Making Decisions Easier

Real Examples of a Digital Asset Management Culture

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Abstract

Management is tricky.
Decisions still need makers.
Answers are rarely absolute.

The combination of loss of expertise and increased need for flexibility in decision making has made it hard to find the right staff for many asset roles. Potential employees with 40 years field experience won't have the tech-skills of 20 year olds. No one wants juniors to "learn from mistakes". How can we help decision makers make the right decisions?

Many recent technologies focus on transforming processes (inspections, controls, operations) but often underestimate cultural constraints. This paper will show by example that digital tools can help to recognise and overcome cultural constraints to asset management maturity.

In these examples, decision-making became more mature and the cultural barriers were reduced by project's design. More people were able to understand and participate in asset management decisions. The use of digital tools to solve cultural constraints can unlock a huge potential for a more resilient and robust future. By embracing a strong, agile, digital culture, modern asset management solutions and benefits will most likely be realised.

1. Introduction

Management is tricky.
Decisions still need makers.
Answers are rarely absolute.

In the ever-expanding, ever-changing world, is the need for asset management being outstripped by our ability to deliver it? Each new building, bridge, road, plant and other exciting "ribbon-cutting" assets will need to be managed, yet are often built without foresight of their ongoing requirements. The asset management profession has arisen from the need to manage this increasing portfolio in the most economical way for owners.

This paper proposes that the increasing complexity of asset management can only be met by adopting a digital asset management culture. Building spreadsheets, implementing software and collecting reams of data no longer matches the challenge asset managers face. This paper will show:

- examples of how the best digital solutions to asset management problems succeeded because they focused on the ends, and not the means;

- how adopting a digital culture can address some of the toughest challenges in turning asset management strategy into actions;

- how digital projects can also be designed

to overcome any cultural shortfall that happen in the asset management chain ;

- and how the structure of asset management is very well aligned to bring the best out of emerging tools like artificial intelligence (AI) and machine learning (ML).

Many asset management challenges can be met with a digital asset management culture, but only with outcome and objectives-focused digital solutions combined with the robustness of modern asset management.

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2.   The Rise of Modern Asset Management

The rise of modern asset management, as epitomised by ISO 55000 standard, is a reasonable new idea linked back to many fundamentals of business and engineering. The ISO standard's focus on "value" [ISO, 2014] is analogous to a business's "return on investment" or an engineering process "meeting system needs".

The boom of the 20th century is coming home to roost with aging assets, expanding populations and greater awareness of resource limitations.

Asset-owning organisations, particularly governments, are starting to see the importance of getting that maximum value from their investment over its lifetime.. The framework of modern asset management also better aligns with outcome focused industries like health (providing services), transport (moving people and goods) and arts (cultural impact) although it can also be applied to non-tangible assets like brands [ISO, 2014].

3. The Difficulty of Expanding Strategies into Actions

Rarely is a service delivered with only one type of asset. An asset manager's portfolio might have both large, expensive objects (buildings, bridges) and networks of small objects (signs, lights, air conditioning units), which require vastly different technical skill sets to manage. Even with a clear macro strategy, there will usually be a need to rely on expertise or experience to inform tactical and operational decisions.

The translation between strategy and operations is difficult. This practical application of asset management is by nature complex, and heavily reliant on expertise and the corporate knowledge it embodies. Most organisations won't have access to every expertise and will rely heavily on local knowledge to inform their tactical decisions. Generic methods are necessarily adapted to local conditions, and evolving working practices are often incompletely documented or under-defined. This enforces a reliance on key staff to steer the tactical decisions and capability gaps are often patched over by expert local knowledge. Delivering on the ideals of a good strategy is often compromised by inability to operationalise efficiently and effectively.

Unfortunately, acquisition of local knowledge is frustrated by the increasingly transient nature of the workforce. Over 75% of the workforce has been at their organisation for less than 10 years [ABS, 2020] with Association of Professional Engineers Australia's Professional Engineers Employment and Remuneration Report 2020 showing 50.0% of public sector respondents saw an increasing lack of in-house engineering capacity as a major issue in their workplace in the past 12 months [APEA, 2021].

For this reason, filling the gap between an excellent strategy and a good operation is incredibly hard for most asset managers. In many organisations, poor alignment between strategic, tactical and operation is overcome by having a good practitioner. For those asset managers who don't have access to expertise or experience, it can be incredibly hard to ensure that the full value is being realised in an asset.

For example, most road agencies have a strategic goal of providing a safe driving environment and yet road tolls are a stubborn part of our road transport system. The complexity of road crashes means translating a strategic objective such as "improve road safety" into wire-rope barriers, line marking, surfacing, licencing, enforcement and car design covers a myriad of experts, agencies and decision-makers. It takes a lot of expertise and local knowledge to deliver on a very simple and clear strategy statement.

ISO 55001 tries to help this alignment by stating that organisations "shall ensure that there is consistency and traceability between the financial and technical data and other relevant non-financial data" [ISO, 2014]. The evolution in modern Asset Information Management Systems, given the size and complexity of most organisation's assets, will inevitably be digitising this capability. The ability of technology to store, transform and report data clearly go hand-in-hand with the desire for decisions in modern asset management to be data-driven.

Unfortunately the most dominant, established digital asset management tool is still the spreadsheet, fed regularly with exports from databases. They are designed to do a single task – budgeting, resourcing, calculations – but rarely cut across the different levels and promote interactions. Combined with the concentration of expertise, the spreadsheet is a poor tool for delivering modern asset management decisions and metrics.

3.1   EXAMPLE 1:
CAPTURING AND REPLICATING EXPERTISE WITH MACHINE LEARNING

Austroads has commissioned WSP to investigate whether the treatment decision process of an experienced pavement asset manager could be reproduced by a machine-learning model. We obtained inventory, historical condition measurements and historical planned works data from four Australasian member authorities to attempt to answer this question.

While the work is ongoing, preliminary results suggest that machine learning is indeed able to reproduce this decision-making process, with similar levels of agreement between ML and the original treatment programmes to anecdotal levels of inter-expert agreement. But what can we do with this capability?

This research is not to replace asset managers, but to address the cultural need for expertise in creating tactical programs. The ML tools can provide decision-support to help capture and develop local organisational knowledge and experience by only knowing the past deliverables. No expertise is needed to build these models (although it helps). Running the tool will produce a list of candidate projects that can be compared to a program developer's current list to understand local methods or anomalies in the existing processes. These kinds of tools could help supplement creating of new programs, or even be used for other assets.

The wider benefit of using such tools will be in the de-risking the current process where expertise are the bottleneck in the delivery of asset management. The balance for this is the requirement to have an organisational digital culture that can be comfortable in engaging such tools. The outcome of this Austroads project will be guidelines for using ML for pavement modelling, including the proof-of-concept trials.

4. Why is Digital Culture More Important Than Just The Tools?

A survey by Capegemini in 2017 listed "culture" as the biggest constraint to digital transformation, even higher than existing archaic IT systems [Capegemini, 2017]. Although basic software programming is now taught in all STEM degrees and even in primary schools in Australia, this is not the case with the current generation of decision makers. It is unlikely that the technical specialists or staff with extensive local knowledge will have been bought up doing programming. To harness tools better than spreadsheets, organisations will have to adopt a better digital culture.

Having a digital culture is about embracing the benefits (opportunities) and understanding the risk of digital tools. The key to embracing this is to be informed of what technologies are available, and be willing to try incorporate them into business. Technology is disruptive by nature as it will provide the shortcut to common tasks. If organisations wait for technology to become established, they will often miss its greatest opportunity to transform and benefit the business. A good digital culture fosters continual learning through trial and error, learning from mistakes to further improve decision making through the use technology.

One of the most common problems emerging embracing a digital culture is addressing is the abundance of unused data in most organisations. Digital sensing and perception technologies have become very mature, resulting in the production of vast quantities of detailed data. Internet of Things (IoT) technology has passed the peak and connectivity is now steadily increasing as digital sensors become cheaper and more reliable. This data creates increasing needs for digital tools to distil this data into information and insights that can support decision-making. The challenge is not whether the data is available to asset managers, but what to do with it all and how much of it do you really need. The key emerging tools needed in a digital culture will not be data-generating ones, but information-generating ones.

4.1 EXAMPLE 2: HOW TO IMPROVE SERVICE EFFICIENCY WITH INTELLIGENT INFRASTRUCTURE

Newcastle City Council wanted to consolidate and manage data from a wide range of connected assets, systems, and citywide sources to enhance the productivity of city services, better connect citizens with timely information, and facilitate advanced data analytics. WSP built a state-of-the art extensible platform that connected existing data sources and allowed easy integration of future datasets. The platform was designed to collate and sort the various disparate datasets so insights and decision making could be built on top.

An example included smart bins. These bins sense when they are full, avoiding unnecessary collections; and they detect being tipped or

vandalised, avoiding complaints. Another set of sensors measure soil moisture, reducing the operational costs of watering and building a local soil hydrology dataset which may be used for future flood modelling and sustainability enhancements.

Rather than focus on converting or standardising data (such as into a single database), it focused on integrating between various platforms. The project's design centred on meeting the council's need for productivity enhancements and valuable insights, the platform achieved a better digital asset management outcome than a traditional data warehouse may have achieved.

5. Why is Having a Digital Asset Management Culture Important to Emerging Tools?

To unlock the next generation of tools, such as AI and ML, an organisation will have a clear idea what outcomes they want. Experience shows is that it's important to treat AI/ML and Digital projects as if they were startup companies: It doesn't matter how good the technology is, everything boils down the value-proposition.

There are many ways a technology solution could be integrated into an organisation, but only a few will actually deliver enough value to overcome resistance to change. Early in the project, it's crucial to rapidly ideate different problem-representations, scopes and value-propositions to arrive at a package that has enough value to maintain project momentum. There is clear alignment to the structure of asset management in the requirements of these digital tools. The tools must have the same objectives as the organisation.

More modern tools fall into two categories: Commercial, Off-the-Shelf (COTS) software solutions, and relatively more customized cloud platforms including data-warehouse and data-lake storage. Many organisations are adopting both to some degree. Packaged software is widely used, and is often a reliable solution for common requirements. When the limits of COTS software are reached, organisations tend to fall back to ad-hoc or bespoke processes.

The use of Cloud platforms is an emerging trend but not without limits. Cloud platforms provide instant, flexible and powerful access to data management tools, along with sophisticated analysis tools. Future asset managers will be able to replace the current ad-hoc and highly manual spreadsheet-based processes with automated data ingestion, transformation and analytical pipelines. The limits to cloud platforms are around digital literacy and security. For younger asset managers, navigating cloud platforms will be a normal part of the job but for the current workforce, these are still emerging issues. At this point, organisations' ability to harness these tools is not about the tools themselves, but about the culture in which you engage them.

5.1 EXAMPLE 3: BENEFITS OF REALTIME TRANSPARENCY ON ENVIRONMENTAL OUTCOMES

Building the Melbourne Metro Tunnel (MTEM) is an incredibly complex and expensive undertaking by the Victorian State Government. As the tunnel goes right underneath the central business district, there are a lot of environmental considerations when doing the building and tunnelling. Strict environmental limits have been set up to balance construction needs with publics rights in such a dense environment of businesses and housing.

WSP was engaged by MTEM to create a real-time Environmental Monitoring platform. Unlike conventional environmental monitoring, based on occasional in-person site surveys, the solution uses digital sensors to continuously record a range of noise and vibration parameters at every site simultaneously. These parameters are available to all stakeholders through a web portal. Metro Tunnel construction potentially impacts many businesses and households, primarily through vibration, dust, noise and traffic. Hundreds of complex environmental rules and limits have been set for different locations and times of day. Many of the sites are highly sensitive, containing specialist medical or research equipment and experiments.

Managing these limits would be nearly impossible using conventional methods, but using a digital platform it is possible to continuously track them all and provide realtime transparency to all stakeholders. This turned out to be a win-win situation, with construction partners able to see and plan around their remaining noise and vibration quotas, and even proactively detect and stop excessive events before critical damage to sensitive equipment or incurring penalties. The solution also allowed accurate tracing of responsibility, dispute resolution, and provided the evidence for adjustments to limits, such as where background noise was higher than expected. Residents also benefited from the transparency to see when and what disruption was caused by construction, or other unrelated events. The shared data helped to reduce complaints and improve relationships between all parties.

6. Why Good Asset Management and Good Digital Culture Align

It is possible that some cultural barriers to adoption are well motivated by past experiences with failed and obstructive digital projects that consumed a lot of time and effort but ultimately didn't improve business processes. The digital industry first recognised that established project management based on the "Waterfall" model was based on the fundamental fallacy that it's possible to foresee and manage all potential complications and opportunities of a complex project in advance, working them into a rigid timeline and ratchet system. Having finally accepted this to be preposterous, the industry has largely moved to an "Agile" project delivery system which was found empirically to lead to much better outcomes [Thesing, 2020].

Agile is a reflection of digital culture as it focus's on flexibility, embracing change and constantly reviewing risks. Under an Agile framework, stakeholders are engaged early, closely, and continually, ensuring that project outputs actually solve real problems. Ideas are repeatedly sought, tested, and accepted or modified to ensure that they actually work. In this we can see that the development of Agile working mimics the way asset management is structured with its cycles of test Plan Do Check Act [AMBOK, 2022].

6.1 EXAMPLE 4: OPTIMISING MAINTENANCE BY PROBABILISTIC PREDICTIVE MODELLING

WSP helped an Australian water authority develop a decision support tool for main pipe renewal project identification and prioritisation. The existing process was working fine, but not scaleable - the process of developing a project was too labour intensive to apply to every cluster of maintenance events in the network, but without developing a project a proper cost-benefit analysis could not be completed preventing optimal prioritisation of candidate projects.

The project development process was entirely automated by drawing data from various sources in the authority's data-lake: Asset inventory, condition data, and maintenance event data including leaks and breaks. The existing workflow was replaced by a software tool that develops candidate projects from every "cluster" of events. The tool included automatic forecasting of future leak or break events and their associated costs through a probabilistic predictive ML model.

Importantly, although the process of generating candidate projects was automated, the renewal process isn't. From the outset, the objective of the project was to support renewal planners by providing them with a complete picture of candidate projects from across the entire network, then allowing them to further develop and improve selected projects (such as extended or truncating the pipes involved, or considering other, unusual cost factors the automation couldn't assess). The interfaces to explain and modify project costing are critical to successful adoption of the solution.

The success of this project was that it supported holistic asset management decisions by integrating the decision making across all clusters of events. The authority was able to extract the best value actions across the entire network by giving planners a more complete picture. This aligned with the organisations overall goals of making best value decisions for their assets.

7. Conclusions

7.1 REFRAME YOUR DIGITAL PROJECTS FOR BETTER ASSET MANAGEMENT

Digital tools can be incredibly powerful in solving asset management problems if they are framed appropriately. A digital asset management culture uses the outcome-focus of asset management and applies it to the design of the digital tools. Rather than designing software or widgets in the traditional "waterfall" way, the digital projects become about delivering an outcome or service in an agile way.

Adopting a digital culture where data and technology are part of the solution and are managed appropriately is key. Understand not only the benefits and cost of digital solutions, but also the risks and opportunities it offers. With a good digital culture that embraces this use of data, the key accountabilities and alignments from strategic through to operational can be realised. For complex, asset-rich networks, this is particularly important to achieving the ideals of ISO 55000.

Embracing of a good digital culture in asset management will also allow for advanced tools to be used. ML and AI require the value-statement to be stated clearly so measurements can be taken. At the heart of modern asset management is the need to objectively state our problems ("can we reduce cost?", "can we increase service?") whilst being clear of the objectives and constraints we must operate in (budgets, resources). The advanced digital tools are most successful when they follow these same rules. A good digital asset management culture is when both digital tools and asset management adopt the same stance.

7.2 POSITIVE EXPECTATIONS FOR A DIGITAL FUTURE

Delivery of asset management, as defined by ISO 55000, is a complex undertaking but with substantial benefits. As would be expected of any complex process, there are some points which are difficult for organisations to incorporate. No longer is the difficulty in getting data on assets, but on making decisions with that data. Some lucky organisations will have the right mix of digital skills, engineering expertise and robust decision-making processes, but many organisations won't.

For those who can't throw more resources at the problem (people, time, materials) a digital solution may have huge benefits. Current tools, such as spreadsheets and database, are acceptable for single-issue calculations but are unsuitable (and risky) for delivering holistic asset management. Emerging digital tools, much like modern asset management itself, work best when they are focused on the outcomes and objectives when being designed and delivered. Because AI and ML are difficult to measure internally, the importance of understanding the value-statement is very important for measuring success. A digital asset management culture should be able to clearly articulate this value-statement. If an organisation can embrace a strong, agile, digital culture, modern asset management solutions and benefits will most likely be realised.

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