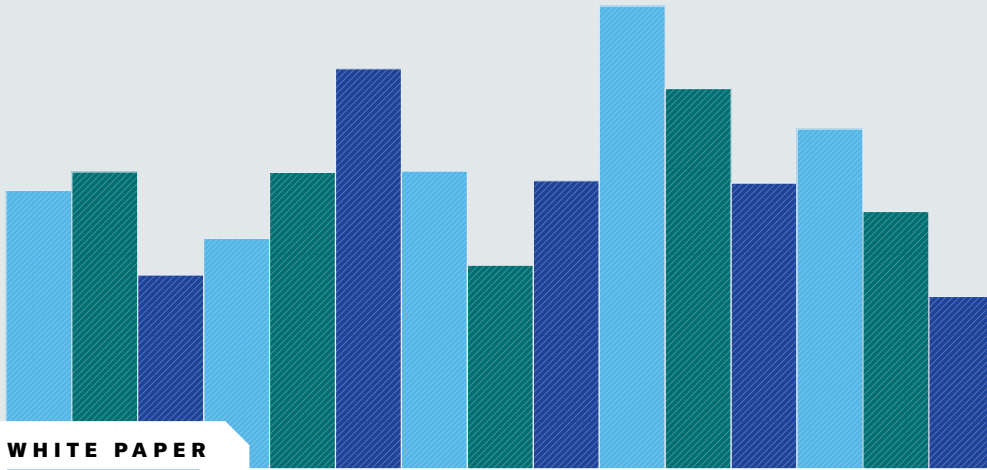




**Harvard
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ANALYTIC SERVICES



Enhancing Innovation in Telecom with Digital Twins



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Twining with Artificial Intelligence

The start of a new year is a critical time for all businesses and enterprises: It is a time to reflect, explore innovative ideas, and set new goals for the year ahead. The start of 2022 brings unique meaning to this often-used approach; after all, we've overcome so much in such a short amount of time living in this "new normal."

To be successful in this ever-evolving marketplace, executives are required to make quick decisions to address the opportunities as well as risks. Despite the increasing availability and sophistication of data and analytics across media, telecommunications, and related industries, major executive decisions are still made based on intuition and experience. However, to thrive in today's marketplace, organizations need to think outside their predictable and set ways of working by infusing the culture of rapid experimentation using real-time data.


This paradigm can be addressed via the use of digital twin-based simulations. In media and telecom, digital twins can be applied to a broad range of business problems and scenarios in areas like sales and marketing, operations, customer experience, finance, network planning, and IT. These business simulation opportunities include testing market responses to new product ideas, maximizing customer lifetime value, and optimizing steps in the value chain, as well as merger-and-acquisition optioneering and risk analysis and mitigation.

This Harvard Business Review Analytic Services white paper sponsored by TCS CMI will explore the challenges media, telecom, and similar organizations face in making strategic business decisions and how experimentation-led innovation, coupled with a data-driven cultural approach, can significantly improve the speed and effectiveness of such executive decisions. It will discuss the benefits of experimentation and innovation using realistic digital twins of an enterprise's market and its constituents, as opposed to physical experimentations, thereby achieving infinitely more iterations that produce instant results at much lower cost and risks across a broad range of business scenarios.



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Enhancing Innovation in Telecom with Digital Twins



Despite the increasing availability and sophistication of data and analytics, for many executives in telecommunications, major decisions about their organizations still rely heavily on their experience and intuition. These analog decision-making processes grow progressively risky as uncertainties such as the Covid-19 pandemic, increasingly demanding customers, and encroachment from adjacent industries make the telecom marketplace even more complex and volatile. To thrive in today's more dynamic and uncertain conditions, telecom organizations need to make better use of their data and expand their capacity for experimentation, innovation, and timely decision making without increasing risk or slowing time to market.

Telecom organizations were already feeling strong pressure before the additional challenges wrought by the pandemic. Total shareholder return for 40 global telecom companies studied by PricewaterhouseCoopers (PwC) from 2016 to 2018 came to just 10% for the three-year period, according to a 2020 report, "Sink or Swim: Making Strategic Choices for the Telecom Industry of the Future." All of that return came in the form of dividends, the firm reports; share prices actually fell 3% over the same span. "In hopes of reversing the trend by boosting shareholder value, many are looking for a better strategic path," PwC notes.

Those traditional approaches to innovation and decision making are making it challenging to craft new strategies to ignite growth. "The core problem faced by telecom companies is complexity," says Tony Clark, deputy dean in the College of Engineering and Applied Science at the U.K.'s Aston University. "There is a huge amount of data in the day-to-day execution of these companies. But they have difficulty understanding the completeness and the consistency of that data to support a reliable way of making decisions."

HIGHLIGHTS

To thrive in today's more dynamic and uncertain conditions, telecom organizations need to **make better use of their data and expand their capacity for experimentation, innovation, and timely decision making.**

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Adopting best practices from those companies more well-versed in digital twin adoption and application can be a smart strategy to achieving **faster time to benefit and more optimal results.**

Digital twin platforms, used to create virtual models of customers, products, processes, and resources, are emerging as one strategy to drive faster innovation and decision making in telecom organizations. Digital twin platforms enable organizations to experiment with and evaluate multiple business strategies at scale to see what the results would be prior to real-world execution, increasing confidence, lowering costs, and reducing risk. In telecom, digital twins can be applied to a broad range of business problems in sales and marketing, operations, customer experience, finance, network operations and planning, and IT.

But telecom firms face hurdles to maximizing the benefits of digital twins due to factors like data silos, misaligned incentives, cultural resistance to change, and limited understanding of the admittedly murky definition of what digital twins are and what they can do.

Moving forward requires telecoms to identify their own decision-making obstacles and understand how better approaches to experimentation—as well as a culture open to this change—can improve the effectiveness and timing of those decisions. Armed with these insights and best practices honed in other industries, they can begin to explore the potential of digital twins of their organizations, markets, and infrastructure. Digital twins ultimately can help telecoms speed and enhance innovation and decision making, so they can better compete in today’s constantly evolving marketplace.

The advent of new approaches to innovation such as digital twins represents “an opportunity to think differently,” says Francis Haysom, principal analyst in the U.K. office of Appledore Research, a Dover, N.H.-based telecom analysis firm. Telecom “needs to be innovative and much more agile, and digital twin is an underpinning technology to enable them to make that transition.”

The Potential of Digital Twins

One of the most important steps for an industry such as telecom to effectively begin using digital twins is clarifying what the term means, and that can be challenging. Perhaps in recognition of the damage that an emerging technology can experience when its name becomes a catchall, the trade group Digital Twin Consortium brought together experts to define the term.¹ Its definition describes a digital twin as a virtual representation of a real-world entity and/or process, synchronized at a specified frequency and fidelity. The digital twin uses real-time and historical data to represent the past and present, and then simulates predicted futures that are inspired by desired outcomes and often tailored to specific use cases. A digital twin is powered by integration, built on data, guided by domain knowledge, and implemented in IT/OT (information technology/operational technology) systems.



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Digital twin usage also follows a maturity curve, from simply capturing reality in a virtual way to creating a 2D or 3D model to connecting a model to static data to enriching it with real-time data and ultimately to operating autonomously based on what it has learned along the way, according to “Digital Twin Maturity Model,” an academic presentation delivered in late 2020.² So while early uses may be limited in scope, such as modeling infrastructure for predictive maintenance, the potential is much larger.

A number of experts with deep knowledge of digital twins and telecom see real opportunity to leverage the capability of digital twin platforms to unify data, enable faster and more data-centric innovation, and infuse this new data-driven way of thinking across the enterprise.

“As more complex ‘things’ become connected to software and produce data with outcomes or actions, having a digital equivalent gives us the ability to optimize deployments for peak efficiency and create other ‘what if’ scenarios, not only in the technical domains but also for customer activities such as order management and time-to-market,” says Giovanni Chiarelli, chief technology and information officer at MTN South Africa, an emerging markets mobile telecommunications operator in South Africa.

Telecom Under Pressure

Digital twins come to telecom at a precarious moment. After years of growth built first on fixed-line telephony, then on mobile phone services and broadband, many telecom organizations across the globe have experienced flat revenue and declining margins thanks to a saturated market and commoditization of their products and services. Investment has been funneled primarily to efficiency rather than innovation. So, as the industry gears up for an explosion of new opportunities in the internet of things (IoT), cloud, 5G, and edge computing, networking and hyperscale tech giants are staking claim on these opportunities with more market-savvy solutions such as SD-WAN (software-defined



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networking) and as-a-service options that reflect their richer understanding and ability to act on evolving customer needs.

“There’s a fundamental problem in the telecoms industry, which is, it’s a very conservative industry that knows it’s challenged, but in some senses doesn’t quite know what to do about it,” says Appledore Research’s Haysom. “In areas like enterprise, for example, telcos aren’t really giving enterprises what they want. They’re still wedded to very specific long-term contracts and not a lot of adaptability.”

Large telecom firms, with their complex structures and greater aversion to risk, seem to be particularly challenged to change. A hyper-focus on bolstering existing infrastructure and early work on digitization served these organizations well during the pandemic, when the volume and shape of customer demand for their core services suddenly shifted. But as the market begins to focus once again on the long term, their inability to move quickly to seize new opportunities is threatening future prospects.

“If you want to do innovation, some long-term view on the world is needed,” says Marielle Weijters, network build operations director at VodafoneZiggo Group B.V., a telecom provider in the Netherlands. “We are now in a situation where we are short-term focused, and the decision making on where to put our money sometimes impedes us to really accelerate innovation.”

Obstacles to Innovation

Telecom companies are swimming in data. But like many organizations, much of this data—and in turn, the systems and people that generate and consume it—is siloed by function; marketing data is entirely separate from network performance or financial data, for example. Because all of this data is generally both historic and unintegrated, senior telecom executives have continued to rely on experience and intuition built over years in the industry to drive decisions.

Innovation, largely focused on cost reduction or new iterations of core offerings, has also used lengthy, practiced methods of prototyping and market-testing real-life products to prove out ideas before adoption—if it’s not outsourced entirely. Telecom organization culture has solidified around these practices and resisted change.

“Large organizations want to be repeatable, and agility and repeatability don’t necessarily go hand in hand,” says Aston University’s Clark. “If you are always looking at your historical data and making decisions based on knowledge that relies on experts that have worked with the company for a long time, you’re going to be very risk averse, and you are not going to innovate very swiftly.”

The culture that has built up around these silos reinforces old practices. “Each of these silos [was] incentivized differently and often work in cross-purposes,” says Sameer Lalwani, cofounder at Digital Twin Sim, a telecom advisory firm in San Diego, Calif. When offered a new technology that could significantly improve network performance, for example, a telecom’s procurement department might shoot down the opportunity because it raises the team’s procurement costs, because this is the metric on which they are judged, despite being a net benefit to operations and the overall organization, he says.

Telecom leadership is well aware of their data, innovation, and decision-making challenges and has taken some steps to address them.

On the tech front, some have turned to market leaders, such as the strategic partnership between BT and Microsoft,³ to accelerate innovation. Vodafone has engaged with Google⁴ to establish an integrated data platform for the company’s analytics. Another common move is to set up an internal data science team, through hiring or acquisition, to help unify data, increase analytics capability, and evangelize data sharing across the organization. VodafoneZiggo, for example, created its Business Intelligence Competence Center to meet huge internal demand for insights. MTN South Africa established its Innovation Center to incubate new ideas in partnership with universities and technology firms.

But efforts to bring in resources for analytics-driven innovation from outside the organization are not always successful. Not all alliances bear fruit, and it can be difficult for telecoms to compete for and retain data science talent also being actively recruited by cutting-edge tech firms. Even fully staffed units are challenged to overcome data and organizational silos, weave data-fueled thinking into existing cultures and processes, and persuade their colleagues to trust the data.



When offered a new technology that could significantly improve network performance, for example, a telecom’s procurement department might shoot down the opportunity because it raises the team’s procurement costs, because this is the metric on which they are judged, despite being a net benefit to operations and the overall organization, says Sameer Lalwani, co-founder at Digital Twin Sim.

For some, “they’ve hired people with very deep data science expertise, but very little domain expertise in terms of telecom background. These teams are able to do interesting analytics but aren’t really aligned with what the company needs, or [they don’t] get enough senior management engagement,” says Lalwani.

Exploring Digital Twins in Telecom

Digital twin simulations are emerging as a possible solution to some of telecom’s decision-making and innovation challenges. While the term “digital twin” has taken on different meanings for different people, the core concept of creating virtual versions of customers, products, processes, and resources by unifying data, and then testing scenarios against that data, is seeing early use in a variety of application areas in telecom, from sales and marketing to capacity expansion to supply chain modeling.

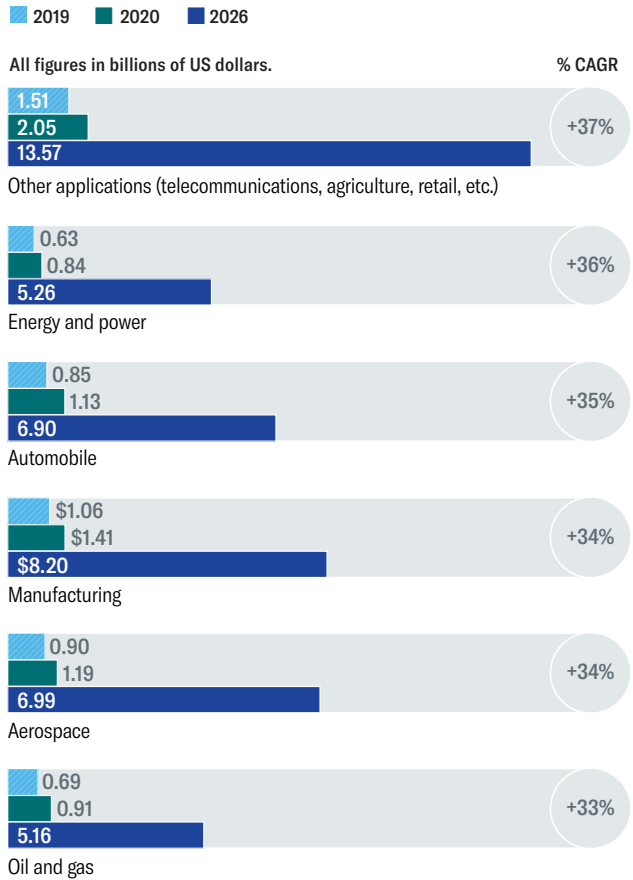
Manufacturing, aerospace, and the auto industry are among the most aggressive adopters of digital twins, according to research from Mordor Intelligence. **FIGURE 1** Telecom is included in the “other” category. Collectively, the digital twin market accounted for \$7.63 billion in 2020, but growth is projected to be explosive, rocketing to \$46.08 billion by 2026, with a compound annual growth rate of 35.01% for 2021–2026.

Gartner, in its July 2021 “Market Guide for Technologies Supporting a Digital Twin of an Organization,” echoes the idea that digital twin simulations can extend well beyond concrete products and systems. According to the report, “It is possible to extend the digital twin concept to complex entities,

FIGURE 1

Global Digital Twin Revenue Poised to Rise

Big leaps in adoption are expected by 2026



Source: Mordor Intelligence, 2021

such as departments, business units, organizations, whole enterprises, or even cities and countries, to support specific financial or other decision-making processes. Furthermore, additional optional elements, such as analytics, control, and simulation, can augment these more abstract digital twins.”

Broad Use Cases Span Telecom

Early uses of digital twins in telecom have tended to focus on tactical decisions, like determining whether billing plan A or B will be more successful, rather than enabling strategic decisions. In fact, the range of use cases in telecom spans both, and early experiments are already delivering business value.

According to Gartner, operational excellence is the leading use case (26.8% in 2020) for the digital twin of an organization, defined in part as a dynamic software model

of the organization itself that forms a proven design pattern for the operationalization of an enterprise operating model.

FIGURE 2 It provides visibility, delivers situational awareness, and supports improved enterprise decisions. Digital business is the second most common use case (24% in 2020), followed by cost or enterprise performance optimization (22% in 2020).

In the telecom industry, one area offering a rich range of digital twin opportunities is in sales and marketing. Use cases include testing the impact of a product or service not just in terms of market uptake, but also its potential for cannibalization and its impact on customer experience, churn, brand recognition, and Net Promoter Score. The ability to bring together disparate data streams such as network performance, user traffic logs, financial key performance indicators, and customer behaviors helps the digital twin produce highly realistic market simulations.

As telecom companies are increasingly able to weave external data such as customer sentiment from social media into such analysis, “that control loop might be as much driven by Twitter trending or Facebook likes as it is about just the raw performance of the equipment in the network,” says Haysom.

MTN South Africa is applying digital twin and machine learning capabilities to the end-to-end order flow and management for post-paid mobile customer order management and simulation. VodafoneZiggo is using a digital twin to prevent customer churn by detecting real-time service issues that, based on historical data, typically trigger customer unhappiness with its fiber-line product and provide an understanding of the lead time or cost impact of that event. “It helps us be more preventive and proactive because it’s being triggered by historical analysis,” says VodafoneZiggo’s Weijters. “We want to also get those lessons incorporated into our processes and policies so we can really solve things instead of letting [them] happen again and again.”

Beyond these internal uses, telecoms are expected to also one day use digital twins in their sales efforts. One communications service provider (CSP) Appledore Research is working with is looking to use a digital twin, via a public cloud, to model a proposed network for a prospective customer, enabling the proposed customer to simulate how the network would run in the real world in order to understand the benefits of awarding their business to that CSP. In turn, that customer could use the CSP’s digital twin offering to simulate their own products and services for their own clientele.

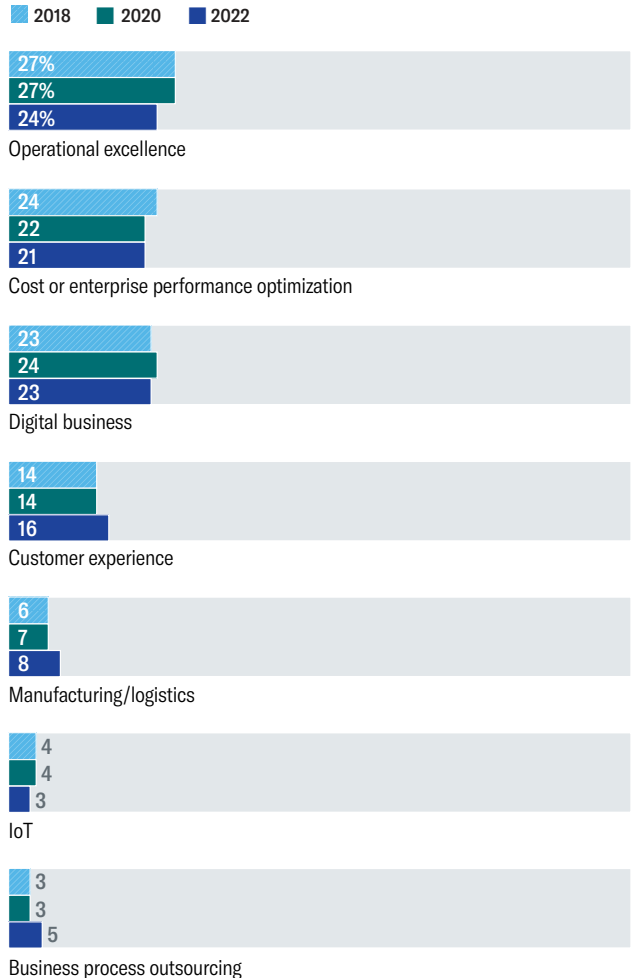
Digital twins are “one of the tools that will help them to develop their commercial proposition as well as their own internal capabilities,” says Mark Newman, chief analyst at TM Forum, a telecom trade association in Parsippany, N.J.

Operations also offers a number of use cases, such as network planning, operational process workflows, capacity expansion, and testing new security protocols, and is perhaps

FIGURE 2

Operations Leads Digital Twin Organization Uses

Digital business uses are catching up to operational excellence in usage across industries



Source: Gartner, July 2021

the most-studied area of telecom application. In its December 2020 report, “Telecom 2030,” Appledore Research predicts that in the next decade, digital twin capability will become central to the efficient management of CapEx (capital expenditures) and OpEx (operating expenses) in telecom networks. This proactive network management could deliver innovative telco suppliers in excess of \$10 billion of revenue over the next decade.

VodafoneZiggo plans to expand its fiber-line application of digital twins to aid decision making in other departments, such as to inform capacity expansion or data center operations. MTN South Africa has successfully applied digital twins to

detect subscription fraud and subscriber identity module (SIM)-swap, a type of account takeover fraud that takes advantage of a mobile phone service provider's ability to seamlessly port a phone number to a device containing a different SIM. "The SIM-swap use case has been a showcase of the technology's capability," says MTN South Africa's Chiarelli. "We have successfully reduced the amount of SIM-swap fraud after the introduction of the technology."

Manufacturing use cases for digital twins include manufacturing planning and scheduling. Digital twins also have a role to play in the management of manufacturing processes, where they are increasingly paired with private cellular networks, says Edward Oughton, assistant professor at George Mason University in Fairfax, Va. "Then you can have a digital twin of the manufacturing process, with the cellular network providing near-real-time data transfer. It's a business opportunity for telcos of all sizes."

Digital twins are also applicable in supply chains to model their diversities and vulnerabilities and enable telecom organizations to simulate new configurations and enable continuous improvement.

Perhaps one of the less-expected digital twin use cases in telecom is in finance, for applications such as identifying the cost to serve, establishing the potential margin in customer opportunities, quantifying the risk/reward of potential strategies, or evaluating new business models. A fully realized digital twin of an organization would feature an information model that includes descriptions of the resources and the state of its systems, including financial systems.

Part of the digital twin process is articulating the goals of the organization in terms of that information model.

"So, you might say, 'I never want the profit levels of this organization to drop below [a] certain amount,' or, 'At the end of 10 years, I want to make twice as much money and only be using green fuel,'" says Clark. "This [information model] will enable you to make decisions about the behavior of the organization, insofar as it impacts the finances. What is my digital twin going to tell me that I need to do in terms of simulating this organization in order to achieve a collection of goals articulated in terms of its execution state?" he adds.

Best Practices for the Best Results

Telecom executives are beginning to see digital twins as a way to help them unify and access more timely data from across their organizations to make faster and more informed, nuanced decisions and build capacity for innovation. But these are early days, with organizations just beginning to understand and explore the possibilities of digital twins. Adopting best practices from those companies more well-versed in digital twin adoption and application can be a smart strategy to achieving faster time to benefit and more



Best practices span the implementation of digital twins themselves and the cultural barriers that stand in the way of optimizing their benefits.

optimal results. Best practices span the implementation of digital twins themselves and the cultural barriers that stand in the way of optimizing their benefits.

Unifying and ensuring the quality and accuracy of data is an essential building block to an effective digital twin simulation. VodafoneZiggo, for example, identified some issues with data accuracy as it worked to create benchmarks as part of its digital twin work. Haysom, meanwhile, estimates that many telecom organizations' knowledge of their networks can be low, with 70% accuracy or lower being common.

A related exercise is building a good information model on which the digital twin will be based, one that truly reflects the current state and rules of the organization, says Clark. "A digital twin needs a good information model of what's going on [on] the ground. It needs an understanding of what's going on behaviorally as well, because essentially it's a form of simulation."

Data science talent is essential to help address data quality and integration issues, guide digital twin adoption, educate colleagues on the benefits of analytics and data sharing, and build trust in the output of digital twin simulations. While it can be more challenging for telecom firms to attract data science talent, devoting resources to building a strong digital twin competency can pay dividends even beyond the impacts of digital twins on innovation and decision making by invigorating other workers.

"People on the workforce side are being inspired by how they can use these new techniques in order to improve themselves," says Weijters. "People look differently at a process instead of what they're doing nowadays. And that value is immense." She credits the use of agile methodologies in onboarding with fostering stronger collaboration across the business.

The most successful digital twin teams go beyond data science talent to cross multiple disciplines, such as network planning, marketing, finance, and sales. This cross-functional team not only increases the chance for a digital twin to successfully address business problems but also builds



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greater trust in the outputs among the workforce and senior management. Digital Twin Sim’s Lalwani recommends that this team be devoted exclusively to this endeavor. “You are forced to work with one another while also understanding the challenges the other teams face. You can’t do this while you continue doing your day-to-day job,” he says.

Best practices in adoption include taking a crawl-walk-run approach, starting with specific use cases and clearly articulated goals, and expanding to additional use cases over time. Organizations should start by combining two data streams that aren’t normally brought together in a digital twin to see what that produces, for example, before adding others.

With each new model and use case, “explainability” is key to promoting understanding of what the digital twin is doing and how it arrived at its outputs, says George Mason University’s Oughton. “Often, you’re better off having a more simple model that you can explain very easily to everyone, rather than having a very complex model which is too challenging for all stakeholders to grasp.”

Leadership endorsement and a project champion are familiar, but nevertheless essential, elements of successful adoption. Due to the wide range of definitions and claims about the term digital twin, gaining senior management support may first require educating executives both on what digital twin means in the context of telecom applications and ensuring they understand use cases, how digital twins reach their outputs, and how to use the outputs to influence decisions.

“Where organizations tend to be a little bit more enlightened, they might be using consultants to advise them on the deployment of digital twins to achieve business goals,” says Clark. “That knowledge needs to be transferred into the senior management team with the organization.”

Another key constituency in digital twin success is a telecom’s IT vendors, such as systems integrators, software developers, and hardware and cloud providers, says TM Forum’s Newman. “Telcos traditionally have really been more buyers of technology than developers of technology. So, if their supplier ecosystem doesn’t have the belief in digital twins, then the telco is unlikely to have that.”

And then, of course, there is the culture of the telecom organization itself. Building trust in digital twin outputs

through organization-wide education, cross-functional participation, and sustained leadership support is essential to drive the data sharing and collaboration required to make a digital twin initiative successful. Aligning incentives to shared, enterprise-wide goals is an important step in that process, as are building trust in the outputs and making it safe for users to experiment and test new ideas. At the same time, it’s important not to overhype what digital twins can do, billing them as the next silver bullet that inevitably can’t deliver on inflated expectations, warns Oughton—something that has already occurred with some artificial intelligence applications and countless other technologies.

Telecom culture also needs to be shifted to adapt to new ways of innovating and decision making that effective use of digital twins can enable, says Newman. “Essentially, [making this cultural shift] means being able to move more quickly so that when you experiment and try things out, that you can move on from that fairly quickly in either a deployment perspective or [a] ‘let’s just forget that and move on’ perspective,” he explains.

Enabling a Data-Driven Future

The telecom industry faces strong headwinds in their efforts to embrace expansive new opportunities in 5G, IoT, cloud, and other technologies with organizations that still retain the data and organizational silos, resistance to homegrown innovation and change, and slow decision making that have brought them to this point.

With their ability to foster cross-enterprise collaboration, greater innovation, and faster decisions, digital twins offer the potential to help them overcome these barriers—if senior leadership is willing to make a sustained investment in staffing, acquiring, evangelizing, and suffusing their new way of driving decisions into the organization.

“I think there is a huge opportunity for telcos to change and adopt this technology,” says Haysom. “At the end of the day, digital twin is about being able to automate things and to make things repeatable at scale, in simplistic terms. And those are two things that telco needs.”

Endnotes

- 1 Digital Twin Consortium, "The Definition of a Digital Twin," December 3, 2020. <https://www.digitaltwinconsortium.org/hot-topics/the-definition-of-a-digital-twin.htm>.
- 2 Yong-Woon Kim, "Digital Twin maturity model," Electronics and Telecommunications Research Institute, Korea, November 2020. https://www.researchgate.net/publication/346470132_Digital_Twin_maturity_model.
- 3 BT, "BT and Microsoft announce strategic partnership," July 29, 2021. <https://newsroom.bt.com/bt-and-microsoft-announce-strategic-partnership/>.
- 4 Vodafone, "Vodafone and Google Cloud to develop industry-first global data platform," May 3, 2021. <https://www.vodafone.com/news/press-release/vodafone-google-cloud-industry-first-global-data-platform>.



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