Cranfield University

VENDIGITAL®

ENABLING BETTER SUPPLY CHAIN PROCESSES AND DECISION-MAKING:

TRANSPARENT AND REAL-TIME TOTAL COST OF OWNERSHIP

Contents

Introduction

Over the last few years, we have seen a period of new challenges, uncertainty and forced change for businesses of all kinds, and this wave of disruption doesn't seem to be slowing down. As a result, businesses are currently battling ongoing business process issues, notably obstacles in their supply chains.

Despite this, many businesses have still found room for new opportunities, and have embraced changes that will benefit them in the long run. In those that have fared well, we can see that the adoption of new methods and technologies has been crucial. The ability to adapt allows organisations to build better business processes, improve resilience, and support an agile business model – all of which are key to surviving ongoing disruption.

The events of recent years have acted as a catalyst for change that many could claim has been on the horizon for much longer.

The need to respond quickly to market changes has highlighted the value of an effective and efficient decision-making process, and in this paper, we explore how businesses can utilise their data and deploy effective technology solutions to enable better process decision-making.

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Roadblocks to **effective decision-making**

In all businesses, the ability to make quick, well-informed decisions is vital – it can mean the difference between success and failure. While this may sound like a simple statement, the reality is much more complex, with a host of challenges blocking the path to a highly efficient and optimised decision-making process.

Key among these challenges is a lack of data visibility and transparency. Often exacerbated by other internal issues, such as silos within the business, an incomplete view of data and lack of insight means that when decisions are made, you are more at risk of running into unforeseen problems down the line.

For example, if you don't have real-time, complete visibility across your supply chain, you are unable to predict how your interactions with one supplier could impact another and are not in a position to optimise the overall performance of the supply chain.

A report from Talend found that, despite having the right data infrastructure, 78% of executives face challenges in using data effectively in their company, suggesting a better way of analysing that data is needed.

In our experience, these challenges are driven by:

1. Conflicting KPIs across the business – This is often a hidden barrier that prevents different areas of the business from truly working together. Different departments may be working towards a common goal, but without a full understanding of the impact of their own actions on another department's KPIs. For example, a direct conflict could arise with procurement wanting high stock volumes while supply chain teams are aiming to reduce inventory.

2. Multiple scenarios to optimise – While there may be a good understanding and visibility of certain scenarios in a business, it is impossible to consider all possible situations. A well cited paper by psychologist George A. Miller suggests that the number of objects humans can hold in their short-term memory is only, on average, 7 ± 2. This highlights the limits of human processing and shows why, when making critical decisions, it's important to have a system in place that allows you to visualise multiple scenarios. It may inadvertently increase risk and vulnerability if different outcomes are overlooked or the knock-on effect of one outcome on another part of the business is not fully recognised.

3. 'Real-time' decisions being required – The reality is that most decisions need to be made quickly, and there often isn't time for months of research and analysis. On top of this, most business decisions that may impact critical business decisions vary by week, day or even hour. The more real-time the data can be obtained, the faster different unfolding situations can be responded to, and the faster decisions can be made. For example, if you can use your data to model the real-world cost implications of rising energy costs, you can act early to move or adapt your manufacturing processes to minimise the financial impact.

4. Company culture – Culture is regularly cited as a barrier to change of any kind, and the implementation of data driven decision-making is no different. In Dresner's Business Intelligence Market Study 2021, 60% of respondents reported that "a culture that doesn't fully understand or value fact-based decision-making" was most damaging to the successful use of business intelligence.

> **All the clients we work with understand the value data can bring to their business, but often they just don't have the systems or internal capacity to optimise how they use it. However, a real data solution involves more than just analysis and solution development – it involves empowering all stakeholders to trust in results that embeds the use of data effectively over the long term.**
>
> **Alec McCullie, CTO, Vendigital**

Building data and agility into your solution

To overcome these challenges and embed real-time data visibility that gives you a transparent overview of your entire organisation, a fundamental review of business models and related data management (and the underpinning digital solution) will be required.

Having the right data will go a long way to ensuring that businesses are able to make better decisions, for example a full understanding of the total cost of ownership of products or complete visibility across the different processes within the organisation.

In a time of rapid change and disruption, however, a further step is necessary. This involves building the foundation for an agile and flexible modelling process that allows businesses to consider changing variables and respond as quickly as possible.

A truly agile solution requires a deep understanding of interactions between different elements of a business and their cross impact, as well as the impact of changing variables and the potential conflicts that can arise or be triggered during the decision-making process.

It's important that the data offers a holistic, independent view that provides a complete picture within the organisation. Once this has been achieved, it can be used as part of an efficient and robust decision-making process and can also be leveraged to ensure buy-in across an organisation when implementing any change.

How can this **be achieved?**

This live view of your data can be achieved by creating a digital twin, which maps against specific elements of your business processes and allows you to gain insights and react in real-time.

In practise, a digital twin offers a virtual representation of an object or process that spans its entire lifespan, takes into account real-time data on all variables and allows businesses to simulate different scenarios and apply analytical capabilities such as machine learning to aid the decision-making process.

A digital twin could represent any number of things – from a car door to an entire supply chain. It gives you an instant overview of the 'thing' at present and allows you to make predictions about the future.

It solves a lot of the challenges we've seen around optimising the decision-making process, by offering full visibility, highlighting conflicts of interest, providing the ability to map multiple scenarios, and supplying 'real-time' data that can be relied on.

What could a **digital twin look like?**

Digital twin technology creates a virtual representation of a real-world asset or process which you can interact with to run scenario models. These scenarios are designed to optimise an operation with complex variables or unlock value by supporting better decisions and root-cause analysis.

A recent study by Cranfield University found that the most common intended outcome of digital twins was to improve asset performance, with over 45% of respondents saying this was the main area of focus. Other common application areas include 'maintenance, repair and overhaul' and 'test and evaluation'.

Before looking into a practical use case, it's important to understand the varying maturity levels in the development of a digital twin solution.

At the lowest level of maturity there is a digital model. In a digital model the data flow from the physical process into the digital process must be completed manually. Then any analysis work is completed by the model before being shared, again manually, back into the physical process.

Increasing the maturity of the solution, a digital shadow automates the data flow from the physical process into the digital process before analysis is carried out. However, the data flow from the shadow back into the physical process would still be manual. This could be limited by inaccurate data or system capability.

To achieve the most effective model in digital twin development, the data flows between the physical and digital process in both directions should be automated, enabling real-time improvements, information, and decision-making. This is the piece that unlocks huge capability across organisations to harness the power of data to make quick business decisions and capitalise on opportunities.

DIGITAL TWIN MATURITY LEVELS

01 **Digital Model**

The data flow from the physical process into the digital process must be completed manually. Analysis work is completed by the model before being shared, again manually, back into the physical process.

02 **Digital Shadow**

Automates the data flow from the physical process into the digital process before analysis is carried out. However, the data flow from the shadow back into the physical process would still be manual.

03 **Digital Twin**

Data flows between the physical and digital process in both directions should be as automated as the systems will allow, with the aim to reduce as much human intervention as possible enabling real-time improvements, information, and decision-making.

Real life application of digital twin technology

We can consider three elements of the supply chain as key areas to implement digital twin technology: procurement/ops, maintenance, and disposal. In its truest form, you would run a digital twin solution in all three, and allow these models to share data freely, to provide an accurate model of the full supply chain and offer the best solutions at each stage.

In fact, in their study, Cranfield found that the most common area of interest was to develop an 'End to end capability'. This shows the value businesses are finding in not only analysing one particular phase of the life of an asset or capability, but also creating a flexible construct that can be used to deliver value across its life as a whole.

In the following graphic, we show a digital twin model that could be applied to any scenario. In this use case, however, we focus on analysing and optimising the maintenance of train wheels, which we recently applied to support a client in the transport sector – ultimately providing end to end visibility of the total life-cycle cost.

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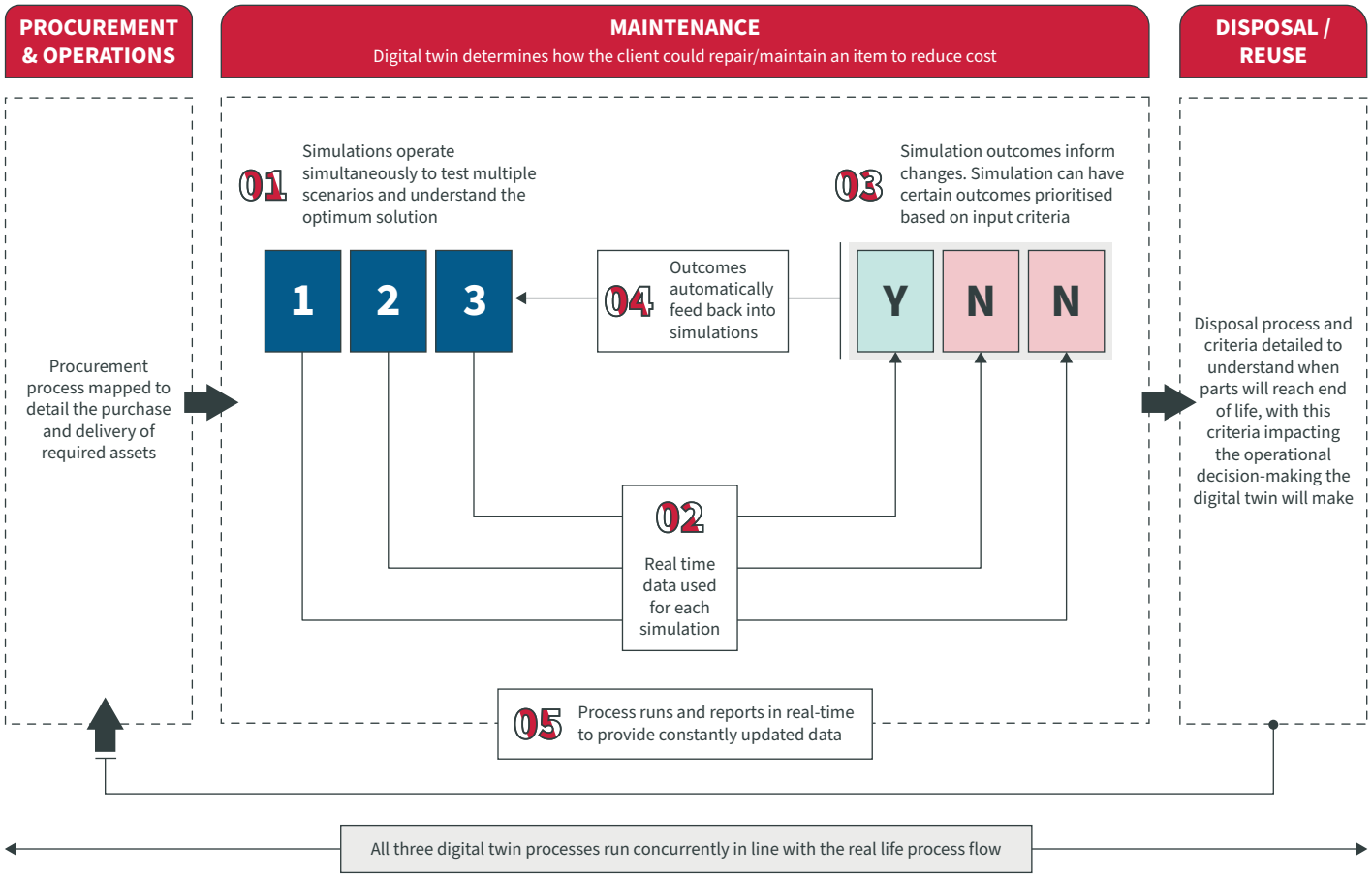

Preparing for the digital twin

Before building the model, we extracted five years of data on the maintenance procedures for the wheel and reviewed them to understand the types of maintenance, maintenance periodicity and the specific impacts of each individual maintenance activity over this period. The important part of this exercise was understanding the relationship between the type of maintenance completed and the impact on the life of the wheel.

In tandem with confirming data accuracy, our cost engineering facility held sessions with the client to confirm the overall process through the life of the wheel, map inspection and maintenance activity and apply real world costs to each of these activities.

The combination of these two efforts gave a detailed and fundamental understanding of the asset maintenance process and the information that needed to be included in the digital twin model itself.

Digital Twin enabling system responses

Data systems can be set up in order to respond to the requirements of the Digital Twin model, either responding automatically if the system has the capability or prompting human intervention to transfer the relevant data to the Digital Twin. The map of a Digital Twin outlines exactly how the systems will work together to deliver the required output, being modified to suit the needs of each problem the Digital Twin is trying to solve.

In the case study, some systems were able to run with automated responses and share information with the Digital Twin as soon as data was available, however some required intervention and clarification before it could be used by the model, demonstrating the different ways that systems can work in tandem with a Digital Twin model.

Building and validating the model

Using what we had learned, we were then able to determine the hundreds of scenarios that would need to be run at stage 1, as well as access the real-time data required in stage 2 and use this to build the digital twin model.

Before we were able to draw any conclusions, we validated the model to ensure it was accurately predicting how long the asset would last, which we did by taking feedback from the client and feeding this back into the process.

Drawing conclusions

With the model validated, we were able to implement the changes generated at stage 3 of the model.

By understanding the relationship between maintenance and cost, the digital twin reviewed hundreds of scenarios to reduce cost by maintaining the wheel assets in a different way. It suggested that if assets had bigger maintenance events, but in between were run longer and missed maintenance events that would have otherwise occurred, then costs could be offset throughout the wheel's life-cycle. This provided great insight into how a process could be changed with
a large cost impact over the life-cycle of an asset.

In the case of this particular asset, the digital twin was able to show and optimise:

- The number of instances of maintenance through the asset life-cycle
- The cost of maintaining the asset throughout its life-cycle
- The optimum (based on cost) opportunity to dispose of an asset
- The total life-cycle cost built up over time

This resulted in a projection that between **10-20% of cost savings** could be achieved through the asset life-cycle by implementing specific optimisations of the maintenance schedule, maintenance methods and supply chain management which will impact the asset life-cycle cost in various areas.

Continuous automation

The outcomes generated at stage 3 can then be fed automatically back into the model, and along with the continuous input of live data, the model can continue to process scenarios and generate changes that deliver benefit.

This resulted in a projection that between **10-20% of cost savings** could be achieved through the asset life-cycle by implementing specific optimisations of the maintenance schedule, maintenance methods and supply chain management which will impact the asset life-cycle cost in various areas.

> **Digital twin technology opens a lot of doors in terms of the long term, real-time TCO solutions we can offer our clients. It is applicable to so many areas and can be highly customised to suit the needs of different organisations.**
>
> **Alex Copeland, Principal Consultant, Vendigital**

Conclusion: The many benefits of digital twin

The above use case highlights the difference between digital twin capabilities and traditional scenario modelling.

Scenario modelling has a limited number of (often historical) inputs which impact a model. While this may be enough to support decision-making where a small number of scenarios are clear, with a digital twin model – as more real-time data is provided into the tool on an ongoing basis – it can continue to learn and enhance its understanding of the relationship between the maintenance activity and the life-cycle cost. The digital twin therefore has the capacity to model hundreds or thousands of different scenarios to find the optimised output, rather than just the few that can be done within a more traditional scenario model approach.

Because of this real-time capability, a digital twin allows businesses to fully realise the benefits that their data can bring, and distils these data points into a central decision-making platform, which can help the business deliver cost savings.

However, the output for a digital twin need not be cost driven. It can bring benefits across many different areas. There could be a need to understand maintenance on customer availability (on time in full, asset time-in-use). There could be a need for cash availability (reducing working capital by knowing when assets fail and when to replace). Or it could be a way of balancing several conflicting KPIs and making accurate decision that best suit the business in that moment. It is the ability to put accurate information in the hands of decision makers that makes this tool so powerful.

Benefits of digital twin include

- Understanding maintenance on customer availability (OTIF, asset time-in-use).
- Increasing cash availability (reducing working capital by knowing when assets fail and when to replace).
- Balancing several conflicting KPIs and making accurate decision that best suit the business in that moment.

> Digital twins are transforming the impact of traditional modelling by making direct changes in critical assets and processes. We are experiencing huge potential in performance improvement, cost reduction, and sustainability gains by developing context driven digital twins.
>
> **Prof. John Erkoyuncu, Head of the Centre for Digital Engineering and Manufacturing at Cranfield University**

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About Vendigital

At Vendigital, we deliver data-led accelerated cost transformation. We achieve this by combining multi-disciplinary consulting expertise and our proprietary digital platform – through our Insights360 methodology – to generate and embed client-specific operational insights.

An award-winning UK top-20 management consultancy, we work across procurement and supply chain; operating strategy; cost and value engineering; and portfolio management to deliver tangible, quantifiable cost benefits for clients.

Core to our approach is our deep industry and operational expertise, and in-house data science capability – importantly, this is underpinned by our extensive business transformation and implementation experience.

Our consultants are industry specialists with extensive experience of working within the sectors we serve – aerospace and defence; automotive; consumer products; industrial manufacturing; private equity; technology, media and telecoms; and transportation and infrastructure.

Whether you're looking to make longer-term strategic cost decisions or drive operational efficiencies at pace, we work as part of your team to deliver measurable and sustainable results.

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