferred, even if the related asset management activities are transferred (eg damage to its reputation). A corresponding control over those risks should be maintained within the organisation.

9. PERFORMANCE EVALUATION		
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context
9.1 Monitoring, measurement, analysis and evaluation		
<p>The organisation shall determine:</p> <ul style="list-style-type: none"> a) What needs to be monitored and measured b) The methods for monitoring, measurement, analysis and evaluation, as applicable, to ensure valid results c) When the monitoring and measuring shall be performed d) When the results from monitoring and measurement shall be analysed and evaluated. <p>The organisation shall evaluate and report on</p> <p>The asset performance</p> <p>The asset management performance, including financial and non-financial performance</p> <p>The effectiveness of the asset management system.</p> <p>The organisation shall evaluate and report on the effectiveness of the processes for managing risks and opportunities.</p>	<p>Monitoring, measurement, analysis and evaluation – general</p> <p>The organisation should develop processes to provide for the systematic measurement, monitoring, analysis and evaluation of the organisation's assets, asset management system and asset management activity on a regular basis. In the development of these processes (and any associated procedures) the following should be taken into account:</p> <ul style="list-style-type: none"> a) Setting of performance metrics and associated indicators, eg condition or capacity indicators b) Confirmation of compliance with the requirements c) Examination of historical evidence d) The use of documented information to facilitate subsequent corrective actions and decision making. <p>The processes should also reference the asset management policy and objectives.</p> <p>More specifically the processes for monitoring performance should address:</p>	<p>When defining performance metrics and setting performance targets, the road administration should ensure that they are:</p> <ul style="list-style-type: none"> Aligned with and fully support the overall asset management objectives and therefore the organisations overall corporate objectives Designed to drive the desired behaviours and don't result in any 'perverse incentives' Represent a coherent set of indicators and any contradictory indicators are minimised Based on data and information that is readily available to the organisation Scalable and available of different levels of aggregation as appropriate Avoid any confirmation bias <p>SMART.</p> <p>The performance metrics and targets should also be extended to include outsourced asset management activities and should be reflected in any contract documents.</p>

9. PERFORMANCE EVALUATION			Highways Context
ISO 55001 Requirements	General Guidance (based on ISO 55002)		
<p>The organisation shall retain appropriate documented information as evidence of the results of monitoring, measurement, analysis and evaluation.</p> <p>The organisation shall ensure that its monitoring and measurement enables it to meet the requirements of 4.2.</p>	<p>a) The setting of performance metrics, including qualitative and quantitative measurements (financial and non-financial) that are appropriate to the needs of the organisation</p> <p>b) The extent to which the organisation's asset management policy and objectives are met</p> <p>c) The evaluation of compliance with legal and regulatory requirements, and any other requirements to which the organisation subscribes</p> <p>d) Identifying when the monitoring and measuring should take place</p> <p>e) The ability to aggregate and report information to those accountable for the asset management system and asset activities (see 7.5, bullet g)</p> <p>f) The quality, reliability and completeness of the financial and non-financial asset information</p> <p>g) Enabling top management to make statements on the organisation's ability to manage its assets (see 4.2)</p> <p>The performance of activities outsourced to external providers.</p> <p>Assessing the performance of the asset management processes, procedures and functions.</p>		

9. PERFORMANCE EVALUATION		
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context
	<p>Proactive indicators that are related to performance of the assets, asset management system, and activities (eg capacity or condition indicators).</p> <p>Reactive measures of performance to monitor failures, incidents, non-conformities (including near misses and false alarms) and other historical evidence of deficient asset management system and activity performance.</p> <p>Recording the data and results of monitoring and measurement, sufficient to facilitate subsequent corrective action analysis.</p> <p>A set of performance indicators should be developed to measure the asset management activity and its outcomes. Measurements can be either quantitative or qualitative, financial and non-financial.</p> <p>Indicators should provide useful information to determine both successes and areas requiring corrective action or improvement. The organisation should consider the relationship and alignment between performance indicators.</p>	

9. PERFORMANCE EVALUATION			
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context	
	<p>The asset management system should employ data from monitoring and measurement to identify patterns and obtain information regarding its performance. These data should be used to evaluate whether the organisation's policy and objectives are being achieved, as well as identifying corrective actions and areas for improvement.</p> <p>Documented information on all periodic evaluations and their results should be maintained. The organisation should analyse and, at planned intervals, evaluate the outcomes from the monitoring and measurement.</p> <p>The performance of activities outsourced to external service providers should be monitored and be based on the evaluation of reported results, audits performed by the organisation, or independent auditor's reports.</p>		

9. PERFORMANCE EVALUATION		
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context
<p>Evaluation of the performance of the asset portfolio and asset management processes – overview</p>	<p>To ensure that reported information used for monitoring has the same meaning with respect to different functions in the organisation, common financial and non-financial terminology should be used in reports. Because cost plays such an important role in reflecting asset related performance, it may be useful to have a shared set of classification systems, hierarchical structures, and a common understanding of how asset portfolios, asset systems and individual assets are broken down for lifecycle management purposes.</p> <p>The change in future value of the assets and the risk profile should be evaluated in both a financial context and a non-financial context. The evaluation team should include stakeholders from relevant disciplines. Monitoring should ensure that there is consistency and traceability between technical asset information and accounting records. In addition, monitoring should address the following key aspects of the data registration process.</p>	<p>For a road administration, cost information may require commercial information from service providers which may not always be available in the required format or level of disaggregation. Care should therefore be taken when defining financial information requirements.</p> <p>Road administrations may be required by national government to calculate the value of the assets they are responsible for. This may simply be based on Gross Replacement Cost (GRC) or may include a calculation of depreciation. Where this is a requirement, local accountancy standards should be followed.</p>

9. PERFORMANCE EVALUATION		
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context
	<p>a) A uniform technical, operational and financial glossary</p> <p>b) A technical, operational and financial linkage, which is consistent and traceable to the assets and their components at a predefined level of detail</p> <p>c) Adequate and accurate financial and non-financial data and information of technical and operational events that have a potential impact on financial reporting.</p> <p>This monitoring in the financial reporting system should be done at a level suitable to the risk, complexity and value of the assets. An asset breakdown structure can be used to identify the individual components of an asset, to enable the organisation to take into account the significance of the value of the components in relation to the asset, and to determine the differences between the technical and economic lives of the components.</p>	

9. PERFORMANCE EVALUATION			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
9.2 Internal audit			
<p>The organisation shall conduct internal audits at planned intervals to provide information on whether the asset management system:</p> <p>a) Conforms to:</p> <p>The organisation's own requirements for its asset management system</p> <p>The requirements of this International Standard</p> <p>b) Is effectively implemented and maintained.</p> <p>The organisation shall:</p> <p>a) Plan, establish, implement and maintain an audit programme(s), including the frequency, methods, responsibilities, planning requirements and reporting.</p> <p>The audit programme(s) shall take into consideration the importance of the processes concerned and the results of previous audits</p>	<p>Internal audit – overview</p>	<p>The organisation should conduct internal audits at planned intervals to ensure the asset management system conforms to its requirements (and to the requirements of ISO 55001).</p> <p>It is essential to conduct internal audits of the asset management system, particularly in relation to critical assets and asset systems, to ensure that the asset management system is achieving its objectives and plans and is identifying opportunities for improvement. Internal audits of the asset management system should be conducted at planned intervals to determine and provide information to top management on the appropriateness and effectiveness of the asset management system, as well as to provide the basis for setting objectives for continual improvement.</p>	<p>Internal audits may be better carried out by external auditors or by internal staff familiar with the road administration's procedures and management system(s) rather than by staff directly involved in asset management or with particular highway experience. Indeed, larger organisations may already have an internal audit function/process in place that could undertake internal audits of the asset management system.</p> <p>Again, any internal audit must include all asset management activities that have been outsourced. Indeed, such organisational interfaces are likely to represent particular risks of nonconformity.</p>

9. PERFORMANCE EVALUATION			
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context	
<p>b) Define the audit criteria and scope for each audit</p> <p>c) Select auditors and conduct audits to ensure objectivity and the impartiality of the audit process</p> <p>d) Ensure that the results of the audits are reported to relevant management</p> <p>e) Retain documented information as evidence of the results of the implementation of the audit programme and the audit results.</p>	<p>Establishing an audit process</p> <p>The organisation should establish an audit process to direct the planning and conduct of audits, and to determine the audits needed to meet its objectives. The process should be based on the organisation's activities, its risk assessments, the results of past audits, and other relevant factors.</p> <p>Internal audits should be based on the full scope of the asset management system, however, it is not necessary for each audit to cover the entire system. Audits may be divided into smaller parts provided the audit programme ensures that all organisational units, functions, activities and system elements and the full scope of the asset management system are audited within the auditing period designated by the organisation. In deciding the scope of an audit, it is good practice to consider the risk associated with both the asset management system and the assets. This can aid the relevance of an audit and help to objectively reassess the risk areas.</p>		

9. PERFORMANCE EVALUATION		
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context
	<p>The results of an internal audit of an asset management system can be used to correct or prevent specific nonconformities, as an input for continual improvement, and to provide input for management review.</p> <p>Internal audits of the asset management system may be performed by personnel from within the organisation or by external persons selected by the organisation, working on its behalf. In either case, the persons conducting the audit should be competent and in a position to do so impartially and objectively. In smaller organisations, auditor independence can be demonstrated by an auditor being free from responsibility for the activity being audited.</p> <p>Audits should support learning and improvement of the asset management system. To achieve this, the audits should focus on the performance of the asset management processes, as opposed to the performance of persons within the processes. Attention should be paid to examples of good practice and improvement opportunities.</p>	

9. PERFORMANCE EVALUATION			
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context	
	<p>At the same time, audits should also determine system deficiencies, by checking conformity of practice and the asset management system with each other and to the requirements of ISO 55001.</p>		
	<p>Self-assessment</p> <p>Self-assessment can be helpful in driving continual improvement. Self-assessments should evaluate the viability and suitability of the asset management policy, objectives and plans to ensure they are consistent with each other, suitable, adequate, and achievable. This requires assessment of the following:</p> <ul style="list-style-type: none"> a) Assumptions related to the organisation's asset management b) The organisation's process(es) and procedure(s), methods, tools and techniques c) The availability and allocation of funds and resources. <p>The self-assessment process should encourage participants to identify opportunities for continual improvement. Active participation, understanding and support of the organisation's employees are important in conducting a self-assessment review.</p>		

9. PERFORMANCE EVALUATION			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
9.3 Management review			
<p>Top management shall review the organisation's asset management system, at planned intervals, to ensure its continuing suitability, adequacy and effectiveness.</p> <p>The management review shall include consideration of:</p> <p>a) The status of actions from previous management reviews</p> <p>b) Changes in external and internal issues that are relevant to the asset management system</p> <p>c) Information on the asset management performance, including trends in:</p> <ul style="list-style-type: none">→ Nonconformities and corrective actions→ Monitoring and measurement results→ Audit results <p>Asset management activity</p> <p>Opportunities for continual improvement</p> <p>Changes in the profile of risks and opportunities.</p>	<p>Management review – overview</p>	<p>Top management should review the organisation's assets, asset management system and asset management activity, as well as the operation of its policy, objectives and plans, at planned intervals, to ensure their suitability, adequacy and effectiveness.</p> <p>The review should also consider whether the asset management policy continues to be appropriate for the organisation's purpose. It should establish new or updated asset management objectives for continual improvement, appropriate to the coming period, and consider whether changes are needed to any elements of the assets, asset management processes and the asset management system.</p>	
	<p>Inputs into management reviews</p>	<p>Inputs to management reviews should include:</p> <p>a) The status of actions from previous management reviews</p>	

9. PERFORMANCE EVALUATION			Highways Context
ISO 55001 Requirements	General Guidance (based on ISO 55002)		
<p>The outputs of the management review shall include decisions related to continual improvement opportunities and any need for changes (see 8.2) to the asset management system.</p> <p>The organisation shall retain documented information as evidence of the results of management reviews.</p>	<p>b) Changes in external and internal issues that are relevant to the asset management system, including changing circumstances (including developments in legal, regulatory and other requirements related to asset management), changes in technology, and changes in market requirements</p> <p>c) Information on the asset management performance, including trends in:</p> <ol style="list-style-type: none"> 1) Nonconformities and corrective actions 2) Monitoring and measurement results including: <ol style="list-style-type: none"> i. Communication and consultation ii. The performance of the assets, asset management processes and the asset management system iii. The results of other evaluations of the assets or asset management system iv. Evaluations of compliance with applicable legal and regulatory requirements v. Audit results 		

9. PERFORMANCE EVALUATION			Highways Context
ISO 55001 Requirements	General Guidance (based on ISO 55002)		
		<p>Asset management activities</p> <p>Improvement opportunities</p> <p>Changes in the profile of risks and opportunities</p> <p>Asset performance and condition.</p>	
	Information for top management	<p>Management reviews provide top management with an opportunity to evaluate the continuing suitability, adequacy and effectiveness of the assets, asset management, and asset management system.</p> <p>Reviews of the implementation and outcomes by top management should be regularly scheduled and evaluated.</p>	
	Management review outputs	<p>The outputs from management reviews should include decisions and actions relating to improvements in asset management system and activity including:</p> <ul style="list-style-type: none"> a) Variations to the scope, policy and objectives b) Criteria for asset management decision making c) Updates to performance requirements 	

9. PERFORMANCE EVALUATION			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
		<p>d) Resources including financial, human and physical resources</p> <p>e) Changes to controls and how their effectiveness is measured, including roles, responsibilities and authorities.</p>	
	Retention of information	<p>The organisation should retain documented information as evidence of the results of management reviews and should communicate the results of management reviews to relevant stakeholders. It should also take appropriate action based on the results, while managing any changes.</p> <p>Management reviews should also cover aspects of the asset management system and activities, if any, that are outsourced to external service providers.</p> <p>Relevant outputs from management reviews should be used by top management during reviews of the organisational plan.</p>	

10. IMPROVEMENT			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
10.1 Nonconformity and corrective action			
<p>When a nonconformity or incident occurs in its assets, asset management or asset management system the organisation shall:</p> <p>a) React to the nonconformity or incident, and, as applicable: take action to control and correct it</p> <p>deal with the consequences</p> <p>b) Evaluate the need for action to eliminate the causes of the nonconformity or incident, in order that it does not occur or recur elsewhere, by:</p> <p>→ reviewing the nonconformity or incident</p> <p>→ determining the causes of nonconformity or incident</p> <p>→ determining if similar nonconformities exist, or could potentially occur</p> <p>c) Implement any action needed</p> <p>d) Review the effectiveness of any corrective action taken</p>	<p>Nonconformity and corrective action – general</p>	<p>The organisation should be aware that nonconformities (including failures) can occur in its assets, asset management activity and asset management system. The organisation should establish plans and processes to control nonconformities and their associated consequences, to minimise any adverse effects on the organisation and on stakeholder needs and expectations. This can be accomplished by documenting and reviewing past nonconformities, evaluating how the consequences were dealt with, and by determining methodologies to prevent future nonconformity.</p> <p>Corrective actions are actions taken to address the root cause(s) of identified non-conformances, or incidents, in order to manage their consequences, and to prevent or reduce the likelihood of recurrence.</p> <p>Aspects to be considered in establishing and maintaining corrective action processes should include:</p>	

10. IMPROVEMENT				Highways Context	
ISO 55001 Requirements		General Guidance (based on ISO 55002)			
<p>e) Make changes (see 8.2) to the asset management system, if necessary.</p> <p>Corrective actions shall be appropriate to the effects of the nonconformities or incident encountered.</p> <p>The organisation shall retain documented information as evidence of:</p> <p>the nature of the nonconformities or incident and any subsequent actions taken</p> <p>the results of any corrective action.</p>		<p>a) The identification and execution of corrective measures</p> <p>b) The evaluation of any impact on risk identification and assessment results, including</p> <p>c) The recording of any required changes in processes or procedures resulting from the corrective action or risk identification.</p>			
	Processes investigating asset-related non-conformities and incidents	The organisation should establish, implement and maintain process(es) and procedure(s) for the handling and investigation of nonconformities, functional failures, and incidents associated with assets, asset systems and the asset management system.			
	Processes for implementing corrective actions	<p>The organisation should establish, implement and maintain process(es) for instigating corrective action(s) for eliminating the causes of nonconformities or incidents.</p> <p>Any corrective actions taken and their timings should be commensurate with the risk(s) encountered.</p> <p>Where a corrective action identifies new or changed risks, the proposed actions should be risk assessed prior to implementation (see 8.2).</p>			

10. IMPROVEMENT			Highways Context
ISO 55001 Requirements	General Guidance (based on ISO 55002)		
		<p>The organisation should monitor and document the timely close-out or completion and the effectiveness of the corrective action(s).</p> <p>The organisation should ensure that any necessary changes arising from corrective actions are made to the asset management system (see 8.2).</p>	
10.2 Preventative action			
<p>The organisation shall establish processes to proactively identify potential failures in asset performance and evaluate the need for preventive action.</p> <p>When a potential failure is identified the organisation shall apply the requirements of 10.1.</p>	Preventative actions	<p>Preventive actions, which may include predictive actions, are those taken to address the root cause(s) of potential failures or incidents, as a proactive measure, before such incidents occur. The organisation should establish, implement and maintain process(es) for initiating preventive or predictive action(s).</p> <p>Elements to be considered in establishing and maintaining preventive action processes include:</p> <ul style="list-style-type: none"> a) The use of appropriate sources of information b) The identification of any potential failures c) The use of an appropriate methodology 	<p>Where asset management activities have been outsourced, then the process of implementing any preventative actions will need to be considered within the context of the contractual agreement with the external contractor or service provider and may incur additional costs to the road administration where there is deemed to be a change to the contractual scope or requirements.</p>

10. IMPROVEMENT			Highways Context
ISO 55001 Requirements	General Guidance (based on ISO 55002)		
		<p>d) The initiation and implementation of preventive action</p> <p>e) The recording of any changes in processes and procedures resulting from the preventive action</p> <p>f) Assessment of the preventive action</p> <p>g) The input to the asset management plan(s) from preventive actions</p> <p>h) The need to keep documented information on the preventive or predictive actions.</p>	
10.3 Continual improvement			
The organisation shall continually improve the suitability, adequacy and effectiveness of its asset management and the asset management system.	Continual improvement – overview	<p>Opportunities for improvement should be identified, assessed and implemented across the organisation as appropriate, through a combination of monitoring and corrective actions for the assets, asset management, or asset management system. Continual improvement should be regarded as an ongoing iterative activity, with the ultimate aim of delivering the organisational objectives. It should not be interpreted as cyclic (eg annual) improvement in asset performance parameters just because they can be achieved.</p>	<p>Road administrations may benefit from involvement in national, regional or international organisations – such as Conference of European Directors of Roads (CEDR) – that promote knowledge sharing and dissemination of best practice.</p> <p>Membership of bodies such as the Institute of Asset Management (IAM) can enable road administrations to share knowledge and experience with asset owners from other sectors.</p>

10. IMPROVEMENT		
ISO 55001 Requirements	General Guidance (based on ISO 55002)	Highways Context
	<p>Top-down or bottom-up continual improvement</p> <p>Continual improvement can be organised as a top-down or bottom-up process, or as a combination. The organisation should establish, implement and maintain process(es) for determining opportunities and assessing, prioritising and implementing actions to achieve continual improvement and reviewing their subsequent effectiveness. These processes may include:</p> <ul style="list-style-type: none"> a) Non-conformity and corrective action (see 10.1), in particular failure and incident investigation (see 10.1.2) b) Preventive action (see 10.2) c) Trends in performance (see 9.1) d) Evaluation of compliance (see 9.1.1) e) Internal and external audits (see 9.2) f) Management review (see 9.3) g) Stimulating employees to come forward with suggestions h) Management of change (see 8.2). 	

10. IMPROVEMENT			
ISO 55001 Requirements	General Guidance (based on ISO 55002)		Highways Context
	<p>Knowledge of new developments in technology and practices</p>	<p>The organisation should actively seek and acquire knowledge about new asset management related technology and practices, including new tools and techniques; these should be evaluated to establish their potential benefit to the organisation and be incorporated into the asset management system as appropriate.</p>	
	<p>Processing opportunities for improvement</p>	<p>Although the opportunities for improvement can be widely different in size and effect, the approach for processing them may consist of the following steps:</p> <ul style="list-style-type: none"> a) Identification of improvement needs and potential b) Evaluation of options c) Estimation and determination of financial and non-financial consequences d) Risk assessment and management of change (see 8.2) aspects e) Links with decision-making criteria (see 4.2) f) Selection and execution g) Tracking of outcomes and review. 	<p>Again, where asset management activities have been outsourced, then any proposed changes will need to be considered within the context of the contractual agreement with the external contractor or service provider and may incur additional costs to the road administration if there are deemed to any changes to the scope or requirements of the contract.</p> <p>Where there are genuine opportunities for improvement, then there may be potential for sharing of benefits between the road administration and the contractor/service provider – for example through innovation forums etc – but issues of intellectual property will need to be resolved.</p>

NOTES

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