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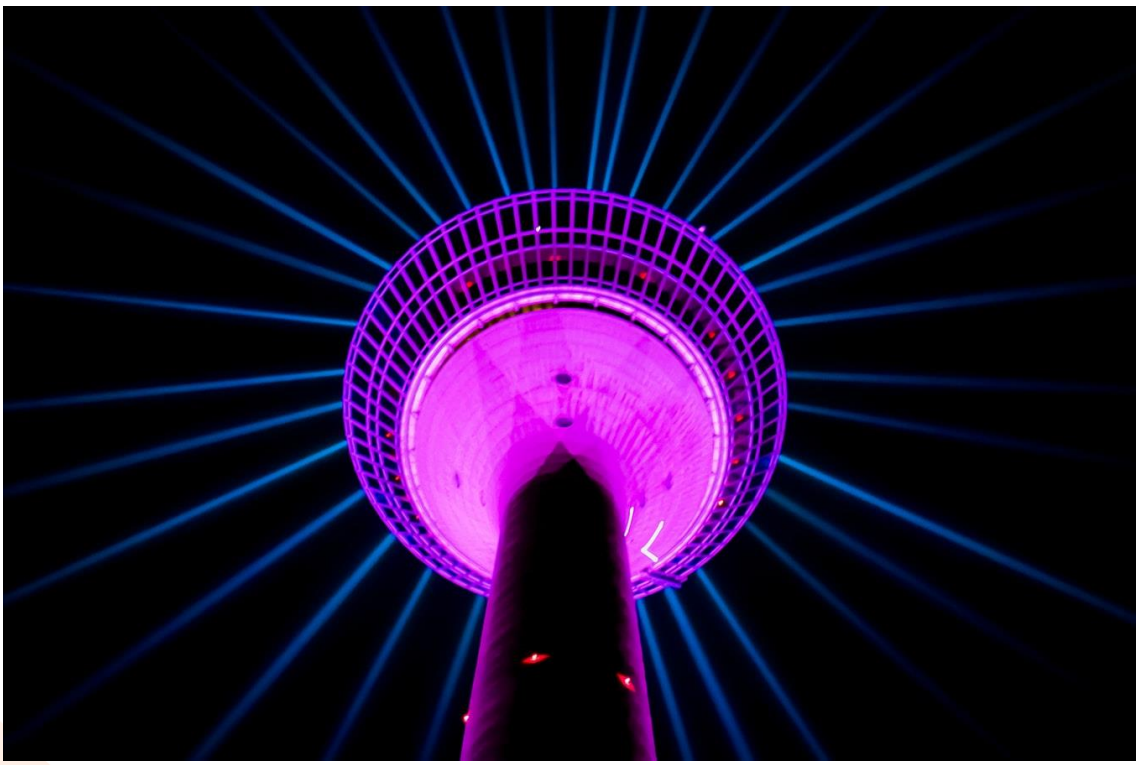
Executive Briefing

THE RELATIONSHIP BETWEEN 5G AND DIGITAL TWINS IN INDUSTRY 4.0

This report explores how the relationship between 5G and digital twins could be leveraged to create value for enterprises in Industry 4.0. We deep-dive on two industries, manufacturing and smart cities, to illustrate how these technologies can address key challenges in the market, and support organisations in their digital transformation.



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Executive Summary

Enterprises should explore their position on the digital twins' continuum

Digital transformation is shaping conversations across Industry 4.0, with new technologies such as AI, IoT and edge computing making big promises on their ability to optimise processes and create value. However, in order to leverage these opportunities, enterprises will need to be prepared to make significant investments. This raises a key challenge for organisations: before investing in new technologies, they will want to understand the opportunities and value they will bring, but this requires at least some investment to be made. This chicken or egg situation could hinder adoption of certain technologies, and impede industry progress towards Industry 4.0.

Digital twins could address this challenge, enabling enterprises to:

- Analyse the opportunities that new technologies could bring before investing in a solution;
- Understand how to leverage existing resources to create value;
- Explore how best to integrate new technologies with existing infrastructure.

However, in order to leverage digital twins in this way, enterprises should understand two key features of the term:

1. **Digital twins as a philosophy**: digital twins is not a static product, but a philosophy of data centricity, enabling the extraction, management and analysis of data to provide users with insights and predictions on their assets
2. **Digital twins as an evolution**: digital twins is a continuum of transformation, where enterprises can accelerate their digital transformation as they progress along the 4 stages – visualisation, simulation/emulation, twin-to-twin process automation and cross-party communication

Enterprises will need to evaluate their position on the continuum, according to their specific business needs (for example cutting costs vs. creating new revenue streams) and capabilities, in order to understand how they can leverage a digital twins solution.

5G could accelerate the business case for digital twins

Underpinning digital twins use cases is connectivity. Take the following industry examples:

- **Manufacturing**: having a connectivity solution with high bandwidth and low latency can enable vast amounts of data, e.g. on equipment, to be collected and processed to provide actionable insights that could improve operational efficiencies within a factory/plant

- **Smart cities**: connected devices generate huge amounts of sensitiive data that needs to be transported reliably and in real-time to avoid fatal incidents, so use cases within this vertical will depend heavily on having strong connectivity.

Therefore, enterprises will need to evaluate their network quality hand-in-hand with their digital twins strategy. The network is part of the digital twin not just an enabler of it.

5G is becoming a pivotal feature of conversations around connectivity, and digital transformation more broadly. It promises a range of capabilities that could transform industry use cases: low latency, high bandwidth, high capacity, strong reliability, advanced mobility and longer battery life. In the context of digital twins, 5G could be crucial to use cases that depend on data being moved from one location to another quickly, securely and reliably.

However, digital twins could also accelerate the business case for 5G

Even amongst some of the most well-funded and innovative industries, such as manufacturing, 5G is still nascent in terms of exploration. This is primarily due to the lack of understanding of how and where 5G will bring value, as well as a reluctance to invest in new infrastructure and replace existing equipment.

Therefore, at one level, digital twins will enable industries to build the 5G business case:

- **In manufacturing**, digital twins could provide an emulation of a 5G network, creating a virtual playground for developers to explore use cases without making large investments;

- **In smart cities**, digital twins can allow developers to test how 5G might interact with other technologies, and how it can support use cases that rely on secure transmission of data.

However, at a broader level, digital twins could enable the acceleration of 5G deployment in markets that have been slower with their rollout. For example, European telcos have been hindered by a lack of defined industry standards and doubts about the return on investment from 5G. With digital twins, telcos could test 5G capabilities through network emulation.

Academia will be a key enabler for 5G and digital twins in Industry 4.0

Whilst investment in 5G and digital twins could create huge value to enterprises embarking on their digital transformation, there are many dimensions to the relationship between the two technologies, as well as nuances between different industries that will need to be considered before big investments are made. In order to address this, enterprises should engage in conversations with academia.

Academia will be a key partner for organisations and developers at different stages of their digital transformation. At an early stage, academia can support enterprises in understanding their specific business needs and evaluating their position on the digital twins' continuum. At a later stage, it can

support the exploration of more niche challenges that may arise as enterprises adopt and extend their solutions.

This paper primarily draws on conversations with key players from Industry 4.0 and academia, conducted between April and July 2020. We conducted interviews with representatives across a range of industry verticals, with a broad variety of job roles, to gain a snapshot of the existing attitudes and ambitions across both industry and academia.

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Preface

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Introduction

The relationship between 5G and digital twins in Industry 4.0

Industry 4.0 hinges on an understanding that digital transformation will create value for enterprises across many verticals. However, this process will require significant investment and raise questions around when to invest, what to invest in (i.e. which will be the most promising use cases) and how to invest (i.e. which technologies will enable that promised value).

As the next generation of connectivity, 5G has naturally been a pivotal part of conversations around Industry 4.0. It promises an extensive host of capabilities that can support a range of new use cases in different industries, and has the benefit of being able to compare these to its predecessor, 4G: it's faster, more secure, more reliable – put simply, it's *better* than previous generations of connectivity.

Yet even some of the most well-funded industries, such as manufacturing, can be slow to adopt and invest in new technologies. In manufacturing, there is an acknowledgement that 5G could bring benefits, but there is a lack of clarity over what these are, and what practical applications of the technology could look like. Therefore, to many players in key industries, there is not a compelling case to invest in the technology and replace existing infrastructure that still functions relatively well.

Hence, there is a clear place in the Industry 4.0 market for digital twins, as a technology that can facilitate adoption and deployment of other technologies, and enable enterprises and developers to predict and understand how to use their existing infrastructure in the most efficient way and how to integrate other technologies to create additional value.

This report explores how the relationship between 5G and digital twins could be leveraged to create value for enterprises in different industry verticals. We deep-dive on two industries, manufacturing and smart cities, to illustrate how these technologies can address key challenges in the market, and support enterprises through their digital transformation.

This paper primarily draws on conversations with key players from Industry 4.0 and academia, conducted between April and July 2020. We conducted interviews with representatives across a range of industry verticals, with a broad variety of job roles, to gain a snapshot of the existing attitudes and ambitions across both industry and academia.

The role of digital twins in Industry 4.0

Though digital twins is not an entirely new term, over the past year it has become an increasingly prominent feature of conversations around Industry 4.0. Digital transformation is shaping industry strategies, signaling a global move into The Coordination Age, and it is in this context that digital twins is emerging as a tool to enable and unlock this transformation.

Adoption of new technologies, such as AI, automation, IoT and edge computing, is already starting to help enterprises make more efficient use of their data to optimize processes and find new methods of creating value. However, many of these technologies require significant investment, creating a chicken or egg scenario where customers want to understand use case opportunities before they invest, but find it difficult to explore them without investing first. At its most basic level, digital twins can enable enterprises to understand more about their assets and processes, and therefore explore and analyse the opportunities brought by these emerging technologies before they invest in them.

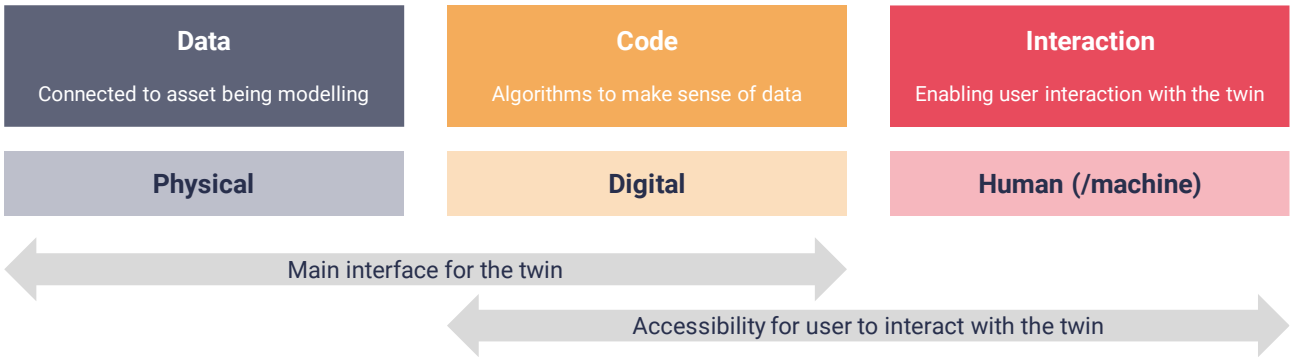
However, until recently there was little consensus on what digital twins actually means, and therefore a limited understanding of the value it could bring to enterprises in different industries. Some organisations still view it as 'tech hype' and understand it as a product or even a CAD/visualization tool. But there is also growing consensus and evidence of deeper engagement with two key aspects: digital twins as a philosophy, and as an evolution.

Digital twins as a philosophy

Our interview programme shows that there is a developing understanding of digital twins, not as a product, but as a philosophy of data centricity, where real data can be efficiently extracted, managed, analysed, and stored to provide users with insights and predictions on their assets.

One interviewee outlined the 3 core elements of the twin, that act across 3 different realms, as illustrated below.

Figure 1: Digital twins is made up of 3 core realms



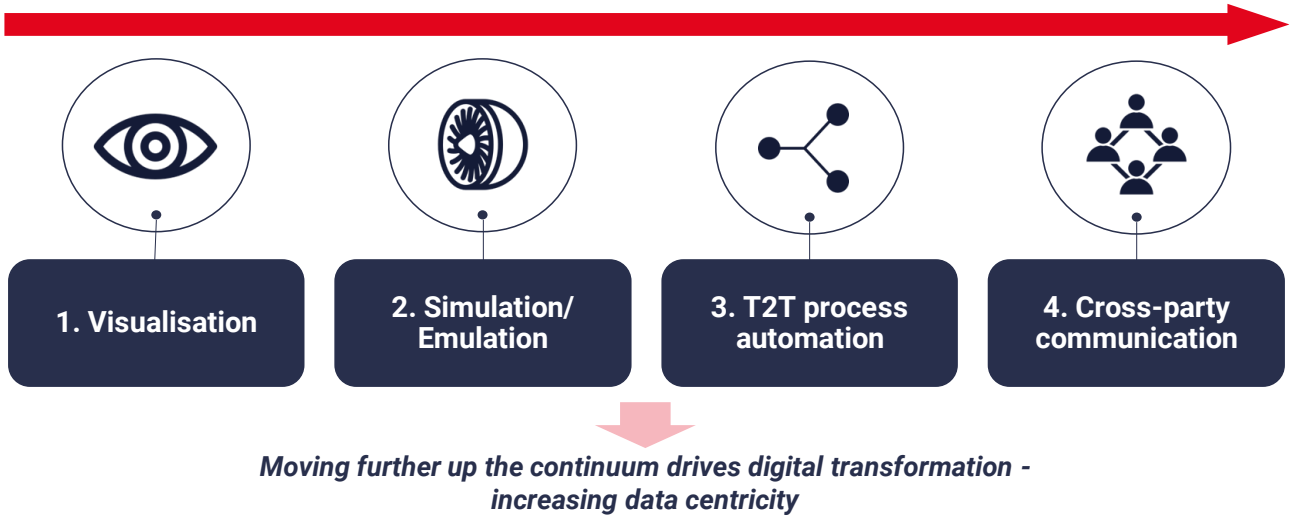
Source: STL Partners interview programme (April 2020)

The digital twin manages the connection between the physical and digital, and digital and human realms, enabling users to interact with the twin, and make use of real data from the modelled asset.

Digital twins as an evolution - use cases will change and advance as industries progress

As enterprises increasingly understand the value that digital twins can bring to their transformation, there is also more engagement with the notion that digital twins evolve – they are not a static solution. It is a continuum of transformation, on which industries will be at varying stages depending on their unique business needs and existing capabilities (see Figure 2). Therefore, there will not be a fixed definition that applies to all applications of digital twins solutions.

Figure 2: The generic evolution of digital twins



Source: STL Partners

STL Partners defines the different stages of the continuum as follows:

3. **Visualisation**: the digital twin is used to create new dynamic visual representations, models and virtual dashboards of assets and processes (e.g. 3D schematics/Virtual Reality);

4. **Simulation/Emulation**: the digital twin is used to perform realistic simulation or emulation modelling of assets; digital twins at this stage can enable the organisation to perform detailed 'what-if' scenarios to streamline their processes (e.g. R&D);

5. **Twin-to-Twin (T2T) process automation**: digital twins are used to enable real-time analysis and T2T communication to automate certain processes through the creation of closed loops;

6. **Cross-party communication**: digital twins communicate and interact (in real-time) with twins across multiple 3rd parties within the organisation's ecosystem or supply chain.

This growing consensus on digital twins terminology will enable enterprises to have more productive conversations and make it easier for vendors to articulate how they can address the business needs of their customers. We spoke to an IT and Digital Services company, with a focus on Smart Factories, who emphasised this challenge: *'vendors are talking about digital twins in different ways, and as a solution provider we often need to understand what customers mean by digital twin'*.

Enterprises should understand digital twins as an evolution

Industries will adopt and progress through the continuum at different rates, depending on their different business needs and challenges, as well as their existing resources and environments.

Some industries, such as manufacturing, aerospace and defence, are already advancing along the continuum, seeing conversations shift from "what is digital twins?" to "what can digital twins do for me?". They are leaders in this space, as an early majority of organisations within these verticals are already beginning to adopt the technology (see Figure 3).

There are a number of factors that put these verticals at the head of the adoption curve:

1. **Mission critical processes**: industries that involve mission critical processes, that are those could be fatal if there is a malfunction, will be more likely to adopt digital twins to evaluate the safety of their system and machinery

2. **High value assets**: verticals such as aerospace and manufacturing work with machines that cost upwards of millions of dollars, therefore organisations in this space will want to protect their assets from preventable damage and generate useful insights on them to rectify any errors

3. **Real use cases**: enterprises in some verticals have existing initiatives involving the exploration of use cases in Industry 4.0, meaning that they will likely be receptive to a digital twins proposition

4. **Accessible data**: inherent in many of the new technologies that are generating buzz amongst key industry players is data; enterprises will need better data extraction, management, storage, and analysis capabilities to enable new use cases and maximise the benefits of these technologies

5. **Money to spend**: the manufacturing vertical sees relatively heavily investment, and contributed ~15% to global GDP[1], whereas others such as oil & gas are highly dependent on natural resource pricing and will be less likely to have the budget for an extensive digital transformation

Industries such as construction, logistics and smart cities are just a couple of years behind these early adopters, seeing increased investments in their digital strategies and use case applications. Further behind them are industries such as oil & gas, who are seeing just a few innovators exploring the digital twins opportunity.

[1] Word Bank, 2017: Manufacturing, value added (% of GDP)

Figure 3: The digital twins adoption curve

Source: STL Partners

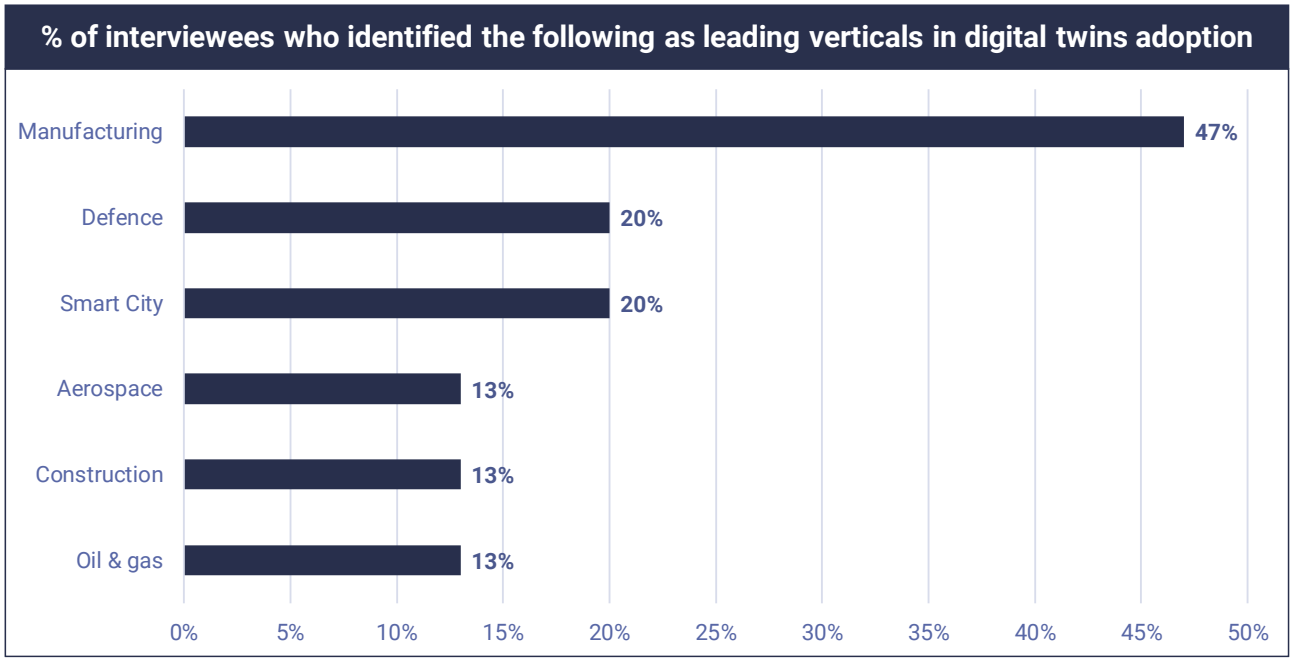
However, there are also a handful of verticals, such as the maritime industry, who face challenges in their digital transformation that stem from their lack of a long-term strategy of how to make efficient use of their data. A lot of their data is therefore locked in with vendors, making it unlikely that they will be able to explore a digital twins opportunity soon.

To illustrate this in more depth, below we explore 2 use cases at different stages on the innovation curve: manufacturing and smart cities.

Manufacturing: paving the way on digital twins

The manufacturing industry is widely perceived as a leader in digital transformation and adoption of emerging technologies. Manufacturers are often looking for ways to improve the efficiency of their processes and use their data effectively: almost 50% of interviewees from our recent research programme, unprompted, identified manufacturing as the leading vertical in digital twins adoption, with one Manufacturing Research Institute taking the view that *'digital twins is going to be very big, in manufacturing especially, as there are a lot of benefits to having that sort of data connectivity'*.

Figure 4: Manufacturing is broadly viewed as a leading vertical for digital twins



Source: STL Partners

The manufacturing industry is already beginning to leverage the digital twins philosophy to enhance its existing data capabilities, and there is a clear role for digital twins to help transform and develop new use cases, for example:

- **AR/VR and advanced visualisation**: using augmented and virtual reality headsets to guide a worker via augmented display and/or a remote expert when carrying out maintenance and repair tasks

- **Precision monitoring and control**: conducting real-time, granular monitoring of a factory or plant (and robots/machinery) to reduce number of defects and optimise production process
- **Advanced predictive maintenance**: collecting data (i.e. through sensors) on the condition of machines to predict maintenance requirements and avoid unplanned downtime and associated costs – we explore this use case in more depth, below

Digital twins use case: advanced predictive maintenance

At both the Visualisation and Simulation/Emulation stages of the digital twin continuum, enterprises are primarily focused on cutting costs and increasing operational efficiency. Use of predictive maintenance solutions is already relatively common in manufacturing, and in a plant or factory, it can reduce breakdowns by up to 70% and lower maintenance costs by 25%[2]. However, as plants become more sophisticated, and 'connected', there will be a growing number of sensors collecting information from factory equipment, generating vaster amounts of data that will need to be aggregated, processed and analysed in near real-time. Therefore, we use the term *advanced* predictive maintenance to reflect the changing parameters of what traditional predictive maintenance solutions offer.

Data is therefore a fundamental aspect of this process, and for the use case to function it is essential that the right data can be quickly moved to where it needs to be. Digital twins can help shape this use case by creating an emulation of equipment in the manufacturing plant and enable sophisticated extraction, management and analysis of sensor data to test different fault conditions.

Smart cities: enabling ecosystems of connected things

Smart city solutions are forecast to be worth over $250 billion by 2025[3], and enterprises are already exploring and implementing use cases in this space. Smart cities' intrinsic dependence on data, and being able to collect, process and apply it efficiently, makes it a strong contender in the digital twins space, with a few early adopters already entering the market.

One SI and Technology Consultancy noted that smart cities are *'seeing a convergence of public and private data' and are 'looking at how to visualise that convergence and monetise it'*.

There are a number of use cases that digital twins could enable in the smart city space, namely in the following categories:

- **Connected devices** e.g. autonomous drones, for example being explored by Atrius
- **Connected vehicles** e.g. V2V/X and smart traffic management
- **Connected infrastructure** e.g. smart building management

[2] Deloitte, 2017: Predictive Maintenance
[3] Bloomberg, 2019: press release

Digital twins case study: smart building management

Smart city use cases are inherently broad and involve connecting multiple assets, such as buildings, vehicles and devices, to enable more autonomous functions. One example is smart building management, for which there are two key phases: the construction process, and the smart building itself.

Phase 1: the construction process

We spoke to a global construction company who outlined the benefits of digital twins in a construction site. Though traditional building information modelling (BIM) models can only provide a high level view of a building, digital twins enable the organisation to design and shape every aspect in a dynamic way, and bring supply chain knowledge to the forefront of the model. For example, digital twins could emulate how aspects such as connectivity, lighting and people flow will function in the building, and whether this will function optimally to suit its purpose (see Figure 5).

Figure 5: Digital twins as a key component of construction sites

Digital Twins in construction need to go beyond BIM	There is a struggle to find the right connectivity to support sites
Digital twins can be used as a platform across the whole value chain to integrate all the information of the design and fabrication of a building	Construction sites need ubiquitous connection that covers the entire site and can be easily moved and relocated
This can be used in digital fabrication and taken on site, enabling an entire building to be designed in approximately 4 hours	Geolocation and high throughput of video are also important
The problem with BIM models is the different levels of design which use different technologies, which then need to be interpreted and re-represented	Many sites currently rely on mobile signal or radios, which can be patchy in basements or remote areas

Source: STL Partners interview programme (July 2020)

Phase 2: the smart building

Once the construction process is complete, digital twins can be used within the connected building to manage other aspects. For example, a network of sensors can collect a variety of different real data sets (e.g. on people flow, temperature, occupied rooms, lights etc.). One interviewee mentioned that a smart building could have millions of sensors, generating several GBs of data per day.

At a basic level (and towards the left of our continuum), the digital twin philosophy and the data centricity it brings can enable the organisation to effectively extract, manage and store this data in a way that enables decision makers to interact with the information it holds. Without digital twins, the noise from the data set could make information prohibitively difficult to extract and understand. This adds real value as it provides the organisation with insights on the operational efficiency of the building (e.g. when and how often lights are on in empty rooms).

As organisations progress through the continuum and explore more advanced use cases, digital twins could enable the creation of closed feedback loops, automating the management of the building, to a

certain extent (e.g. when a room is empty turn off the lights, when the temperature reaches x degrees turn down the heating). Even these relatively simple sequences drive efficiency in the building and help to cut operational costs.

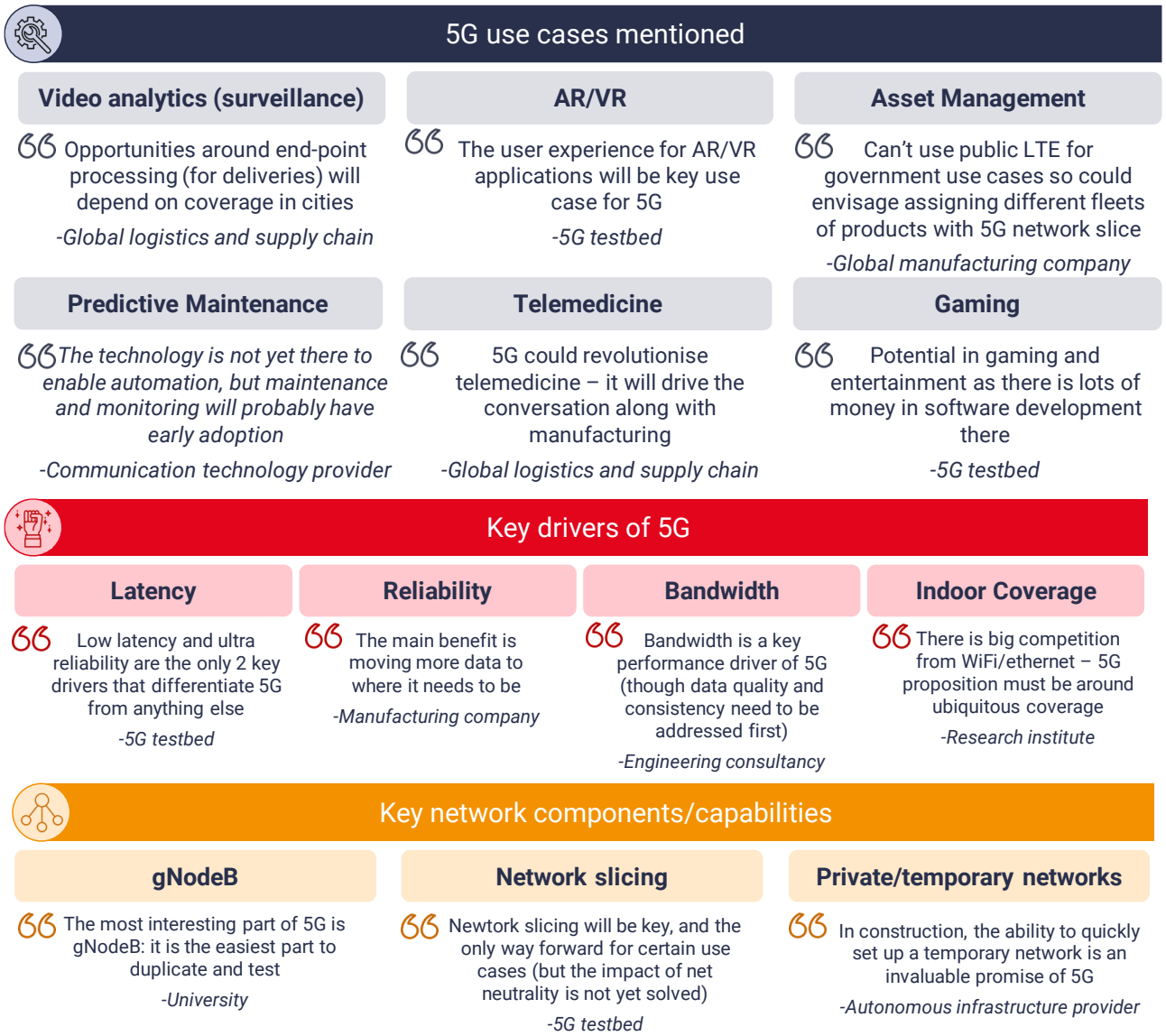
Connectivity: the key to digital transformation

The use cases explored above hinge on connectivity. Take the example of smart cities: it is crucial that relevant data is extracted and moved from A to B at the right time in order to enable mission critical applications such as autonomous vehicles. It is therefore essential that organisations consider the quality of their network as part of their digital twins strategy.

How 5G may accelerate digital twins' value

5G is becoming a fundamental feature of conversations around connectivity, with promises to bring in new waves of digital transformation across Industry 4.0 (see Figure 6).

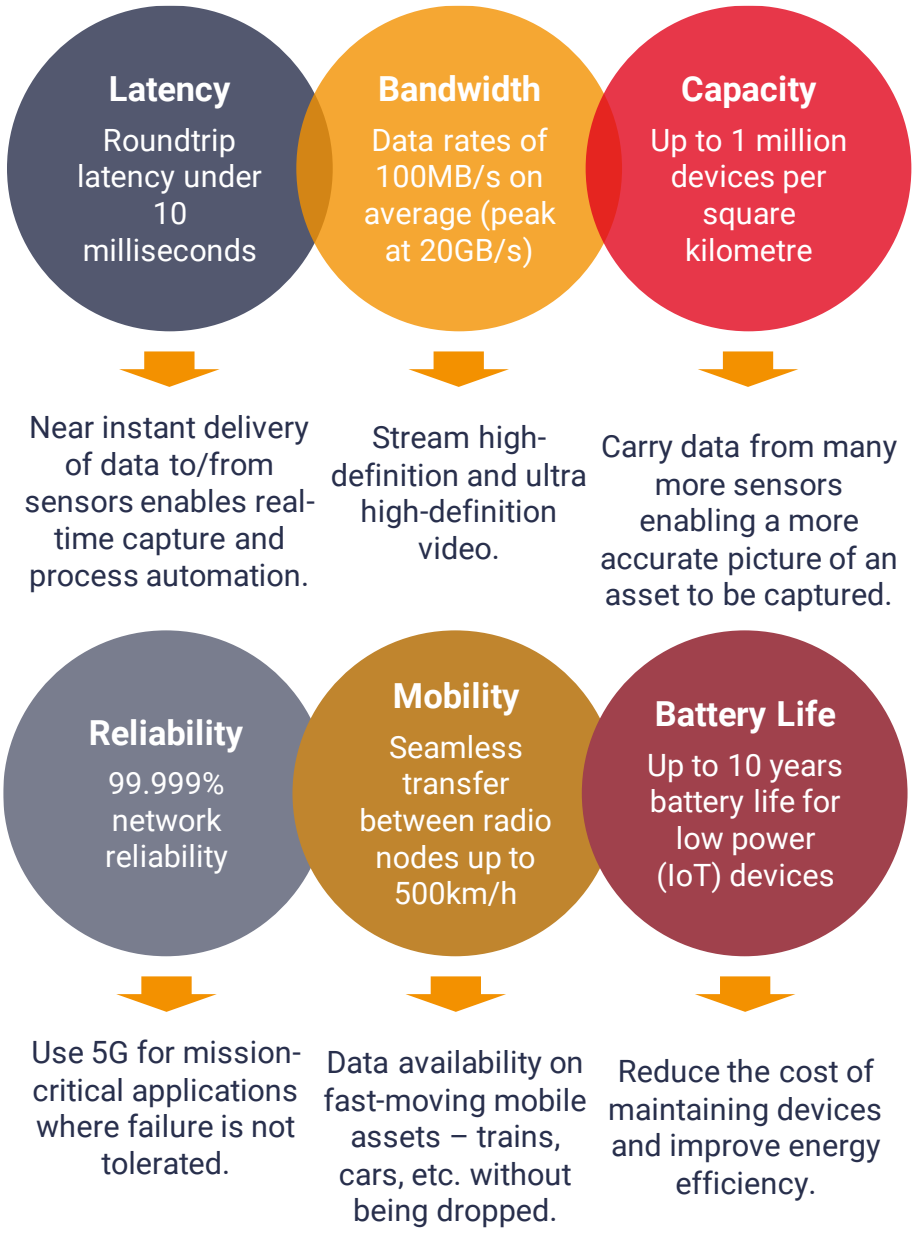
Figure 6: 5G will be a key enabler of new use cases in Industry 4.0



Source: STL Partners

5G's capabilities (see Figure 7) can enable a number of digital twins use cases that depend on the efficient and reliable movement of vast amounts of data.

Figure 7: 5G's key capabilities



Source: STL Partners

Manufacturing: the role of 5G

As mentioned previously, enterprises in the manufacturing industry are striving to improve their operational efficiency and maintain a competitive edge in the market, for example by processing vast amounts of data from their machinery in real-time to ensure the efficient functioning of processes. 5G could address many of the challenges facing the manufacturing use cases identified above by enhancing the ability to gather, use and analyse data.

Use case: 5G for advanced predictive maintenance

As explored in the context of digital twins, the predictive maintenance use case relies on vast amounts of granular data to be collected and processed in real-time to predict a potential machine failure and avoid unplanned downtime and its associated costs. 5G holds key capabilities that would be well-suited to address these challenges:

- **High bandwidth**: ability to process data from a large number of sensors (approx. 5-10 times more than without 5G), enabling richer predictions and more accurate analysis
- **Low latency**: can collect data in near real-time (<10ms) to enable instant responses
- **Long battery life**: enables up to 10 years of battery life for some IoT devices, reducing maintenance costs and avoiding the need to replace equipment frequently

Therefore, 5G offers new ways to save costs whilst improving the quality and reliability of processes.

Smart cities: hinging on data

Smart cities are hugely dependent on the effective management and use of data. Connected devices generate huge amounts of data that need to be processed and analysed in order to ensure the operability of smart city use cases. They also need to span a wide area, and devices often need to share data and roam, making cellular connectivity a key enabler in this space.

Use case: 5G for connected vehicles

Connected vehicles will generate an increasing amount of data as they become more autonomous in their functions. It is estimated that they send around 25GB of data to the cloud per hour[4], and as cities become 'smarter', they will only put a more extensive strain on existing network infrastructure. Beyond the amount of data generated, the connected cars use case will be significantly hindered if end-customers are not convinced by its reliability, due to the mission-critical nature of replacing human decision-making on the road, and the amount of sensitive data that will need to be carried over the network. Hence, it is essential that data collected from sensors can be acted upon in an instant, and that it cannot be accessed by third parties.

Therefore, 5G will be fundamental to autonomous vehicles by addressing some of the concerns mentioned above:

- **High capacity**: can support up to 1 million devices per square kilometre, allowing for a more wholistic view of other vehicles on the road
- **High network reliability**: in the case of V2X, any lack of functionality could be fatal
- **Mobility**: able to collect and process data on mobile assets without losing signal

[4] McKinsey, 2018: What's driving the connected car

- **Low latency**: can instantly deliver data to and from sensors for processing
- **Security**: data encryption and network slicing can maintain the security of critical data

5G and digital twins – a virtuous cycle

So far, we have outlined the opportunities that digital twins could enable for enterprises in Industry 4.0 and the importance of (5G) connectivity in supporting many of the key use cases being explored. However, there is another dimension to the relationship between these two technologies shaped by the challenges that are hindering widescale adoption of 5G. Using the examples of manufacturing and smart cities, we illustrate below how 5G and digital twins could mutually depend on each other to accelerate adoption and innovation in Industry 4.0.

Manufacturing: building the 5G business case through digital twins

Most of our interviewees identified manufacturing as *the* leading vertical for digital twins adoption, but most also agreed that a lot of manufacturers may 'still be in the dark ages' when it comes to 5G, and cellular connectivity more broadly.

Based on these discussions, we identified two key challenges facing 5G adoption in manufacturing.

Challenge 1: Integration with existing systems and environments

There are some practical challenges to implementing 5G in industry that will vary depending on the environment of each plant or site. For brownfield sites, 5G may need to be integrated with existing connectivity solutions, such as Ethernet and WiFi, which may deter some enterprises from investing in the opportunity.

There also need to be considerations around the suitability of the radio environment – will there be greater interference in factories with comparatively high volumes of metal, and how significant will this interference be (e.g. semiconductor production plants)? Are there other nearby entities which are emitting their own radio signals which could cross with the organisations'? Furthermore, some factories may span both indoor and outdoor locations and may need to manage 5G coverage across these different environments.

Challenge 2: Lack of understanding of 5G capabilities and benefits

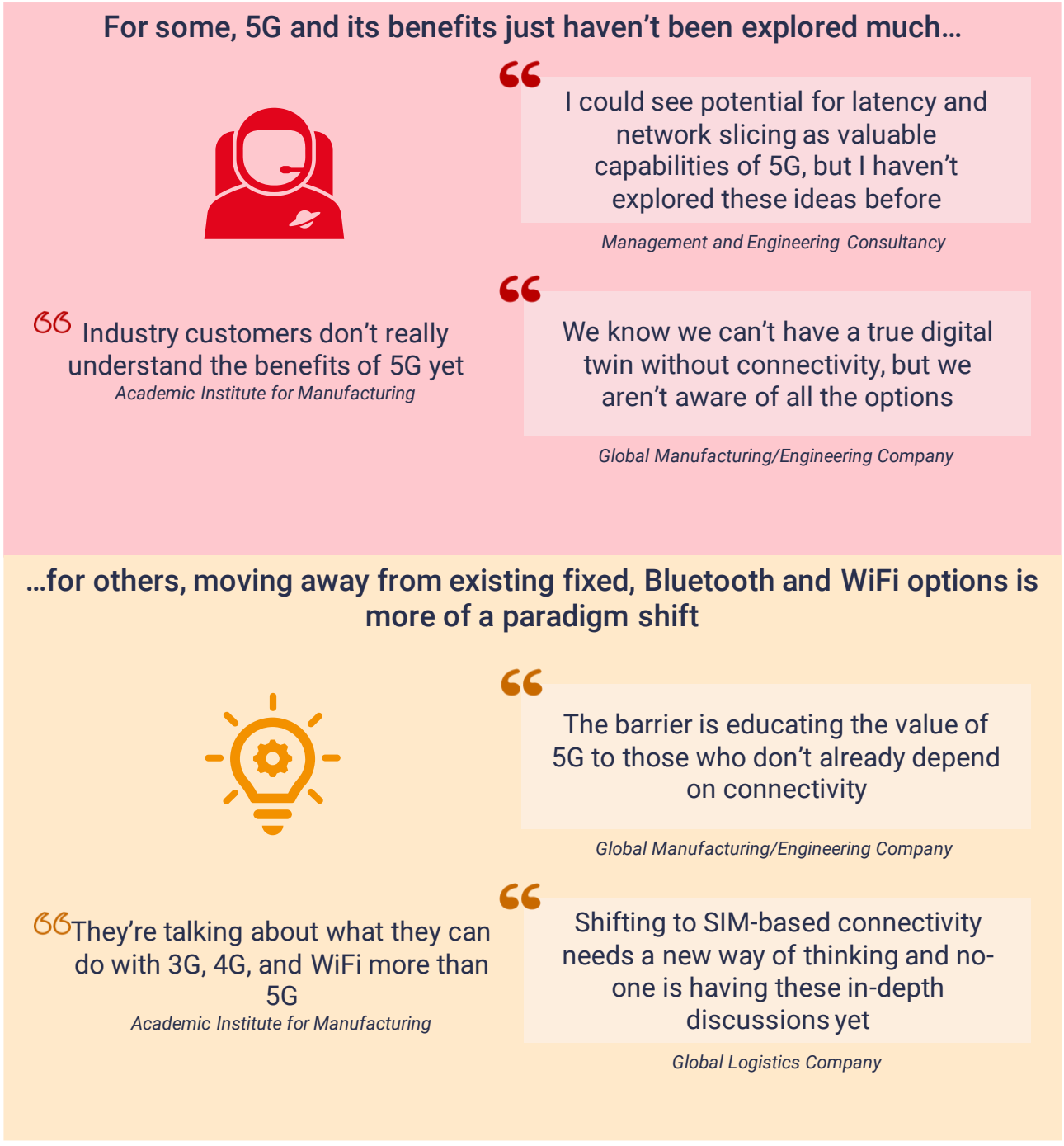
In order to invest in combatting and solving these challenges, enterprises would need to be convinced of the value that 5G could bring them. However, there is a general lack of understanding of the capabilities and benefits of 5G in the manufacturing industry, as well as concerns around the costs of replacing existing legacy equipment and integrating with existing systems (see Figure 8). To overcome this, there will need to be a mindset change in the industry to embrace the move from fixed to cellular connectivity, and to justify the expenditure of adopting 5G, despite the associated challenges.

The solution: digital twins?

Just as 5G can be an enabler for digital twins use cases, digital twins could be key for addressing the challenges that are stalling 5G adoption. Digital twins can help manufacturers better understand the business cases for investing in 5G and make sense of the data extraction and transmission that 5G can enable.

For example, a digital twin emulation of a 5G network could create a virtual playground for developers and manufacturers to plan, test, configure and optimise their infrastructure. They would be able to explore 5G use cases and understand the potential impact of their innovations (and any potential challenges they may need to address to achieve this) without a taking the significant upfront risk of adoption.

Figure 8: There is a lack of knowledge of cellular networks and 5G



Source: STL Partners

In addition, not only would they be able to plan new greenfield sites, but they would also be better placed to explore how 5G fits in as part of the wider connectivity ecosystem in brownfield sites. We spoke to a Global Logistics Company who suggested that '5G will be mostly for greenfield sites as network hardware replacement cycles take a long time', noting that the move to 4G was a 'slow, painful process of change'. Several other interviewees echoed these sentiments, highlighting the role for digital twins in changing attitudes towards 5G.

Smart cities: understand the power of 5G in the wider ecosystem

Another way to illustrate this interdependence of these two technologies is through the smart cities industry: as explored above, there are a number of mission critical use cases in this space that 5G can address, to a certain extent.

However, as the capabilities of connected infrastructure, devices and vehicles improve, and become 'smarter', there will likely be a need for even lower latency. For example, some AR/VR applications such as gaming require an ultra-low latency of <5ms[5] to ensure a high quality of experience for end users, and to avoid motion sickness from lag times, whilst others such as autonomous cards depend on real-time responses to prevent fatal accidents. At least in the short term, 5G may not be able to offer this, and will need to be explored in conjunction with other emerging technologies such as edge computing.

In this sense, digital twins can enable organisations and developers to understand the interaction between 5G and other technologies. For example, in the case of edge computing, they can explore how workloads can be moved, as well as the different network architectures and topologies that would be involved. You can find out more about why 5G needs edge computing here.

Secondly, 5G will enable connected assets to process vast amounts of personal data, which leads to concerns around data privacy and security. For example, in the public sector digital twins could enable 5G-enabled security solutions, and test updates for a potential failure of breach before network rollout. It could also allow enterprises to better understand network slicing and its potential benefits. We spoke to an Edge Software Provider who noted that 'network slicing is central to 5G', especially in the case of government and defence use cases where privacy and security are prominent concerns.

Digital twins: enabling telcos to accelerate 5G deployments

Based on these challenges, it is unsurprising that, despite the promise it holds in unlocking digital transformation across Industry 4.0, the current rollout of 5G has been relatively hindered in the majority of global markets. South Korea and the USA are amongst just a handful of regions that have seen widescale 5G rollout.

[5] Huawei, 2017: 5G unlocks a world of opportunities

In this context, there are two ways that telcos could leverage digital twins: accelerating the rollout of 5G and using digital twins to offer services to customers.

Telco opportunity 1: accelerating 5G rollout

Many operators have been hindered by a lack of funding for 5G, resulting in slow and staggered deployments. This is partly due to the lack of defined business cases in many regions. Telcos could use digital twins, within their own network, to address this.

For example, there are doubts surrounding the ability of 5G to provide reliable indoor coverage, deterring industry stakeholders from investing. By creating an emulation of the network, it may be possible to test and address these skepticisms. Furthermore, by leveraging digital twins to provide a virtual copy of the network and right time visibility on network performance and key metrics, operators can take a step towards deploying truly cloud native, dynamic, and virtualized networks. This will be essential for deploying standalone (SA) 5G and delivering the promised capabilities laid out above.

In addition, regions such as Europe suffer from a lack of defined industry standards. Although there has been some progress on this from 3GPP, the telecommunications standards body, it is not yet clear whether there will be certain requirements that could hinder rollout. However, telcos should seek to help inform this process, and could use a network emulation to evidence the standards that would be needed to enable use cases.

Telco opportunity 2: becoming a provider of digital twins

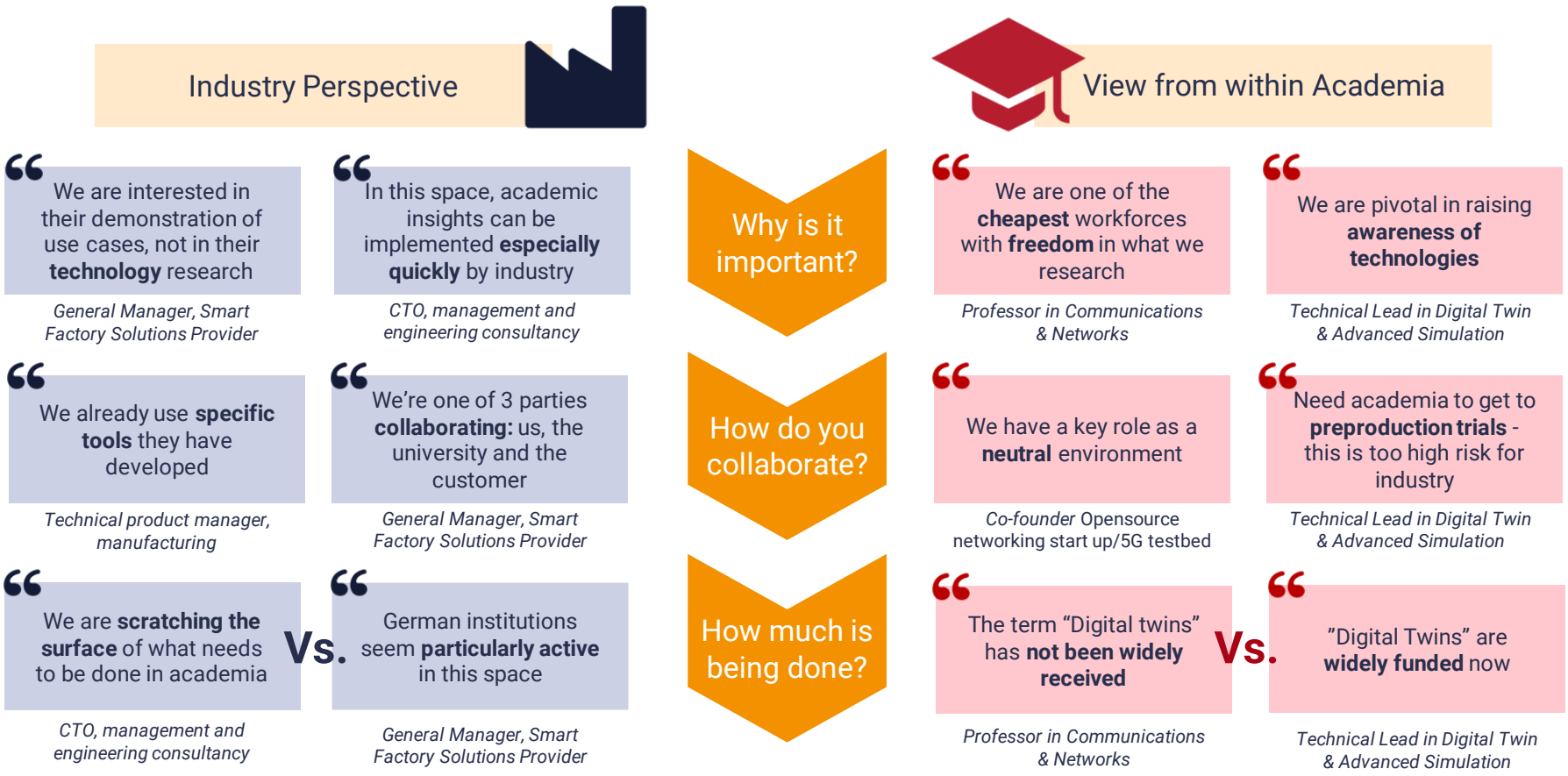
Telcos could offer enterprises a digital twins private network as a managed service. Digital twins can provide increased visibility and control for enterprise customers as a private network, enabling them to view and interact with their network twin. Beyond this, digital twins could allow telcos to access a broader range of industry verticals, and play in different parts of the value chain, for example in the case of smart cities, where use cases are very broad and multiple components depend on the same connectivity.

Academia: a key enabler for 5G and twins in Industry 4.0

So far, we have demonstrated how 5G and digital twins could be key digital transformation and help move enterprises along the path to Industry 4.0. However, there are several components to consider, and there will be niches within each vertical that will need to be addressed to shape each of these journeys. Therefore, the final component of our research programme was considering the possibilities of academia, as a tool for addressing many of the challenges outlined so far.

It was broadly agreed that academia will be a key partner for enterprises across Industry 4.0 who are looking to explore their digital twins strategy, both in the short and longer term, with its ability to bring together relevant groups and make sense of complex systems and connectivity requirements (see Figure 9).

Figure 9: The importance of academia is widely acknowledged amongst key industry players



Source: STL Partners

Though approximately 85% of our interviewees agreed that academia would be important in this context, there were more nuanced views regarding what their primary role would be:

- **Unbiased source of expertise**: a handful viewed them as being a uniquely neutral source of knowledge on many of the technologies that are shaping Industry 4.0, that would help accelerate the initial adoption of a more complex technology such as digital twins, without making false promises

- **Exploring the continuum**: some felt that academia could enable industries to understand their place within the continuum and explore how best to evolve in this context

- **Shaping use cases**: a couple also felt that the role for academia might fit in well at a later stage, when it comes to investigating more specific use case applications and technology requirements

Despite these variations in opinion, there was strong agreement that enterprises should look to academia when exploring the digital twins opportunity.

Conclusion and key recommendations

- Contribute to work on digital twins in your industry and in cross-industry bodies to learn more about how digital twins can support you and to agree on a standard terminology and framework for digital twins, relative to your position in the **digital twins' continuum.**
- Use digital twins to create a **holistic view of your environment**, including your different connectivity solutions and their associated characteristics for different use cases
  - Connectivity is a key part of delivering transformative use cases which can drive efficiencies across Industry 4.0
  - Consider what the optimal portfolio of networking solutions might look like to support your **digital transformation** activities and how a network digital twin fits into your digital twin strategy.
  - Engage with solution providers and connectivity providers (e.g. telcos) that can support your digital twin activities both for your assets and the **connectivity** required to improve their performance.
- 5G and digital twins support each other in a virtuous circle - leverage digital twins to **build the business case for 5G** and understand how 5G fits within your connectivity ecosystem and existing connectivity solutions.
- Engage with **academia** on (applied) research activities to progress digital twins' adoption and usage across the industry.

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