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A POSSIBLE ANSWER TO THE QUESTION: WHAT IS ASSET MANAGEMENT?

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Asset Management is the culmination of a long history of development in the management of physical assets. It is about asset intensive businesses achieving a level of service, risk profile and funding requirement that is acceptable to stakeholders for the life of the assets. Asset Management involves making decisions about the interventions to physical assets required to achieve this, and can often involve a trade-off between short-term and long-term benefits. Good Asset Management concerns itself with the justification of decisions based on the best use of available information and the most appropriate tools and techniques for deciding what the optimum trade¬offs are between the costs and risks inherent in all asset lifecycle activities. Ensuring organizations implement good Asset Management is of increasing interest and importance not only to the organizations themselves who stand to save vast sums of money and to control risks more effectively, but also to regulators and customers who seek best value for money and consistently good output performance both now and for future generations. Understanding, measuring and improving Asset Management capability is therefore of increasing interest too.

Key Words: Asset Management; Maintenance

MAINTENANCE AND ASSET MANAGEMENT

The design of maintenance system and the corresponding logistic support is a very complex process, during which the aim is to find the compromise solutions regarding the relations among different maintenance procedures and the ways of their implementation. As a result of this, various solutions can be adopted, since this is conditioned by a series of of important factors and criteria, which can be contradictory sometimes [7]. There are different perspectives on ways of solving practical maintenance problems, that is dilemmas when it comes to the choice of maintenance concept. The principal dilemma is how and when to decide on carrying out maintenance procedures. Should the decision be based on theoretical grounds or experience, how does one reconcile those two extremes, who is to decide upon this?

The importance of prevention of failures in industrial facilities, and their timely identification and correction, if they occur, cannot be overstated. An indication of the amount of attention various aspects of maintenance have attracted in recent years, is the number of publications and books published. Generally speaking, from a broad theoretical and practical aspect, maintenance is defined as the combination of all technical, administrative and managerial actions during the life cycle of an item intended to retain it in, or restore it to, a state in which it can perform the required function [4]. Thus observed, maintenance is a complex functional system, united by a single goal and unique criterion function. In engineering sense, the system of maintenance of one machine, device or any other technical system can be realized in various ways and variants.

Quite often the term “maintenance” has a negative conotation. In most organizations, the func-

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tion of maintenance system is regarded as the lesser evil or a needless cost, the so-called “white elephant”. Due to this conotation, insufficient time and effort is spent on activities of maintenance control and the resulting cost. It is a well known fact that, during the analysis of life-cycle cost of a technical system, the most visible is usually the most evident, and that is acquisition cost. However, the “invisible” part that represents operational cost, maintenance cost, spare parts and supply cost, staff training cost, the cost of provision documentation on handling and maintenance etc., significantly exceeds the acquisition cost. For that reason, there are constant efforts to identify and treat in a much better way this bigger portion of cost. It is evident, for the above-mentioned, and many other reasons, that there is a need for developing new methodological approaches to maintenance concept selection, and looking for the ways to improve the existing methods [5-7].

Organisations worldwide are looking for opportunities to reduce the cost of maintaining their assets, improve the performance of those assets through effective decision making, and gain competitive advantage. In many industries regulatory requirements as well as safety criticality of these assets add to the complexity. In this environment, it is essential for organizations to accurately track the current configuration and trace historical configuration changes throughout the asset lifecycle. However, traditional configuration management systems have often proved inefficient for managing maintenance, repair and overhaul data because they represent only the last asset configuration and fail to provide the ability to consistently trace the current and historical changes to the asset configurations. Hence organizations often experience a lack of information between the initial acquisition of the asset and the following service operations. For instance, the acquisition information regarding the asset is often obsolete due to changes in the asset setup since installation, and considerable amounts of time are wasted on inefficient updates. For all of the above mentioned, the importance of the new and broad approach to maintenance of all systems – the concept of Asset Management, is quite clear.

INTRODUCTION

Asset Management emphasizes integrated approach in decision making. It integrates asset development, operating of asset and upkeep of assets. An important part of asset development is determination of capacity needs and capacity creation which means investment planning and investments. Operating of assets means production and especially the part of production that influences assets and their prevailing production capability. The last dimension, upkeep stands for the maintenance function. Although business oriented Asset Management sounds at first glance working against sustainable production methods, it actually supports sustainable development strongly, because Asset Management strives at economic use of scarce resources taking into account market dynamics.

We need Asset Management, e.g. to manage our investments and capacity in the more competitive way. There are many reasons for losses during the life cycle of production equipment, which demand for the more effective Asset Management [3]:

- economic lifetime is not in balance with technical lifetime,
- all processes are not functioning at the same operating rate,
- during process and product transitions production capacity of large concentration of assets is lost,
- demand does not match with capacity,
- during installation and commencing of investments production losses may be huge,
- low OEE (overall equipment effectiveness) causes production losses,
- due to low flexibility of assets equipment is used in ineffective way (product mix and insufficient adaptation to demand fluctuations),
- construction of equipment is not up to date.

In order to minimize the above mentioned production losses during the life cycle of the equipment, replacement investments and maintenance activities has to be optimized. Typical Asset Management decisions and questions linked to replacement investments and maintenance activities within plants in operation are following [3]:

- should we replace or maintain,
- should we modernise or replace with the similar one,
- where should we replace when should we replace,
- what would be our budget,
- which level technical performance should be aimed at what availability performance should aimed at,
- what OEE would be optimal.

Plants' internal strategic traits (role in corporate production system, competitive position, product portfolio and economic structure), development in the markets and available technology and its development determine critical success factors for the engineering assets. The used technology gives limits and potential to the plant's ability to meet the requirements of the markets.

Asset Management definitions

There are many definitions of Asset Management. If we use Google to get the answer to the question from the title of this paper, we get the following responses:

- Investment management is the professional management of various securities (shares, bonds and other securities) and assets (e.g., real estate), to meet specified investment goals for the benefit of the investors. Investors may be institutions (insurance companies, pension funds, corporations etc. (en.wikipedia.org/wiki/Asset_management)
- Fixed Assets Management is an accounting process that seeks to track fixed assets for the purposes of financial accounting, preventive maintenance, and theft deterrence. (en.wikipedia.org/wiki/Asset_management_general)
- A process that oversees the cradle-to-grave status of key plant-floor machinery. It involves the acquisition of such equipment, along with their use, function and ultimate disposal, in order to maximize their potential performance and longevity. (www.reliableplant.com /Glossary)
- A management system that ensures the efficient use of business equipment such as vessels, measuring equipment, etc. (www.fugro.com/corporate/faq.asp)
- The practice of taking a comprehensive view of the entire portfolio of resources available in order to achieve system-wide agency goals at optimal cost benefit. This includes the ability to show how, when, and why resources were committed. (ops.fhwa.dot.gov/publications /fhwahop09028/glossary.htm)
- The investment of large sums of money, normally in stocks and shares or other interest bearing accounts for the purpose of either producing an income or growing the original capital sum or a mixture of both. (www.cwseriousinjury.com/glossary)
- Range of services offered by banks for the active management of a client's assets under a portfolio management mandate. Asset Management is essentially synonymous with portfolio management or wealth management but in practice often refers to the service provided to institutional investors. (www.ubs.com/1/e/gcc/bankingterms.html)
- Professional services and activities aimed at maximising the value and return of the fund's real estate assets, by identifying measures enabling strategic Asset Management.(eng.fondoalpha.it/_sef/Glossario.php)
- The management of a portfolio of assets (e.g. bonds, shares, cash, property) of an individual or company in order to maximise return on investment. This is a service provided by financial advisors such as Acumen & Trust. (www.acumenandtrust.com/glossary/)
- The various disciplines involved with managing real property assets from the time of investment through the time of disposition. (www.searchsacramentohomesforsale.com /real_estate_glossary.html)

It is quite clear that none of the previously given definitions provides an absolutely accurate answer to the question: What is Asset Management?, but each of them offers one of the possible answers to this question from a certain angle. An important issue arises – is it possible, due to the breadth and the complexity of the concept of Asset Management, to define it in a simple way, and in one sentence.

WHAT IS ASSET MANAGEMENT?

Simply put, Asset Management is "The optimal life cycle management of physical assets to sustainably achieve the stated business objectives" [8]. Asset Management allows asset intensive

businesses to use limited resources to achieve their stated business objectives in the most cost effective way. It combines engineering and mathematical analyses with sound business practice and economic theory. This definition leads to some key principles which any Asset Steward should follow [8]:

- Decisions shall be clearly linked to the overall business objectives;
- Asset Stewards shall manage risks and not resources;
- Decisions shall be analysed for whole systems and not their parts;
- Decisions shall be made from a whole-life perspective;
- Asset Stewards shall leave assets in at least the same state they inherited them;
- Uncertainty shall be actively embraced and managed; and
- Stakeholders shall have a full understanding of the choices available.

Asset Stewards can begin to deliver Asset Management in line with these principles by focusing their organizations on the management of the asset lifecycle, as shown in Figure 1 [8].

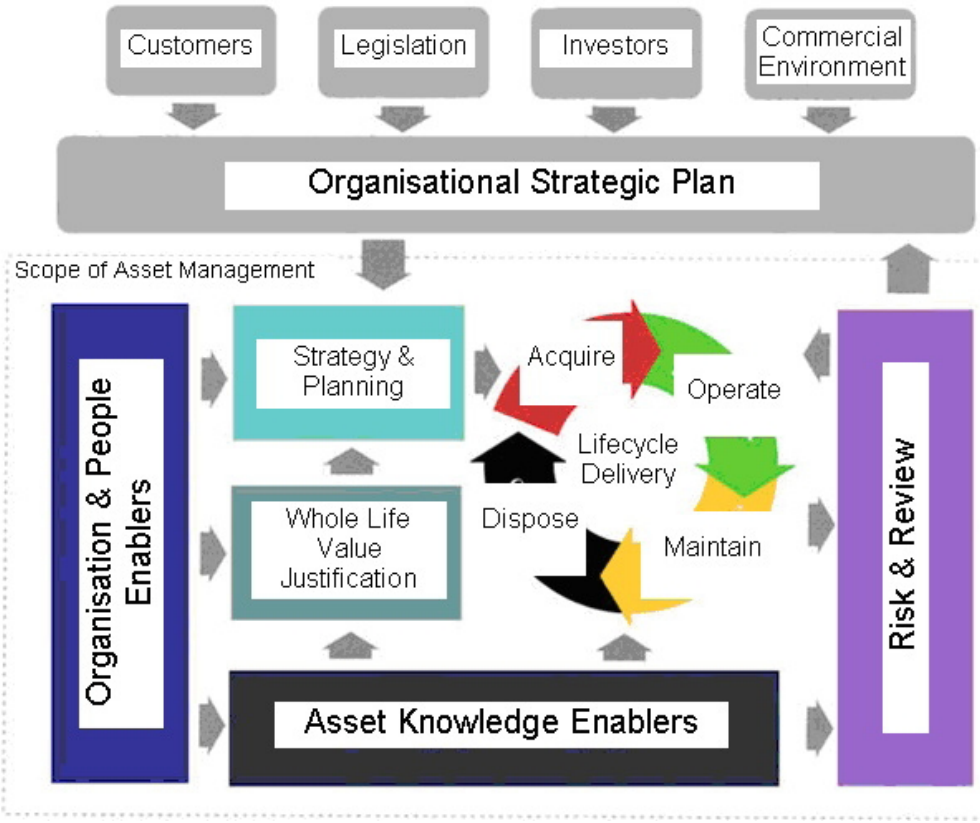

Figure 1. Making Asset Management the focus of an organization's activities

CONCEPT OF ASSET MANAGEMENT

Asset development contains e.g. determination of business needs:

- expected life cycle,
- capacity,
- capability,
- flexibility (in relation to volume and /or product),
- efficiency,
- performance rate (e.g. operating rate, OEE, maintenance costs).

Asset development contains also determination of asset options to be used, design and construction of production equipment in compliance with life-cycle needs, capacity, capability, flexibility, efficiency and performance rate requirements (maintainability and reliability included). Operating of asset may have significant effect on production assets e.g. [3]:

- allocation of orders on various plants or production lines,
- break downs because of misuse of assets,
- OEE oriented activities,

- immediate production actions such as process control and machine operations, operation can also include adjustments or replacements of consumables, etc.,
- in addition to operation, operators' duties include tasks related to integrated operation and maintenance such as sanitation, cleaning, lubrication, settings, minor repairs of production machinery as well as machine-specific condition monitoring and follow-up of production capability.

The system of the maintenance function consists of several separate sub-processes [3]:

- determination of requirements,
- determination of maintenance objectives,
- maintenance planning,
- resources management and development,
- management of maintenance processes,
- execution,
- follow-up and continuous improvement

All these three dimensions influence each other and should be therefore handled in an integrated way as illustrated in Figure 2 [2].

All the above mentioned dimensions interact with each other. For example, operating and maintenance of assets has a significant influence on asset development. Exogenous influencing factors such as market development, technological development, financing of assets and stakeholder requirements affect asset management activities (planning, decisions and implementation). Actually, market and technology development are key factors when determining the critical success factors of the business in question and requirements on assets. Financing and stakeholders give constraints to asset management activities. Legislation and EU requirements give a societal framework for Asset Management [3].

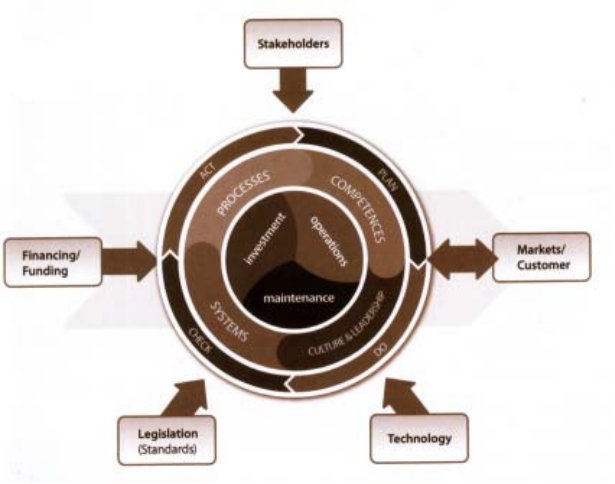

Figure 2. EFNMS conceptual model of Asset Management

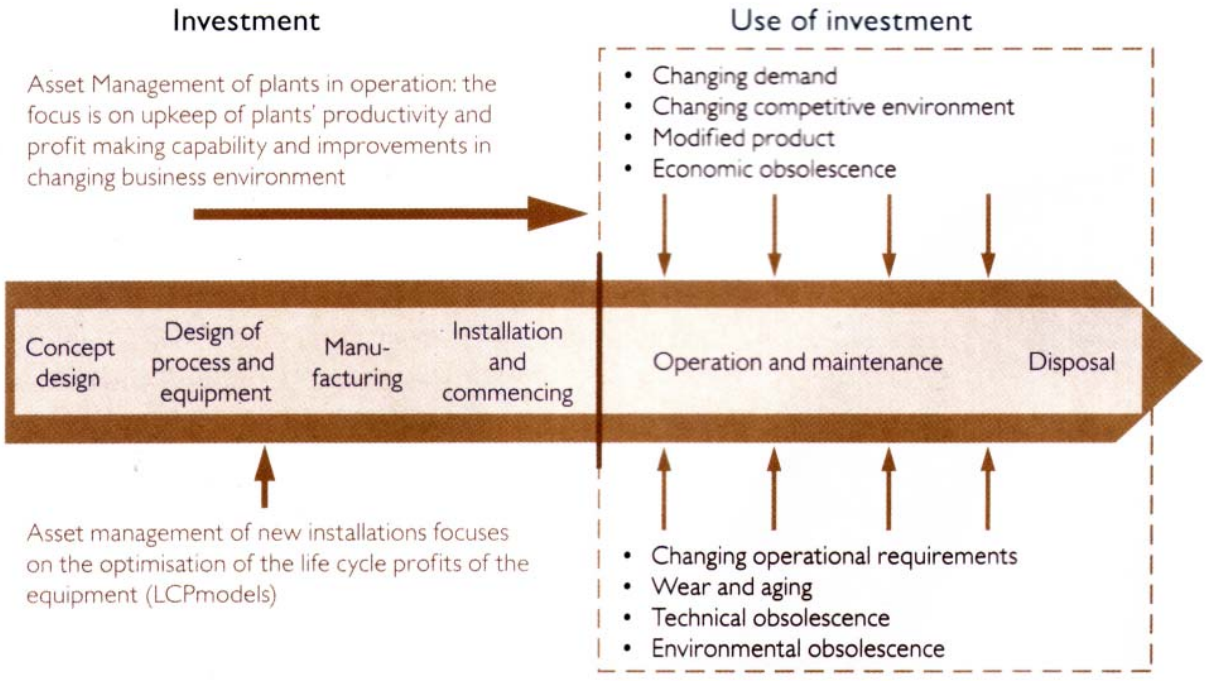

Figure 3. Two guiding factors of Asset Management [2]

There are at least two standpoints when creating investment policies and carrying out investment oriented Asset Management. The one is reactions to the changes in the business and technological environment and the other is to make investment decision based on life-cycle profit (LCP) or life-cycle cost (LCC) calculations. Especially in the case of replacement and development investments to the old production line, LCP or LCC-approach would often be a powerful tool to make effective decisions.

A LCC/LCP analysis can be applied to the evaluation and optimization of the life cycle costs and profits of the investments taking into account specified performance, safety, reliability, maintainability and environmental requirements. Other reasons for performing LCP-analyses can be, for example, to identify cost effective improvements and cost drivers (i.e. cost factors that have large-scale impacts on the investment profitability), or to choose between different suppliers and products. However, as soon as the installation of the equipment has been carried out the business environment begins to change (Figure 3). Changes may occur in all the exogenous or internal factors which the investment calculations have been based on [3]. The essential question is how to sustain or improve the life cycle profits of the original investment. Another essential question is how to ascertain high life cycle profits for green field investments or the replacements of the whole production line. These ones are the core issue of Asset Management of the production assets. In the case of replacement or development investments to the old operating plant or production line LCP or LCC-approaches combined with some other economic indicators could give the better indication of the profitability of investments than many of the traditionally used indicators.

WHY IS ASSET MANAGEMENT IMPORTANT?

The world is facing a growing challenge with respect to the ability of global society and indeed the planet itself to meet the needs of an increasingly growing and demanding population. Infrastructure investment in the emerging economies will be $2.25 trillion annually over next three years [11], and in the US the ASCE reports that US infrastructure requires investment of $2.2 trillion over the next five years, twice the expenditure currently planned [10]. In Britain a recent study by the Policy Exchange concluded that investment in Britain's infrastructure, which is among the oldest in the world, needs to be £434bn by 2020 and that the 18% productivity gap between Britain's and France's productivity is in large part due to Britain's ageing infrastructure [9].

Add to these raw figures the growing concerns over the social and environmental impact of infrastructure projects, questions are bound to be asked about what we will hand over to future generations. Forum for the Future, a UK based sustainable development organization, recently published its thoughts in 'Rethinking Capital' [12]. It concluded that falls in capital markets, most notably during the recent economic crisis, occur for a number of interlinked reasons [8]:

- Incentives are not aligned with the public good;
- Critical goods and services are not valued or are under valued;
- We lack imagination and awareness about new and systematic risks;
- Regulation is inadequate; and
- Progress is based on unsustainable growth models fuelled by credit.

Although Asset Management cannot answer these questions directly, it can provide a long-term view, based on rational and justified analysis, of the impact of decision-making on complex infrastructure portfolios which can strongly support the right decisions. The key decisions are [8]:

- How, where and in what to invest?
- What risks need to be managed?
- How to trade-off short and long-term costs and risks?
- What demands must be served?
- Where can costs be deferred or cut?
- Can this be done without cuts in service levels?

All of these decisions of course, have to be made in the face of huge uncertainty. We must therefore not be put off making hard decisions because they are uncertain. The processes that underpin good Asset Management can us help understand and reduce this uncertainty, and so give us a better route to success.

THE ASSET MANAGEMENT SYSTEM

The Institute of Asset Management, the UK member of the EFNMS, defines the asset management system as [1]:

Systematic and coordinated activities and practices through which an organisation optimally and sustainably manages its assets and asset systems, their associated performance, risks and expenditures over their lifecycles for the purpose of achieving its organisational strategic plan.

However in a sense there is nothing special or new about asset management systems. A number of elements of modem asset management systems have been used for many years. For example the manufacturing sector has developed a range of operating and maintenance regimes which maximise the productivity of its factory assets. Furthermore Asset Management is not an exclusive activity. Almost everyone in an asset intensive business has some role to play in the asset management system. On a day to day basis operational staff will be maintaining and running existing equipment assets while in the board room new investment plans which may add capacity, or increase production flexibility or efficiency are under consideration. Accordingly it may seem strange that Asset Management has, over the last 20 years, become a subject in itself. However there are three factors which are changing the business environment of asset rich organisations, and creating a need for more effective Asset Management. These three issues are [1]:

1. Short and long term conflict: Operational staff often see the need for day to day maintenance most clearly, while senior managers are looking even harder for ways to reduce investment. Getting the balance right between these two conflicting pressures is becoming more difficult.
2. Complexity: Complex businesses create complex conflicts and make it difficult to allocate investment efficiently. How often have we seen someone get funding for the wrong reasons?
3. Oversight: These days there are many people prepared to examine our decisions looking for errors in our work. For example after an accident our every decision can expect to be studied and questioned. We have to be much better at demonstrating why we had to make the decisions we have made.

What is good asset management practice?

In order to be effective and efficient good Asset Management requires a clear and 'joined up' understanding of the most strategic and the most tactical business decisions being made. Figure 4 illustrates the different types of tasks which need to be undertaken.

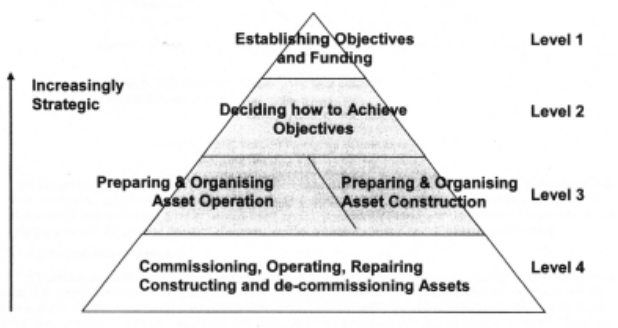

Figure 4. Strategy hierarchy of asset management decision making [1]

For a 'normal' manufacturing business a small group of people may be able to take a view on Level 1 and Level 2 objectives. However form a complex business with many operational sites, of a regulated utility which if only funded for the ideal investment plan decision making can be much harder to get right. All utilities and many companies employ people who find others within their own business make decisions which make it difficult for them to do their job well. For a well organised business ownership of decision making for each of these different levels of thinking may well rest with different departments or groups of staff across the company. However by having 'owners' who are accountable for each of these levels of thinking and who are prepared to work constructively with others in the asset management system is critical. Ultimately the most strategic aspect of any decision needs to be sponsored collectively by the board of the company. In this way while particular departments of groups may 'own' certain types of decisions, the most senior leaders across the organisation need to be comfortable with the most strategic decisions being made which affect their accountabilities. Implemented well decisions are more likely to reflect all the important factors which add or destroy value in the organisation.

It should be noted such systems need not be complex however there is a great tendency for them to become bureaucratic if allowed to do so. This may be because almost any higher level document or objective has the scope to accumulate detail (much of it increasingly duplicated in other documents) and so create a source of potential confusion. If the important issues cannot be clear in several paragraphs there may be a deeper problem which needs clarity.

The need for capable asset management systems

A review of asset management practice in a range of utility companies located across the world has indicated asset management approaches vary significantly across the world. As asset management systems add costs as well as gives visibility of risks and value. It is this complex trade-off which determines what sort of asset management system is appropriate for a particular utility organisation. These conflicts are illustrated by the figure 5 [1].

The Climate, Complexity and Goals are the factors which determine the type of capability of the asset management system which is appropriate for a particular business. For example a utility which operates in a tough regulatory environment, and which must enter into fixed price five year regulatory contracts, has a greater need for a sophisticated asset management system than a utility whose budgets are reviewed annually in the light of events. However once an organisation has resolved to establish a certain type of system it is the Tools, Organisation, and Teams determine the actual capability which a particular business is able to achieve at any point in time. Climate and Complexity are particularly defining factors.

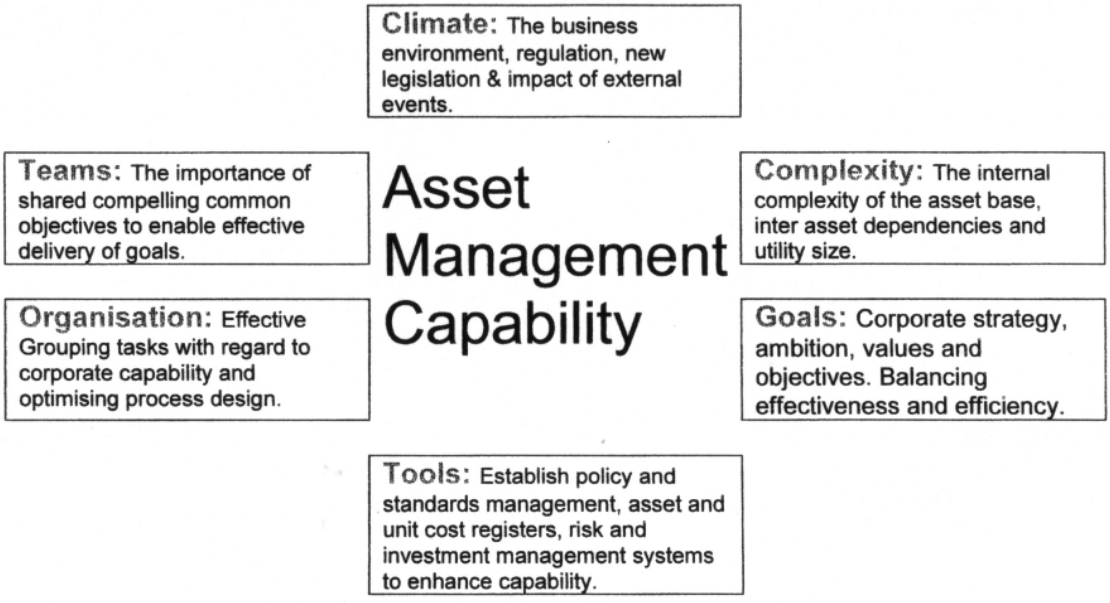

Figure 5. Asset management capability model

HOW CAN ASSET MANAGEMENT BE MEASURED?

The development of an organisation's capability in Asset Management can be described in terms of developing maturity, i.e. from initial awareness of the importance of asset management processes (or 'Innocence'), through to a state where the organisation's asset management processes are appropriate, sufficient and capable of producing consistently good performance (or 'Excellence'). This is summarised in Figure 6 which shows the impact of asset management capability, or maturity, in the horizontal dimension and the performance / outputs of an organisation in the vertical dimension.

Customers and regulators typically concern themselves only with the vertical axis of this matrix - the output performance of the organisation; yet the ability of the organisation to consistently deliver economic and sustainable performance requires mature asset management capability in parallel.

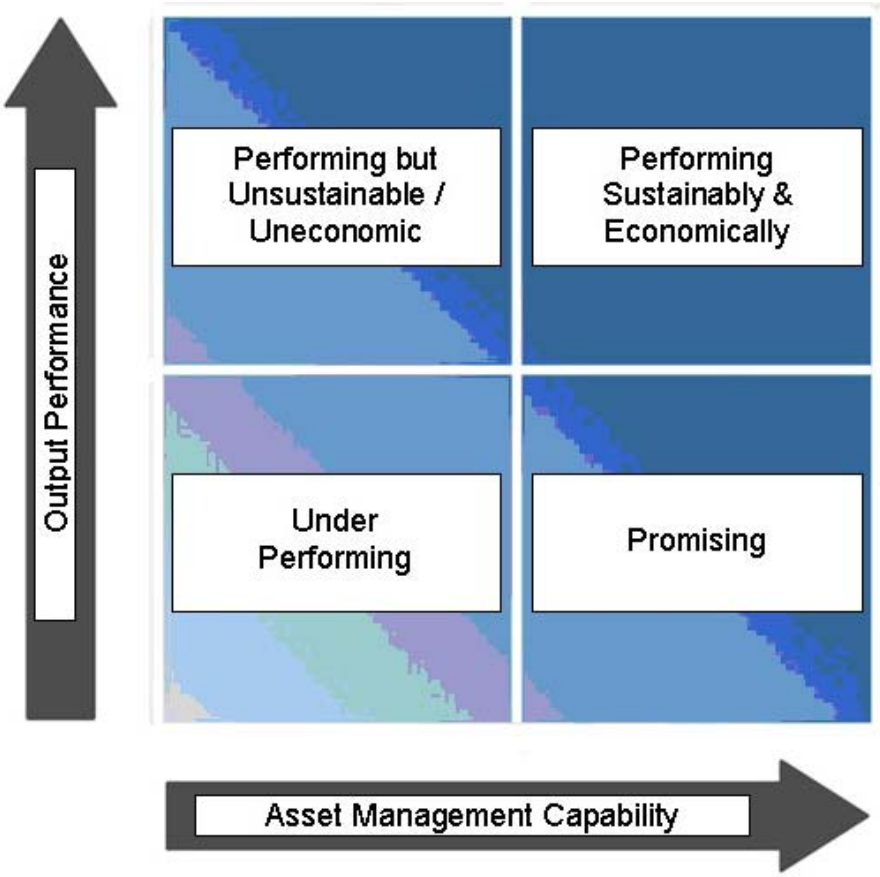

Figure 6. Asset management capability versus output performance [8]

An "Under Performing" organisation is likely to lack the underlying capability to significantly improve consistently poor output performance. A "Promising" organisation is also likely to have consistently poor performance, but has at least recognised the need to develop process maturity, noting that there can be a significant lag between improvements in asset management decision-making and this being reflected in the outputs of an organisation.

Organisations that have a wide variability in their performance (i.e. sometimes achieving the desired performance, but not being able to maintain it) will typically have a focus on outputs, but a low level of underlying asset management capability. This is usually the result of transitory efforts to address the 'latest problem' but often not in the most sustainable and economic way to deliver the required outputs.

CONCLUSIONS

Asset Management can be defined as managing infrastructure capital assets to minimize the total cost of owning and operating them, while delivering the service levels customer's desire. It can be effectively use to improve operational, environmental, and financial performance of any system that delivers a significant service. Asset management programs with long-range planning, life-cycle costing, proactive operations and maintenance, and capital replacement plans based on cost-benefit analyses can be the most efficient method of meeting the challenge of providing the best possible service under numerous real-world constraints (e.g. limited funds, capacity).

Optimisation of assets and more particularly of engineering assets is a key and challenging issue for modern industrial societies. Engineering Asset Management (EAM) is an emerging interdisciplinary field that combines technical issues of asset reliability, safety and performance with financial and managerial requirements. The emphasis of EAM is clearly on sustainable business outcomes, risk management and value. EAM is concerned with assets throughout the lifecycle. Efficient EAM is realised with the efficient development of closed loop product lifecycle management technologies allowing for the efficient man-

agement of all the business processes distributed along the product's lifecycle phases. Middle of life and particularly maintenance is of particular interest and importance for EAM. Along that line predictive maintenance and maintenance for sustainability approaches, models, methods and tools need to be developed.

Integrated view on the development of companies' engineering assets has become more important and even vital in the very dynamic business environment which we meet today. Development of technical assets, development in operating them and development of the maintenance of those assets cannot be carried out separately, because it leads to sub-optimization and ineffective solutions. Productivity of capital could be increased, which results in more sustainable production. Demands for higher turnover of capital, better return on assets and improved sustainability of asset solutions in the fast changing business environment have led very sophisticated decision making situations where a lack of effective and proper decision making tools is evident. However, various industrial sectors differ from each other as far as the requirements on assets are concerned. Therefore, industry specific requirements should be clearly kept in mind when making decisions concerning engineering assets. These trends and business development mean that decision making concerning technical assets demand good technical expertise just as before, but in addition to that, expertise in business analyses and strategies is as important as technical expertise. Economic analyses are increasingly important in Asset Management. Market dynamics, technological options, life cycle cost and profit objectives and life cycle cost structure have a significant influence on the plant asset strategy and strategic choices. Within the asset management framework a challenge to meet is how to sustain or improve the life cycle profits of the original investment and at the same time to improve the sustainability of asset solutions.

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