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THE FOUR BUILDING BLOCKS TO UNLEASHING CONTINUOUS INNOVATION

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Organizations today need to innovate continuously to survive and thrive. This not only requires fostering new ways of collaboration across departments, but it also requires everyone leveraging common data to make intelligent and timely decisions. Unfortunately, companies find themselves drowning in a constantly rising tide of business data. To stay afloat and enable strategic decision-making, business leaders need the right platforms to collect, aggregate, elevate, represent, and analyze information, combined with the right context to understand this data. The digital twin provides this important context, and when paired with artificial intelligence (AI) and embedded analytics capabilities, it can help companies unleash continuous improvement and feed sustainable innovation. By establishing four building blocks to raise digital twin maturity and maximize utilization, organizations can achieve greater operational excellence, customer satisfaction, and annual revenue growth, and they will be poised to engage in new business models and capture market share.

Challenges & Problems

Businesses are drowning in their data. In fact, Aberdeen's research shows that 37% of organizations find more data is available than is used for meaningful analysis, and 35% of them find that data needed for reporting is spread across different functions (see sidebar). Engineers, analysts, and executives all have unique perspectives and unique data, so when information is overloaded in separate silos, it makes collaboration and sharing across departments difficult.

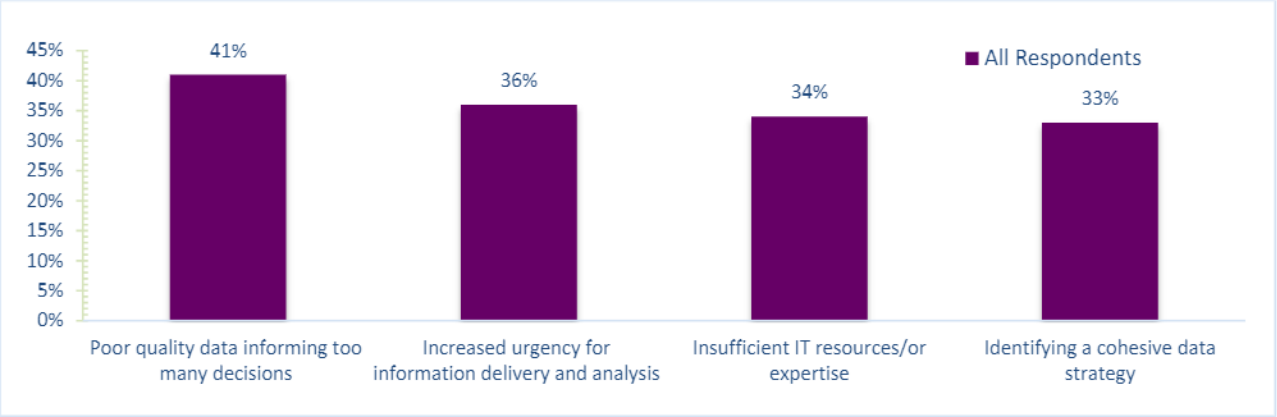
In isolation, the data is not sufficiently rich, meaningful, or accessible, and manual data manipulations are time-intensive and error-prone. Without communication across requisite departments, data has no chance of realizing its full potential of being turned into valuable, actionable insights. An unfortunate result is 41% of organizations have insufficient or poor-quality data, and they are unable to make optimal – or even trusted –

Pressures Driving an Organization's Approach to Leveraging Data

- **37%** of organizations find more data is available than is used for meaningful analysis
- **35%** of organizations find that data needed for reporting is spread across different functions
- **32%** of organizations find that critical business decisions demand more sophisticated analytical support

decisions when it comes to innovation, whether it be for processes, products, or manufacturing (Figure 1).

Figure 1: Challenges in Today's Data Environment



Respondents: n=250, Source: Aberdeen, October 2021

When the challenges of managing, connecting, and collaborating around data are addressed, the data can be used as a trusted foundation for more holistic, meaningful, and multi-faceted insights. If engineers, analysts, and executives apply their unique perspectives to real-time data, they can see and understand the full picture of the business. Everyone can work together, effectively collaborate, and capture ideas using the same information powered by analytics. They can achieve alignment that drives ongoing cycles of decisions, actions, and innovation at all levels of the enterprise.

Organizations know they have an arsenal of data behind them, and they know critical decision-making and innovation rely on elevating data into a consistent, normalized language and model, and including input from the right stakeholders. But how do companies reach this desired unified state? The answer lies in building, utilizing, and enriching digital twins of products, factories, and companies, with AI and embedded real-world analytics representations.

Introducing the Digital Twin

A **digital twin** is a highly-detailed representation of a physical object (like an aircraft) or an enormous entity (like a city) combined with real-world data. Some players are going beyond digital twin, not only leveraging a representation, but extending its materials, mechanics, systems, and historical and expected behaviors for a fully actionable virtual model of the product.

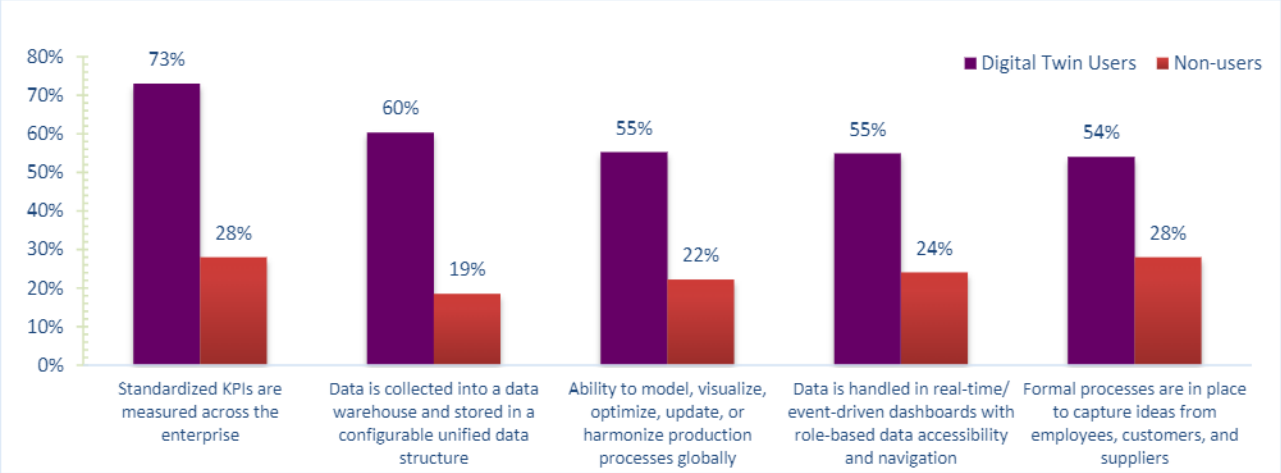
This extended digital twin is a lever to interpret and contextualize enormous amounts of data. Of course, to achieve that, the data must be organized into the right semantic models and representations, including Natural Language Processing, analytics, and predictive and prescriptive models.

Humans learn and innovate through failure, and failure is much less costly in the virtual world than the real world. In the context of digital twin, learning and innovation happen when relevant processes or parts are virtually replicated so that the company can confidently predict how that process or part will perform in alternate situations. In other words, leveraging these virtual, actionable models with real-time data enables science-based, realistic *what-if* scenarios at scale. For a jet manufacturer, this could mean capturing flight and maintenance data from many IoT and human sources to build predictive failure models and identify the aircraft usage parameters that minimize risks on flying aircraft, while identifying evolutions for new aircraft. A larger-scale example would be leveraging digital twin technology to understand efficiencies and carbon footprint of a widespread, complex, and dynamic environment, like a factory with an array of moving machines, people, and materials.

Digital twin technology with AI and embedded analytics helps stakeholders make optimal decisions and transform their massive influx of information into new innovations. For example, digital twins allow organizations to productively use data from across the enterprise to predict product states/behaviors or accurately model events in real time. This enables organizations to make decisions and take actions that lead to business-altering innovation while respecting corporate social responsibility objectives. Because of these benefits, digital twin platforms are continuing to gain traction in the marketplace, with 58% to 65% of digital twin users leveraging digital twin platforms for everything from manufacturing processes to product design and innovation.

As a result of digital twins, organizations have improved their data management, collaboration, and analytics practices. Those who use digital twins are 2.6x more likely to measure standardized KPIs across the enterprise. They are also 3.2x more likely to collect data in a configurable and unified data structure (Figure 2), an essential requirement for leveraging data analytics.

Figure 2: Digital Twin Empowers Organizations with Better Data Practices



Respondents: n=407, Source: Aberdeen, October 2021

A unified data system with digital twins builds essential trust in the data that drives business decisions. Every discipline can access the correct enterprise data in the right context wherever and whenever they do their work. Silos, disparate systems, and time-consuming data manipulations disappear. The ability to effectively collaborate strengthens decision-making. This helps digital twin users stay ahead of their competitors when it comes to innovation and capturing ideas.

But the implementation and deployment of digital twin technology doesn't happen overnight, and maximizing the use of insights from embedded analytics may take even longer. So where should your organization start? For those who already utilize digital twins or are considering implementation, there are four building blocks on the way to unleashing continuous innovation.

Building Block #1 – Enabling Data Consumption

The first building block of continuous innovation through digital twin utilization starts by enabling all employees to access, analyze, and learn from business data. Digital twins can take on different forms depending on who they serve – they are multi-faceted and relevant to whomever is leveraging them. The digital twin becomes the context to experience the virtual and real-world data, as a digital map becomes the context to display traffic data. Together this helps stakeholders bolster their understanding and make the best decisions.

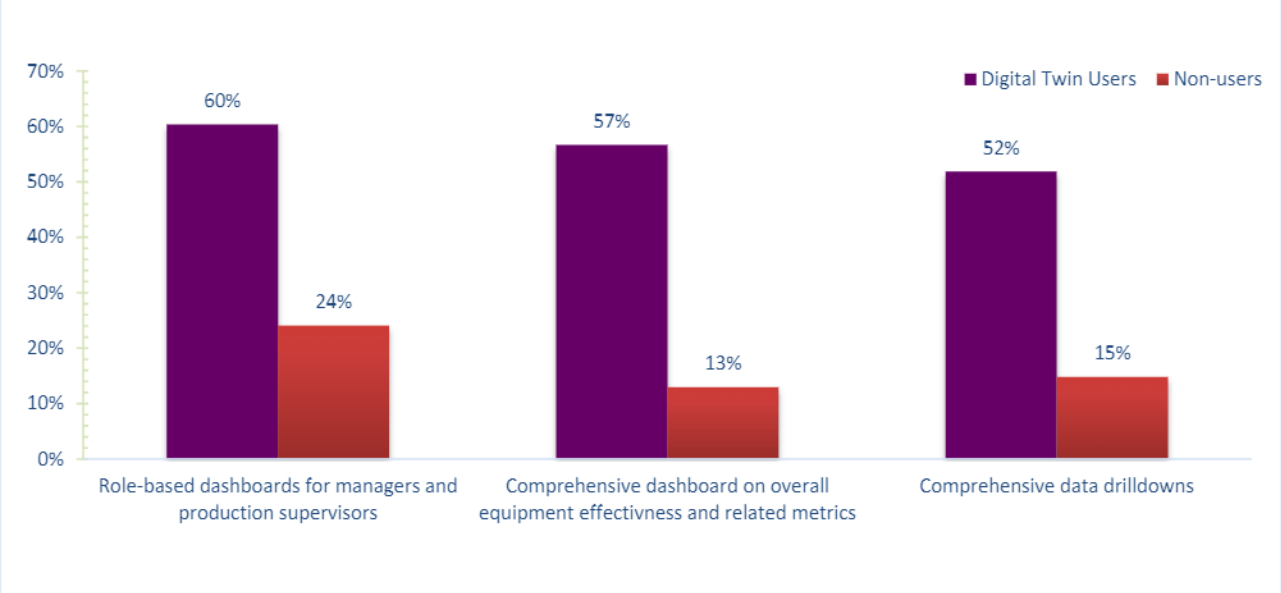
Engineers and manufacturers can map data to 3D models and visualize the data in the context of the models to gain product design insights.

But this sort of digital twin experience is about more than just basic, single-use visualization. Managers can use digital twins to track key business metrics, while analysts can use them to evaluate the results of virtual product or process innovation. In a world where every business function operates on multiple platforms in different ways, a digital twin enables optimal decision-making by allowing stakeholders to understand the impact of their decisions (big or small), both on their specific discipline, as well as on other disciplines, facilitating cross-discipline tradeoffs for maximum performance at multi-scale. When different departments look at multi-faceted data, they not only see what is relevant to them, but they can all reach similar conclusions thanks to the ability to experience the data in context.

Figure 3 shows how organizations using digital twins can empower their employees to leverage business and engineering data through comprehensive dashboards and drilldowns.

In a world where every business function operates on multiple platforms in different ways, a digital twin unifies data and people as it contextualizes relevant data for all.

Figure 3: Digital Twin Promotes Visibility Across the Enterprise



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Compared to non-users, digital twin users are 2.5x as likely to have role-based dashboards for managers and supervisors. These allow business leaders to focus on the metrics that matter most to their teams. They can identify areas for improvement and make changes in operations to dynamically adjust to new conditions, measuring the impact of any decisions on future states. For example, a production supervisor with a digital twin of the factory floor could virtually test the process for generating new product introductions and determine areas or times

to allocate machinery, materials, or people for optimal operational efficiency while minimizing waste and reducing the overall carbon footprint.

Companies leveraging digital twins are 4.4x as likely to analyze and visualize overall equipment effectiveness with comprehensive dashboards and 3.5x as likely to provide employees with drilldowns for a more granular view of the data. Leveraging data in context through digital twin technology gives the entire organization a deeper, more unified view into how their products and processes perform, thereby revealing overall business performance. Organizations that have established this first building block for digital twin utilization enable data consumption across business units by providing employees with a personalized view of the data that is most relevant for them. However, this is just a first step in realizing the full potential of a digital twin.

Building Block #2 – Contribution with Purpose

Once a digital twin is in place and departments across the company are consuming data from it, organizations must figure out how each department can continuously contribute to updating the digital twin.

Clearly, the digital twin is a key enabler to break down data silos. But to be successful, you also need to break down organizational silos. At the same time as you implement the digital twin, you also need to implement the associated business and collaboration methods that will foster and equip the way people continuously connect and contribute together across organizations.

Some teams build the models that extrapolate data and test scenarios, while others share data that tells the story of past decisions and their impact in the real world. Other departments can add financial or supplier data and define financial KPIs. With everyone contributing relevant virtual and real-world data and KPIs into the same system where engineering and authoring is happening, all information is connected perpetually. This enables stakeholders to make decisions based on trustworthy and real-time KPI monitoring within the context of constantly changing engineering definitions. These regular and recurring contributions lead to the best decisions that support continuous innovation, improved quality, and corporate social responsibility.

Today, businesses innovating with digital twins are seeing benefits like a 25% greater year-over-year decrease in the number of engineering change orders in comparison to non-users (Table 1).

Table 1: Business Impact with Digital Twin

KPIs	% Difference in Improvement over the Past Two Years Digital Twin Users vs. Non-users
Decrease in # of Engineering Change Orders	+25%
Increase in Product Return on Investment	+12%
Decrease in Total Cost Per Unit	+7%

This advantage indicates that companies leveraging digital twins are better able to virtually test designs and ensure quality and manufacturability before moving them into real production. The result is fewer costly changes being sent back and forth between product development and manufacturing teams. A unified platform connecting development and manufacturing helps improve time-to-market and reduce operating costs, as shown by the 7% decrease in total cost per unit for digital twin users. When companies are operating on very slim margins, a 7% improvement in unit costs can be the difference between profitability and bankruptcy.

Digital twin users also saw a 12% greater increase in product return on investment when compared to non-users. This means that with digital twins, businesses are better able to meet their customers' needs from a go-to-market perspective while outweighing the cost of their investment.

Encouraging ongoing contribution and collaboration with all stakeholders in the value network helps to build an authentic and trusted source of unified data. Each stakeholder can share insights and immediately see the impact of their decisions as well as everyone else's. This drives holistic and recurrent improvement for everyone, laying the groundwork nicely for the third building block to unleashing continuous innovation with digital twins.

Building Block #3 – Predictions & Automation

Once there is a trusted foundation allowing dynamic usage and contribution to the digital twin platform, AI that enables prediction and automation can be confidently built on top. With AI, the digital twin becomes much more than just a virtual representation of the real – it becomes a strategic instrument that can be used to amplify the innovation of products and business operations.

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For organizations that still need to be convinced of the importance of AI, its usage drives a 14% greater year-over-year increase in data sharing and collaboration and a 16% greater year-over-year increase in speed of decision-making (Table 2).

Table 2: Improvements in Efficiency with AI Capabilities

KPIs	% Difference in Improvement over the Past Two Years AI Users vs. Non-users
Increase in workforce productivity	+20%
Increase in speed of decision-making	+16%
Increase in data sharing and collaboration	+14%

While digital twins can recreate real-world conditions to be tested in a virtual environment, it is AI and machine learning algorithms that can take the data from those tests to identify patterns to help organizations uncover innovation opportunities as well as plan and test new features. Real-time data provides feedback on what is happening and allows stakeholders to continuously improve the AI model. This aids in the optimization of workforce productivity and the implementation of more intelligent, agile, and sustainable processes.

The efficiency advantages of AI contribute to the 20% greater year-over-year improvement in workforce productivity for AI users compared to non-users. Engineering teams can easily identify, test, and implement potential design adjustments, while executives can confidently use product data and production schedules to plan realistic launch dates. As development processes get faster and faster and the AI and machine learning algorithms become more accurate and comprehensive, AI users can continuously improve their use of digital twin technology and reap the associated business improvements.

Successful companies gain the full benefits of digital twins by combining the science-based representation of the product/factory/company through modeling and simulation with the prediction brought by real-world data science.

Building Block #4 – Continuous Improvement & Exploring New Opportunities

Once businesses maximize their data and innovation discovery through the application of AI, as well as science-based modeling and simulation,

on top of their unified and trusted digital twin, they are now ready to better serve their customers. Organizations in this stage should focus on leveraging AI, science, and digital twins to better understand their customers and their partners. Specifically, organizations can be more competitive by anticipating customer, partner, and employee needs and offering new services. Table 3 demonstrates the holistic business advantages for digital twin organizations that are currently leveraging AI compared to non-users.

Table 3: Business Outcomes for AI Users

KPIs	% Difference in Improvement AI Users vs. Non-users
Increase in employee retention (past year)	+29%
Increase in customer satisfaction (past 2 years)	+20%
Increase in operating margins (past year)	+19%
Increase in revenue (past year)	+9%

AI users are seeing 20% greater improvement in customer satisfaction compared to non-users. By unifying data and visualizing customer requests via their digital twins, companies can rapidly explore and test the feasibility of new ideas that come directly from their customers. These innovative organizations can better understand customer needs and partner with those customers to improve outcomes. For example, if an aircraft engine manufacturer identifies a customer need for uptime monitoring and predictive maintenance, they can act on this opportunity and add to their service offerings with the power of digital twin, AI, and embedded analytics. By accessing the right data and connecting that data to the digital twin and predictive AI models, businesses can estimate the risks involved with new categories of offerings and deliver the best customer experience when the offering is rolled out.

Happier customers are more likely to remain loyal and increase their spending, which culminates in the 9% greater improvement in overall company revenue for AI users. This gain in revenue is further enhanced by the 19% greater improvement in overall operating margins for AI users reached through a reduction in inefficiencies and risk. The agility and foresight available with AI-powered digital twins helps organizations better prepare to meet customer needs and outperform their competitors.

Key Takeaways & Recommendations

Companies today still struggle to maximize the use of their data. Engineers, analysts, and executives are surrounded by exponentially increasing amounts of disparate data and cannot easily leverage this data to collaborate across departments. In the absence of any resolution, organizations are faced with incomplete views of their businesses and product offerings, leading to an inability to navigate and make decisions based on data with speed, confidence, or consistency. Digital twins, AI, and embedded analytics are the key to leveraging an abundance of data and contextualizing it for purposeful, responsible, and strategic decision-making that can both improve current and predict future states of the business. When planning for or adopting a digital twin, consider these four building blocks to unleash continuous innovation:

- **Enabling Data Consumption –** Once the digital twin has been set up through the mapping of virtual and real-world data, organizations can focus on enabling meaningful digital twin experiences and access to data across the entire organization.
- **Contribution with Purpose –** Now that departments across the enterprise can experience data through the contextualization capabilities of the digital twin, organizations must determine how each department can contribute expertise and data to the twin to further enhance collaboration.
- **Predictions & Automation –** With a trusted data foundation and dynamic usage and contribution to the digital twin, as well as science-based modeling and simulation, AI can be built on top to amplify product innovation and business operations. This optimizes workforce productivity and promotes more intelligent, sustainable, and agile processes.
- **Continuous Improvement & Exploring New Opportunities –** Once businesses maximize their data and innovation discovery through the application of AI and digital twins, they can focus on deepening the understanding of their customers' and partners' needs, improving outcomes, and launching new business models to exceed customer satisfaction and outperform the competition.

Bringing together these four building blocks not only solves the barriers to accessing real-time data in context – it takes the usage of data far beyond operational advantages to achieve holistic and lasting business benefits. Leveraging digital twins with these building blocks modernizes and drives

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strategic initiatives across not only your business but your customers' businesses as well. By getting the right products into the right markets with the right quality at the right time, companies that have maximized the value of their digital twins with these four building blocks are better positioned to improve customer satisfaction, meet corporate social responsibility objectives, and exceed the increasing pace of innovation.

Related Research

- *Digital Manufacturing One Step at a Time;* December 2020
- *Connected Products, People, and Processes: The Business Value of Industrial AR and IoT;* December 2020
- *Business Agility Requires IT Infrastructure Agility;* July 2020
- *Connected Product Lifecyle Management Meets (and Beats) Product Complexity;* March 2018

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