APPLICATION OF A UNIFIED REFERENCE MODEL ACROSS ASSET TYPES: COMPARATIVE CASES

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Asset Management has grown over the last few years and has begun to use many terminologies and concepts across different applications. This has notable negative effects on the further growth of the discipline, as the present conditions only contribute to complexity and chaos rather than leading the way towards a commonly acceptable approach. In this context, a common reference model becomes extremely useful that can provide the necessary elements which can be capitalized for learning and development efforts for wider applications. The issue here is to get the principles intact that has comparable and defining features across many contexts. In this respect some initial efforts were invested to develop an approach for a unified asset management reference model. This paper brings further work on this reference model into perspective by discussing the application of the reference model across different asset types. The purpose here is to communicate the potential of such a unified approach as a valuable foundation to build on.

Key Words: Asset Management, Reference model

1 INTRODUCTION

Managing assets in the modern industrial climate has begun to provide different realms for different asset managers in different sectors. The traditional thinking and the use of varied approaches has only contributed to creating disparities rather than assimilating the development solutions. This to a certain extent is not a matter of the complexity of the subject but rather the immaturity behind the thinking process on what asset management really is about, and the lack of insight to the deeper meanings of the roles of assets and the functions of asset managers in different contexts. Concepts and terminologies that are largely seen used today have failed to provide the level of maturity required. In many industrial minds, thus unfortunately, asset management remains a hypothetical and an academic solution rather than embracing it as a timely relevant and value creating concept.

To shed some light in this regard, some initial work done was discussed by Wijnia, de Croon and Liyanage [1] where attempts were made to develop the basis for a unified reference model. This is based on the understanding that despite the obvious differences between the fields, there seems to be a deeper unexplored commonality. Given that every asset manager is in his or her own way and context trying to optimize value, many application fields have the potential to derive effective solutions from a single generic concept. In such a case, lessons may well be learned between know-how across the fields as well as sectors. Such pragmatically usable generic concept should not be too far out from the realm in sectors. If the cash flow is the only idea shared between the fields, there is not much to learn. In this paper, the idea of such a generic framework is furthered by structuring the basic framework developed across different asset types. The purpose of this second phase of the study was to explore the potential of the initially developed reference model as a common ground.

2 STRUCTURING TYPES OF ASSET MANAGEMENT BY THE FRAMEWORK

For this particular task three types of assets were considered, namely infrastructure, production facility and financial. Those assets have specific attributes of their own and at the same time follow management processes that are regulated by relatively different contexts. This provided a fruitful basis to have a meaningful insight into the realm of asset types using the common reference frame.

2.1 Infrastructure asset management

Infrastructures are, in the most conventional definition, technical systems that provide paths between points. The plural is on purpose. A technical system providing a path between two specific points is "just" a link, a connection between A and B. The interesting thing about infrastructures is that they connect A not only to B, but also to C and so on. Typical examples of such conventional infrastructures are roads, railways, waterways, the drinking water system, sewage systems, electricity and gas distribution grids and telecom grids. Despite technical differences, infrastructure assets seem to share many characteristics:

1. They have a long to very long lifespan (sometimes more than 50 years)
2. They are costly but cannot be sold for another purpose (how to sell an overpass)
3. They mostly are passive elements, they just provide a path; only the controls (switches and so on) are operated
4. Because of longevity not all records of current assets survived: the asset base is not fully known
5. Infrastructures are evolutionary systems, growing over time with sequential add-ons
6. They are networked, with little or no key elements that can bring down the system
7. They are dispersed and operated in the public domain
8. The owners / decision makers are not the users
9. Infrastructure users can be highly anonymous, opening the door for misuse of the assets

Based on discussions with Dutch infrastructure asset managers [2, 3], no specific key lifecycle phase for all infrastructure assets could be indicated. For some assets the focus is on design in terms of capacity and route (cables, pipelines, roads), for others there is more attention for maintenance (switches, road surface) or operation (switches). In general, passive elements are mostly design and perhaps a bit maintenance, for active elements the equipment is generally of the shelf, with more attention for maintenance and operation.

The environment for most infrastructure assets tends to be very stable. The infrastructures are the facilitators of some very basic needs (power, drinking water, mobility), and their volume does not show much volatility, but is highly correlated to the population size and state of the economy. An exception can be made for the telecom companies, which have seen major changes in the last decades (mobile phones, internet). However, even though the growth was significantly larger than in other infrastructures, the growth has been consistent. The market prices are also stable compared to commercial industries. In many cases, infrastructures are monopolies and the income is determined by a regulator or some other governmental agency. Again, this does not apply to telecom, as there is competition between infrastructures in that domain, with accompanying pressure on prices. For most infrastructures is the development of technology rather slow. Cables, pipelines and roads are old technologies. There is continuous improvement in cost per unit, reliability and so on, but breakthroughs are rare. Not surprisingly, telecom is the outlier again. A major technology change has passed (copper to glass), and the services provided over the system are not comparable with the old.

Asset characteristics	**Environment**
• Function: provide path for the public • Behavior: mostly passive, they do not require operation to function, nodes may be active • Life cycle length: long to very long for equipment, the geographical routes tend to be unlimited • Location: Fixed, distributed, line assets (links), linear assets and point assets (links, switches), in the public domain • Type: Electrical, civil, mechanical	• Market volume: very stable • Market prices: Very stable • Technology development: slow
Key life cycle phase	**Management attention**
• Key life cycle phase: o Passive elements: design o Active elements: operation	• Main activity: investment planning for passive assets, maintenance for active assets • Analysis tools: demand prognosis • Value system: reliability, safety, as long as affordable • Asset control: partial, asset users are not the owners or managers

Figure 1: Characteristics of infrastructure asset management

For most infrastructures, management attention not only focuses on the financials. Reliability and safety matter as well. The reason is quite straightforward: as the assets are in the public domain, any incident will be visible. Ill-performance with regard to safety and reliability will draw attention and may result in undesired involvement of government officials, or even the shareholders, who tend to be government as well. Over the years the operators learned to deal with it by internalizing the public values. This is especially true for electricity, gas and water. The reliability of those systems is extremely high (over 99.9% [4,5]), potentially beyond the point of the economic optimum. With regard to the safety, despite the potential of respectively electrocution, explosions and poisoning, a very high performance level has been reached. In figure 1 important characteristics of infrastructure asset management are presented.

2.2 Production facility asset management

Production facilities are in essence locations where resources are converted into products. The term product is used in a broad sense, including both goods and services. In this view, a call center (which converts knowledge and human resources into answers, advice or complaint resolution) is a production facility as well as steel mills (which convert raw materials like coal and ore into steel). Other examples are oil and gas refineries, chemical plants, discrete manufacturing (cars, electronics), food processing, electricity generators and defense industries.

A binding characteristic of production facility assets is that they require operation: they are active assets, not passive assets. If any of the needed resources (power, feedstock, operators) lacks, nothing comes out. All production facilities for goods use rotating equipment. Rotating equipment is vulnerable to wear and tear. Depending on the task and operating conditions, rotating equipment may function for hours or days (drill head in mining) up to years (pumps, ventilators, transportation belts). Non rotating equipment (reactor vessels, ovens, frames) typically lasts much longer. Another typical characteristic of production facilities is that they are confined physical locations, at least for goods. Services may be produced dispersed as well (facilitated by modern communication technology, which means a call center operator may work from home), though the investments needed to do so and the lack of direct control form an incentive to work on a confined facility. Production facilities are often designed at the start, though their design may change significantly over the years. Furthermore, production facilities may be sold, both in terms of superfluous equipment (after an upgrade for example) or as a whole. The latter will require some due diligence, for second hand equipment markets exist.

For production facilities, the operational phase is everything. The design needs to be right, but in general any production facility will see significant upgrades in capacity during its lifetime. It is not unusual for chemical plants to outcompete their design capacity by multiple times, by optimization of the operational parameters. And in discrete manufacturing processes, the continuous improvement of the operation may result in a significant decrease of the takt time. The Scania truck manufacturing plant in Zwolle for example reported a 40% increase in the productivity of the location in 18 months by optimization of the production process [6].

The environment for production facilities can be range from stable (though not as stable as for infrastructures) to very dynamic, which strongly depends on the product. Basic needs like energy and food will have a more stable environment than consumer goods like electronics. Interestingly, the lifecycle of the production assets may be much longer than the product lifecycle[1]. The production facility for cars for example can produce many different models over the years with the same equipment. On the other hand, in computer chip manufacturing, the capacity of the chips strongly depends on the resolution with which the circuits can be printed. Every new generation of chips therefore requires a new production asset. Remembering Moore's Law of capacities doubling every 2 years or so equipment can become obsolete very fast.

Asset characteristics	**Environment**
• Function: Produce goods for the owner to sell • Behavior: active, assets require input to function • Life cycle length: short/medium (discrete manufacturing) to long (chemical industry) • Location: concentrated, fenced off • Type: Electrical, civil, mechanical	• Market volume: reasonably stable (food, oil & gas) to volatile (electronics). • Market prices: stable (food), to volatile (oil and gas) • Technology development: fast (e.g. mobile phones) to slow (oil and gas)
Key life cycle phase	**Management**
• Key life cycle phase: o operation	• Main activity: maintenance management • Analysis tool: past performance • Value system: financial: reliability, safety are constraints time to market? • Asset control: full, owners are the users though activities can be outsourced, assets are fenced off

Figure 2: Characteristics of production facility asset management

As mentioned, the key phase is the operational phase, so that is where management attention is. But it is as much on increasing performance with current assets as it is on reducing the risk of malfunctioning assets, the role of classical maintenance. But because of the omnipresence of rotating equipment, maintenance cost are significantly higher than those of infrastructure assets, usually in the order of 1-2% of asset value [7]. The assets exist to make products and produce income, therefore the most important value is the financial one. Reliability can (should) be judged economically and is thus financial. Safety, compliance, sustainability and the like are treated more like constraints than as true values. After all, the facility is fenced off, and most incidents stay within the fence. Yet, for production facilities (or rather the products they make) image can be very important. Shell lost a significant share of market volume in 1993 when they decided to sink off the obsolete oil rig Brent Spar. Nevertheless, in most cases the asset management decisions hardly influence the image of the product. In figure 2 characteristics for production facilities are summarized.

[1] The product lifecycle is the time the product is available on the market, not the life expectancy of the product itself. A specific computer model may only be sold for a few months, whereas the computer itself may function for years, and the production facility for tens of years. On the other hand, disposable cups have a useful life expectancy of a few minutes, whereas the product may be on the market for years.

2.3 Financial asset management

Financial asset management deals with tradeable securities. These can be any form, ranging from common stock, bonds and commodities to more complex derivatives like swaps, options and futures. Securities can be direct like a share of a company or a treasury bond, but also indirect, like an investment in an index fund. The liquid markets provide every opportunity to construct a portfolio of assets that matches the risk profile of the investor, though it can be inconvenient for smaller investors to do so. Therefore there is a large volume of pre-packaged assets like the already mentioned index funds. In some cases the assets are securitized debts, like collateralized mortgage obligations. Financial asset managers generally manage a portfolio of securities (to keep in line with the risk profile of the investor), but there is no attachment to the securities in the portfolio.

Financial assets are characterized by a number of things. Most importantly, the assets are traded on very liquid markets[2]. This removes the need for managing the underlying securities, as they can be sold immediately if underperforming. Furthermore, the assets are highly dispersed. A portfolio can consist of shares in companies all over the world, and because of modern communication technology, asset managers can get involved in all markets of the world. Thirdly, the value of the assets is determined by anybody trading anywhere in the world, as the asset price is the average price of all transactions in the last timeframe. Normally, this is just a bit of noise, but if everybody acts coordinated the effects can be dramatic (like the credit crunch of 2007-2010).

Within financial asset management, it is difficult to pinpoint the lifecycle phase as it strongly depends on the viewpoint one has. For example, if the portfolio of securities is regarded as the asset, it seems fair to state that the key phase is operation and maintenance. The performance of the parts of the portfolio is monitored, and underperforming parts are replaced. Given the enormous value of the trade compared to the value of the underlying assets, it seems equally fair to state that the design and construction of the portfolio is most important, as the securities are not replaced by the same securities, but by something completely different. The portfolio is so to say continuously redesigned. In the context of this paper the maintenance perspective is used.

The environment can be extremely volatile. This is not only true for individual securities, but for the portfolio as well. Market averages can drop over 20% in a single day of trading[3]. Volatility may have been increased by modern communication technology, so that asset managers can react faster to movements in the market. However, the production technology did not change very fast. The basics of a portfolio are still shares and bonds, though they may have been repackaged into exotic assets.

Management attention in financial asset management is on buying and selling assets. Because of the limited share the asset owner generally has in a company, it is difficult to control the management of the underlying asset directly. And there is no need to either. Because of the high variety of securities traded today it is much faster to change the portfolio.

Financial asset management is purely about financials, both in terms of profit as in terms of risk. Any other value is indirect at the most. Some funds may focus on sustainable investments, but if they do not deliver financial value they will not generate profit for the investor. However, there is a significant amount of emotion into the asset value. If traders “believe” an asset will do well in future, it will do well tomorrow as the high demand for shares will drive up the price. This may result in stock market bubbles where securities are traded well above their fair value, waiting for the inevitable collapse. A famous Dutch example was the Tulip Mania of the 1630s[8], though there is debate on the truth of this. Other examples are the Mississippi Scheme or the South Sea Bubble. This emotional response opens the door for malignant speculators to manipulate the value of their securities by providing false information. In figure 3 characteristics for financial asset management is presented.

[2] The average daily volume on the New York stock exchange was 153 billion dollar , about 1% of the annual GDP of the United States of America.

[3] On the 19th of October 1987 the Dow Jones index dropped 22,6% in a single day.

Asset characteristics	Environment
• Function: produce income for the owner • Behavior: active • Life cycle length: extremely short: the portfolio can be reconstructed overnight • Location: distributed, not fenced off. Any trader around the world • Type: Financial, packaged rights to earnings of some underlying real assets	• Market volume: volatile to extremely volatile • Market prices: volatile to extremely volatile • Technology development: fast, both in terms of the trading infrastructures as in the development of securities sold on the market (especially derivatives)
Key life cycle phase	**Management**
• Key life cycle phase: o Design: packaging securities to form a new type of asset o Operation: managing a portfolio of assets	• Actions: portfolio composition • Analysis tool: historic prices though in some cases the underlying asset is analyzed • Value system: financial • Asset control: partial, portfolio can be changed, but the value of the underlying assets is subject to actions of all participants in asset trade

Figure 3: Characteristics of financial asset management

3 DIFFERENCES AND SIMILARITIES

If the characteristics of these different asset systems are compared, differences and similarities can be noted. The interesting thing is that there is no clear order. Production plant assets are in some aspects quite similar to infrastructure assets: they are big, lumpy technical things. But with regard to the value system plant asset management is more like financial asset management: they are both in the private domain to generate income for the owner. This would suggest that on a continuous scale plant asset management is somewhere between infrastructure and financial asset management. However, in some respects infrastructure assets are more like financial assets. They both are highly dispersed and open for external influences. Plants assets are fenced off from the outside. This would suggest that infrastructure asset management is between plant and financial asset management, which is contradicting the previous ordering. The only viable solution is to say that the 3 forms of asset management are the angles of a triangle, as shown in figure 6.

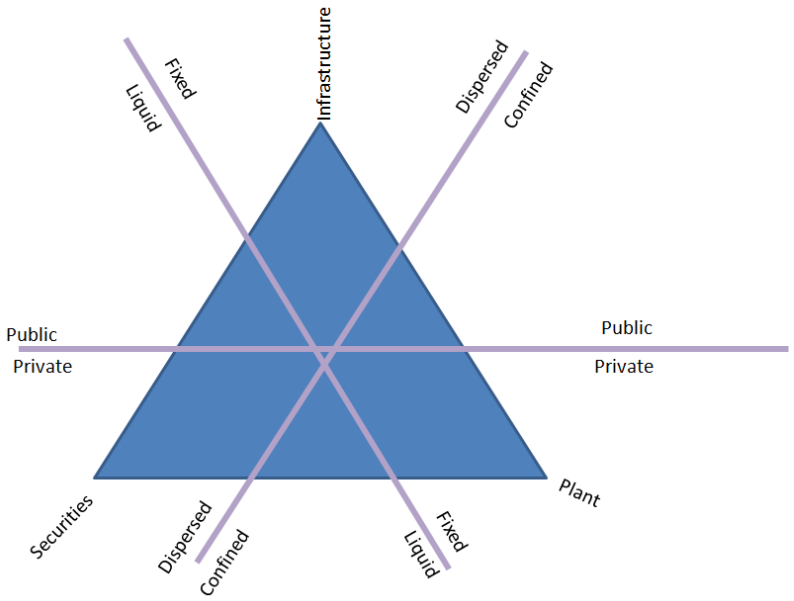

Figure 4: Mapping extremes in asset types along with their distinguishing factors

Parallel to the sides, there are the demarcation lines: infrastructure assets are public, whereas securities and plants are private in Western countries. Securities on the other hand are liquid assets, whereas plants and infrastructures are fixed. Plant assets are also special, as they are confined, whereas securities and infrastructures are dispersed.

Key question now is whether the scales are dichotomic or continuous. Are there assets that are half way the sides? To start with the liquid to fixed scale, examples are real estate and rolling stock. They are real, technical assets, but on the other side markets exist in which they can be traded. However, the time needed to sell a house or a car is most likely much longer than that of selling a financial asset, which is basically a mouse click. This may suggest that the liquidity of the market is the true

distinguishing factor, but that in itself depends on the uniqueness of individual assets. Markets in which highly standardized asset are traded are much more liquid than the markets for unique assets as the buyer of a standardized asset knows exactly what the asset is, and for unique assets some more research is needed. But as a proxy, liquidity may do very well.

The second scale is that of dispersed versus confined assets. One example of something in between is a collection of plants as owned by a multinational. Each plant is confined, but the plants are scattered around the world. And due to political instability, even fenced off plants may be very vulnerable in some countries. Another example is a fenced of private infrastructure, like the “leidingstraat” in the Netherlands, which is a fenced of zone for large pipelines.

Finally, the boundary between public and private is crossed by for example the public private partnerships like DBFM contracts in road infrastructures. A private party then designs, builds, finances and maintains the road, and gets paid by the public authority according to how well the road performs. For the private partner it is an asset to generate income but for the authority it delivers public value, if the right key performance indicators are set.

However, it seems difficult to think of any asset truly in the middle, with characteristics somewhere between fixed an liquid, public and private, and dispersed and confined. If there is no such asset, it is not surprising there is no common framework for asset management, as it has no natural anchor point. And any deviation of the center will result in asset management addressing issues that simply do not match characteristics of all assets around the world. Think about selling infrastructures, lubing securities or voting about the production scheme of a chemical plant: it just does not work.

4 CONCLUSION

In this paper, the total realm of asset management has been explored. The forms discussed were infrastructure asset management, production facility asset management and financial asset management. An interesting finding was that these types of asset management have no natural order: they can be both an extreme as be in the middle between the other two. Financial asset management is like infrastructure asset management and unlike production facility asset management in the lack of confinement of the assets, but it is the other way around in terms of the value system. Infrastructures and production facilities share the lumpiness of their assets, contradictory to the liquid assets in finance. Yet, a true unifying asset sharing characteristics with all three forms is difficult to envision. Therefore, in terms of concrete management actions similarities seem to be missing. Further research has to be done to arrive at a true common framework beyond the abstract process model.

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