VISASQ / COLEMAN

Digital Twins – Manufacturing

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About Our Expert:

- President & CEO - Digital Cities LLC
- Director and General Manager, Global Product Management at Pitney Bowes (March 2022 – August 2023)
- Senior Product and Innovation Leadership (Chief Innovation Office) at The Boeing Company (January 2015 – February 2022)

Dr. Ahmed Abukhater is a globally recognized thought leader, strategic consultant, and innovator with over 27 years of experience in digital twins, manufacturing optimization, intelligent cities, and geospatial solutions. His extensive career spans roles in city planning and manufacturing, with a recent position as Senior Product Innovation Leader (CIO) at Boeing, where he spearheaded the mapping of factory operations using digital twin technology to optimize their just-in-time supply chain process. Currently, Dr. Abukhater is President and CEO of Digital Cities, his own consulting firm focused on solving complex urban problems facing communities today.

Moderator:
Max Le Sieur

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- Founder & Managing Partner at Rosemont Legacy
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- Investment Banking Associate at BMO Capital Markets (07/2016 – 08/2020)

Expert Insights On:

- Overview and applications of digital twins
- Primary use cases in manufacturing
- Characteristics of a company that could benefit from digital twins
- The value of digital twins vs costs of implementation
- Key industry players and competitive dynamics
- Investment opportunities and related technology
- Where the space is heading and the relationship of data, digital twins, and AI
- Current state of adoption
- Risks associated with Digital Twins
- The next industry to benefit

Introduction

Max: Hi, Ahmed. So as alluded to, my name is Max and I'll be leading this call on behalf of VisasQ Coleman today. As you know, the purpose of the discussion is to learn about the use of digital twins in the manufacturing and industrial markets.

Before we begin, I would like to remind you that we are in no way soliciting any material non-public information or confidential information related to any company or organization you are currently or have ever been affiliated with.

If you believe any answer to a question involves confidential information, please tell me right away and I will take us in a different direction. Any questions before we begin?

Ahmed: Nope. Sounds good.

Max: Awesome. And so, I would like to start with overview and applications of digital twins. And so maybe we can start from the top, which is to say, what is a digital twin?

Ahmed: Yep. It is recreating a digital replica and a blueprint for the real world, with continuous data exchange between the digital twin and its physical representation. It is simply a digital copy of the physical assets, that looks and behaves identical to the real world. And it could be an object or a number of objects, assets, or even processes and systems within their environment as they operate.

There are of course smart and content-rich models that also incorporate data and store attributes about each of these objects, that allow us to also conduct analysis and drive insights from that data. So it's not just pretty pictures and 3D visualizations, but it is also a database attached to each individual object that makes the model smart and intelligent. And so the high level, a smart digital twin is an integrated system of three components.

The first one is the data layer, which includes data collection, management and storage. The second one is the model layer, which is the visual representation and how the model also behaves. And the third layer is the service layer or the interaction layer, which is the user interface, and it really allows user to interact with the digital twin. And this is where design meets analysis, and where modeling meets data and insight.

Overview & Applications

Max: Got it. That's super helpful. Ahmed, that all sounds really good, but can you explain what the primary applications are for digital twins today? What does all this sophisticated data application model enable?

Ahmed: Yeah. So digital twins technology is useful and it's very important, really is helpful in representing the real world and providing a mechanism for us to interact with it, analyze it, and conduct with F-scenarios. But also, it helps us better understand the world in a simple way, so people can visualize complex phenomena that are otherwise hard to imagine or grasp. Like groundwater modeling. It's invisible and it's hard to visualize without the utilization of these tools. So good example, we used to really ask people, "Imagine if you will..." So we used to call it imagineering. We don't have to do this anymore. We can just create a real world digital model that resembles reality and represent reality, and people can view them and interact with them on the fly. And so you then have the ability to create a virtual reality, which is a completely immersive virtual world, augmented reality, which is a real world experience boosted by virtual features, or mixed reality where we can juxtapose the different components of the digital twin model with parts of the real world.

So these can basically allow us to interact with the environment in a more immersive way, and enables us to form better understanding. Not to mention, in many cases, it is a huge cost saving because you don't have to take the physical assets out of operation, like taking an airplane for example, to conduct some training or... So we don't have to stop the operation that way. So it provides great tools to enhance the efficiency of the workplace and cut costs. So primary applications, it's used pretty much in every industry and it has unlimited applications.

The AEC industry, particularly, that's the architectural, engineering and construction industry, is a key application of digital twins. It's widely used throughout the typical product lifecycle, or the project lifecycle. So we plan, we design, we build and we manage the project, or any physical assets. And the digital twin helps us in imagining the design of the project before it's built, with design reviews and evaluation of various iterative design options. And also communicating these immersive design models to various stakeholders. Designers, architects, the engineers, the construction contractors, maintenance and operation crew. So it also facilitates its construction and even operation, after it is built.

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Max: What about the manufacturing industry? What are the primary use cases there?

Ahmed: So creating a digital twin of your manufacturing operation from warehouses, all the way to factory floors and production zones, is very helpful and useful, right? You'll have the different components. You have the industrial IoT sensors to gather data about the physical objects. You've got the virtual reality, augmented reality and mixed reality we talked about, to visualize the physical objects in 3D environments. And also, you've got the cloud, to store data that we gathered from those IoT sensors. And you can use AI and machine learning to analyze object data and generate insights, detect patterns, and make decisions and predictions. So there are a number of useful use cases and applications here, in the just-in-time supply chain. So we can utilize location-based services where products are delivered where they are needed on time, in full, delivered. You can optimize operational efficiency, increasing throughputs, identifying choke points and bottlenecks in the production line, to be able to decrease time to market and enhance efficiency, improving product quality while reducing operational costs, and facilitating goods and machine movements.

Basically improving safety by eliminating incidents in the factory, and with the interactions between humans and machines. Also automating the factory floor and creating smart factories with sensor fusion. You have all kind of sensor, call it sensor fusion technology, and indoor orchestration processes. Also tool utilization and detection, knowing where the tools are on the floor, and determining tool utilization gaps and needs in certain zones. Digital twins enable manufacturing companies to proactively monitor equipment conditions, also identifying potential failures and reducing downtime, enabling predictive maintenance as well. It is useful in delivering better workforce training, that we are able to simulate real-world scenarios, and allowing workers to gain experience and knowledge and learn how to operate equipment, troubleshoot them and improve their operational efficiency. And finally, we are always interested in sustainability, and this is another benefit, right? Digital twins can identify areas where waste can be reduced, leading to more sustainable manufacturing operation.

Max: Okay. And how do you distinguish between use cases in the manufacturing and use cases in the industrial sectors, if at all?

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Ahmed: Yeah. So the use cases are pretty similar, but the application is different. So it is all about saving money or making money, while enhancing operational efficiency, product quality and sustainability, with a better understanding of the operation. We can cut cost, waste and time, basically. It also enables learning and workforce training, as well as creating a common operating picture of the whole process. It's the ability to create and interact with the product, without having to pay for the cost of the actual physical asset or take it out of service. So if we're talking about pilot training for example, we can create a digital twin of the plane instead of having the plane out of service, which could be very costly.

If we are talking about the architectural and design and construction industry, we can create the digital twin that mimics the visual characteristics of the as designed or as built, and we can interact with it and do design iteration, collaboration on the fly. So in a nutshell, it is all about enhancing the efficiency of the workplace, enabling us to do more with less, and accomplish our job better, faster, cheaper and safer, with high level of quality and reliability. This all boils down to providing real time operations monitoring and increased insights into the operation, and employee performance, improved insights through scenario simulation and tangible cost saving.

Max: Got it. And can you explain a little bit how it's applied and what are the characteristics of a company that could benefit? Does it involve putting sens... You have a large factory floor for example, and you have to deploy a bunch of sensors? Or can it all be done digitally and it's actually suitable for a wider variety of company and operations types?

Ahmed: Excellent question. I think we can do both. Both is done, and both can be done. You can have sensors with internet things, and those sensors will transmit data to an application. And that application, you can build the digital twin model and interact with it, and that data can be represented with the digital twin. We can also create data from the field without sensors, or you can have ready to use content that you can construct your own digital twin model. That's the second part of the question. The first part you were asking about the characteristics of a company that could benefit, right?

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Max: Right.

Ahmed: In my mind, any company can benefit from using digital twins. There are typically six building blocks of the organizational digital backbone, which is all powered by data and insights. And all of these components can benefit from digital twin technology. We have strategy and innovation, focusing on customer value, customer decision journey and deep analysis, understanding of the customer pain points and value augmentation. We have operational efficiency, agile operations. We have also automation and processes and enterprise level digital technology. And finally data and analytics, to generate usable customer data for better decision making. So digital twins is just part of the technology building block and it does interact with data, as you mentioned, but it has to be supported and integrated into all these aspects of the organizations, or an organization needs to create and implement their own digital twin strategy that works for them and ensures alignment of successful implementation. This is really a foundational breakthrough, technological advancement, that every company needs to be able to thrive, not just survive. It is a comprehensive set of tools, and it is a competitive advantage and a differentiating capability, to enhance product quality and operational excellence.

Max: Okay. So what is the ROI, or what is the argument that typically wins over a typical business owner or manager with regards to implementing digital twins? Right? Beyond just saying, "Analytics, insight, better decision making," what is the tangible return on investment and way to demonstrate value? Where it's like, you're going to have to spend X thousands of dollars or X hours of time to implement this technology, and you're going to see Y dollar benefits in a specific amount of time. Can you walk us through what those conversations look like and where you've seen those play out?

Overview & Applications

Ahmed:

Yeah, absolutely. There will always be an initial investment in digital twin infrastructure associated with the upfront cost of implementing the system and also maintaining it. Compare this with the cost of working with a provider, for example. This is another option. So you will need to really determine the best development strategy. You'll either build, buy, partner kind of decision, right? The ROI of implementing digital twin technology is clear. It's better operation and understanding of your operation, and understanding of the bottlenecks and challenges, and also the opportunities for improvements. The data-driven insights digital twin provide, it can lead us to optimization, streamlining of the operation. This will save time and resources by eliminating these bottlenecks and reducing time to market, while being able to generate better products in terms of quality and reliability. A lot of organizations achieved significant ROI, such as reduction in time to market, by increasing decision speed, improvement in product quality and reduction in maintenance downtime, and increase in cost savings.

Also improved resource allocation, and hence supply chain agility and resilience, and increased customer insight and satisfaction and royalty. And so, safety is also a big component, increasing safety, and ribbon of growth, retention of workforce and workforce knowledge, as we discussed earlier. Now for any organization to realize the full ROI of implementing digital twin technology, we need to take a comprehensive approach to integrating and resolving organizational problems. One thing we know that this is not about technology alone, it's about a number of things within the organizations. We might have a discussion about a specific aspect, like hardware incompatibility or fragmented software, but really the real conversations that need to happen is, "Okay, can we look at the whole organization in a comprehensive way to look at the software?" Usually, it's fragmented software and compatible hardware, restricted and stranded data. We've got variant methods and segregated operations. And as a result, disconnected people. And these are symptoms.

And so, the result is really slow time to market, fragmentation of portfolios and data and knowledge and workflows, and you've got data silos. And also, difficulty to collaborate. And ultimately, duplication of effort and organizational inefficiency. This is the starting point, really the challenges, where the organization can see these kind of challenges. But the root causes are what I mentioned, like the hardware and the software, the data, the methods. So our focus should be, in this conversation, is to devise a comprehensive strategy that helps us integrate digital twins technology to systematically solve these organizational challenges. So we can have integrated software, compatible hardware, liberated data, consistent methods, streamlined operation and connected people. This way, we can connect the dots. And this is where digital twin technology can have the biggest impact as far as ROI is concerned. So you connected people, places and activities.

Overview & Applications

Max: You mentioned a build, buy, partner decision. Can you walk us through how that's typically evaluated in the context of moving forward with a digital twin system?

Ahmed: Yeah. So once an organization identifies that there is a need for a digital twin implementation, then the organization needs to think about how to implement it. You need to think about their development strategy, and what is the best way to do it and the fastest way to do it. And they need to understand really what their needs are, and is it a new solution that they're standing up from scratch, or do they have gaps. Do they have to fill in gaps in technology? And they need to figure out really why they're implementing it. Is it creating competitive differentiation or offering a new solution, or augmenting existing solutions? Once these were figured out, then they will need to think about their risk level. Is it low? Is it high? And speed of expansion, that we need to expand. How fast, how slow, do we need to expand into new markets? They need to think about resource availability, how available the resources internally, or do they need to get external help in terms of skill set of their workforce? How similar is the technology?

Is it the same technology they have, or is it new and foreign concepts that they may not be able to do it themselves? And so based on this evaluation, they need to figure out, if we build it internally, we have more product control, we own the IP, there's a profit opportunity. If we buy it, there's short time to market, and then we still own the IP. If we partner, it's really the shortest time to market, because we can sometimes white label some of this technology and bring it in, and make it ours. So we can save resources, building relationship, tailoring, partner leveraging, [inaudible 00:27:11] partner technology, and leveraging their channels and brand equity. So we can also... Access to their customer base. Right? Sorry, go ahead.

Max: What path is most popular?

Ahmed: For this, it depends on the industry and it depends also on the expertise and size of the organization.

Key Industry Players

Max: In manufacturing and industrials, what path is most popular?

Ahmed: It's a combination of both of these. So in many cases, the digital twin ecosystem within the manufacturing industry is so nuanced. So you get the hardware components, you've got the software and data components, you've got the visualization and the operational dashboarding components. It's oftentimes, I've seen it nine out of ten, it's a combination of both. So sometimes they build the data infrastructure internally, they build the software components internally, but then they purchase hardware components, like sensors. They buy the sensors, or they partner with a company that manages the implementation as a whole within the digital twin ecosystem, or they also purchase certain analytical and dashboarding tools. So it's a combination of both usually, it's not just one thing fits it all, especially considering how difficult and complex digital twin implementation is. So it's not just standing up a model, it's really an enterprise deployment of digital twin components.

Max: Who are the key industry players in the digital twins space?

Ahmed: So there are a few companies in the digital twin space, and depending on the industry really, you'll see different players. But generally speaking, we have Autodesk, PTC, Microsoft, Cisco, Dassault Systems, General Electric, IBM, Oracle, Siemens, and sometimes you'll see other smaller geospatial providers in the space. Right? Now I cannot endorse specific companies. I would say all of them provide great solutions. It's really up to your organization, given your specific industry. So it's really up to you guys to figure out what solutions work best for them and look at the various OKRs that they have in considerations for selecting the solution, like integration, or with backend systems, usability, fit for purpose, training, cost structure, configurability, model visualization, analytical fidelity, ROI, etc.

Key Industry Players

Max: Yeah. I'm curious to understand the competitive dynamics in the space. And where I want to go later is where you think there are investable opportunities for investors that look at the industry. But before we go there, you mentioned names I recognize, names I didn't recognize. How entrenched are some of these companies? How sticky are some of these solutions? How much of a head start do they have? Are the big companies, like Siemens and Microsoft and IBM, just going to run away with this, fairly obvious, it's really hard to compete, we just can't tell who the winner is going to be from that subset? Or are there a lot of challenger companies, it's really easy to displace people, usually there's multiple vendors within the same system? I would like to understand those competitive dynamics.

Ahmed: So there isn't a specific dominant company across the board. It's interesting because digital twins is a unique space. So depending on the industry, you've got certain dominant players. So there's not one that is, I would say dominating and creating a monopoly across the board. But there are a number of competitive differentiators, like ease of use and ability to integrate with other back end systems, and the ability to provide intelligent digital models and digital twins. And so, especially in the manufacturing analytics, that's where the design meets manufacturing and analytics. Also collaboration and integration of the model, and the ability to save it, share it, and provide ubiquitous access. Remember, these models are very large in size, and a big challenge that I saw in collaboration across geographies is how large the model is. It's hard to either save it or share it, and provide that kind of interaction and collaboration across the different teams.

Max: So Ahmed, can I pause you there? You mentioned a few things that were interesting, easy to use, integration with other backend systems, size of model. Are there players that are ahead on some of these metrics? Is Microsoft better than Siemens? Is Cisco better than everybody else? Just, what are some of the takeaways of the category leaders?

Key Industry Players

Ahmed: Yeah. I don't think one is better than others. It really depends on the deployment. So deployment mechanisms, like on-prem would definitely work because you're having on-premise, you have more control on it, you can save it locally. But for cloud and hybrid, that's where you will see these kind of challenges. But for the most part, we know that the bandwidth is pretty big now. So depending on your bandwidth and the size of your model, you can actually optimize it to make it shareable, and you can share it with other people and edit it, and do iteration and collaboration, simulation, measurements even. So I don't think the differentiation is in the shareability as much as it's with other tangible differences, like measurements, providing measurements, direct measurements on the models, doing updates and maintenance, and managing late design changes, like how iterative the model is. Does it allow multi-tenancy in a cloud environment, where people can chime in and interact with the model, and incorporate their impact on the fly?

It's also the ability to provide best of suite enterprise solutions, not just a point solution. So this is where we're talking about stickiness and creating high switching costs. So it's not just offering a point solution. That is the ability to offer suite of solutions that enable end-to-end operation and efficiency across different teams. And so, the ability to really support all the product lifecycle from the planning, designing, building, and managing. And so, some of these players are more specialized, smaller players. They're more specialized in specific phases of product lifecycle. A lot of the big names that I mentioned, they cut across all of them. So they have technologies that's comparable. And it depends on, like I said, you've got to look at, as an organization, your size of organization, size of your implementation.

Max: Sorry, what's the competitive moat for a digital twins company?

Ahmed: Yes. Yeah, I think it is really... We talked a little bit about incorporating smart models. Some of these companies that offer digital twin technologies, they have 3D visualizations and all kind of mixed realities and augmented realities. But what they lack is incorporating georeferenced and geo-triangulated models, that have location and spatial components in it. This is a big competitive differentiators. So we can produce spatially aware digital twins that can leverage the power of geospatial analytics and integrate into a larger geospatial infrastructure. This is where-

Key Industry Players

Max: But, Ahmed, can I just challenge this just for one second? Is that the type of thing that's a differentiator today for folks that have it, but can everybody else just catch up? Is that a sustainable kind of competitive moat the way... Yeah. Is that a sustainable competitive mode?

Ahmed: Yeah, it is, and it is a niche market and a niche industry. Not everyone can bring these kind of capabilities because it takes a lot more than just pretty 3D renderings. It's really the ability to turn it into insights and show them in relation to a specific location, where the model exists and operates. And so, the ability to contextualize the model within its spatial environment, and has its spatial accuracy and situational awareness, it allows us to study the relationship with its surrounding environment, and the impacts of the environment on the model, and vice versa.

And so, these digital blueprints and all of their components become connected to each other. And we will be able to look at it and be able to understand patterns and relationships that otherwise wouldn't be able to do with just pretty 3D models. So these technologies are not easy to implement, but they're possible. But they have a long runway. In other words, you've got to partner with other geospatial companies, either do that or acquire your own geospatial expertise, to build the geospatial infrastructure and presence in that market. Because that market is a niche market. So if you're able to crack this nut, you'll be able to open up a whole new market and a whole new customer base in the geospatial industry.

Max: Got it. That's super helpful. Okay, last question on industry players. I've noticed there's a suspicious omission of any of the big tech companies in the players you named. My beginner view of this would've assumed that big tech companies would've been around these kinds of systems and these kinds of technologies. Can you explain why or why not their involvement?

Ahmed: Yeah. Big companies are implementing digital twin technology. And if some of them are not, I think they're either ready to implement it or are implementing it internally. So they certainly have the need for it and can benefit greatly from adopting a digital twin technology. The important things is to develop their own strategy that works for them, and a roadmap for implementation. It needs to include certain elements.

Investment Opportunities & Risk

Max: Sorry, sorry, Ahmed. I mean, would Amazon and Google, or Facebook, not be vendors of digital twin systems and technology? I guess you mentioned Microsoft, but that's kind of the only big tech company you mentioned.

Ahmed: Yeah. So Google, Amazon, they can provide certain components, like the mapping components of it, but not kind of the end-to-end provider for digital twin technology. I know even Google, at some point, they had Google SketchUp. So Google SketchUp provides early design concepts, 3D visualization. And it is considered digital twin, but it's not very sophisticated, and it's not meant to be sophisticated. It is for an early design concept, to understand the building design and showing in 3D, and conceptualize the design. And that even was not retained. It was acquired by Trimble. And so, yet another geospatial leader. And so these big companies, I don't know if it's ability or inability, or not willing. Because I guess they can't just shoot at everything that moves. But they can help in its implementation for sure. They provide critical components in the geospatial infrastructure.

Max: Got it. Thank you. That's insightful, that they provide components but not the full packages. Moving on to the third topic I wanted to talk about today, is investment opportunities and risks. These sound like complicated systems. It kind of depends on the industry, the deployment. What are the investable opportunities if capital allocators were looking at this space? Is it in IoT? Is it in kind of 5G slicing? Or is it more in the application layer kind of closer to the way it's used? I'm curious for your views on investable areas within digital twins.

Ahmed: Yeah, I think IoT and cloud computing, and AI and machine learning, are all tangible areas to digital twins. And their enablers. So investment there is certainly possible, and it's an area of investment. So they can support digital twin deployment and applications. For example, cloud offers storage for these models. Some of them are larger, as I mentioned, and they provide easy access from anywhere. And they can increase its value and dissemination, to a larger audience. And this is really the whole idea behind digital twins, is to provide a ubiquitous access for all kind of stakeholders to collaborate. So depending on the computing power and capacity of the cloud, we can deploy and share a digital twin on the cloud, and be able to interact with it in a multi-tenant environment. IoT also, or industrial IoT, can support digital twin with sensors and constant data transmission from the field into the office. A digital twin can also be built out of input from IoT sensors on real equipment, which means it replicates a real-world system and changes within that system over time.

Investment Opportunities & Risk

Ahmed:

And the data is very critical to the success of the digital model. And a great example emerges from smart factories where we can digitalize all aspects of the factory operation, to be able to enhance safety and optimize production. With sensor fusion, we have all kind of sensors and utilization of various types of sensors, we are able to figure out where each part is located in the larger supply chain. Is it outside on the truck? Is it at the warehouse? And we can facilitate the movement of these parts, so we can locate them where they need to be and when they need to be, at the right zone and at the right time, so the whole production operation doesn't slow down. So yes, this is a big investment opportunity.

But also you talked about 5G. And 5G is also an area where it's worth investment, in edge computing. So we have data, applications and users. Those are the three things that we need to keep in mind, those three tiers. And we have the application to connectivity, user to application connectivity, and the application to data connectivity with 5G high bandwidth, to collect and store and manage data. So these system help in creating accurate and responsible virtual models. And the physical devices have sensors also, in key locations, that could send data in real time, utilizing multi-axis edge computing, that utilizes 5G network.

And this way, you can get constant updates to the digital twin. So it's real time life kind of data feed, if you will. So there's low latencies and all this good stuff. This is what 5G can enable. And so, the great bandwidth that we have today with 5G technology provides us with the ability to perform complex operation and deploy heavy models on the cloud that are otherwise hard to store and share. So yes, investment in, I would say 5G, cloud computing, edge computing where the data is generated, IoT and AI, are all worthwhile investments in digital twins.

Max:

Got it. Thank you. So is data a competitive moat here? Or not so much? Because data can be, it's specific to each deployment and it can be replicated so quickly if there's digital versions of everything. I think the conventional wisdom is that data creates a moat and creates a competitive advantage because it's proprietary. But based on everything you've said, it sounds like that may not apply for digital twins the same way.

Investment Opportunities & Risk

Ahmed: Yeah, that's an excellent way of looking at it. Data definitely plays a big part because it fuels the digital twin. If you wanted to get insights and make decisions, we need data. And so it's all about having the right data, the most authoritative data, reliable data, that you can use and deploy, and show on the model, and being able to generate insight and make decisions. And we have a lot of data being generated with smartphones and sensors. The question is, which dataset do I use? Where it's stored, how it's managed, and how often it's up-to-date. So how complete the data is, how accurate it is, and how fresh it is. Those are the three things that we need to consider when it comes to data. Right?

Max: Got it. Well, just to follow up to that, I'm curious, does this space end up converging towards just an AI-ML layer, on top of data captured by sensors, whereby the application layer of digital twin just gets replaced by some LLM or version of an LLM type model? Where, because the capturing of data can be done by each individual company, you just then put a model on top of it and you're able to extract all the insights pretty in a straightforward way. Is that the right way to think about it? Is that where you think this is headed or is that a mischaracterization?

Ahmed: Yeah. No, this is a little bit of... I mean, it's not a mischaracterization. This is definitely where this is heading, but it's missing a layer, which is the digital twin layer sandwiched in between the data and AI and machine learning.

Max: Got it.

Ahmed: So you can apply machine learning and AI, and it is where it's heading. And we've seen applications of that. We've done these applications. But the elements that's missing is the 3D visualization, the actual digital twin model, where the whole point behind it is to provide collaboration and interact with a model, and create that immersive experience. Yeah, but AI still, I would say even if you look at, for example, the hype cycle, it's still in the peak of inflated expectations. That means there's a lot of hype behind it, but little meaningful implementation, especially in this space. But the potential is there. We definitely see the potential. I've seen very successful implementation examples where AI and machine learning there has been applied on top of the, of course you have the data infrastructure. Then you've got the digital twins on top of it, and AI and machine learning on top of it, to generate data and insight so quickly, and do predictive analytics.

Investment Opportunities & Risk

Max: Got it. Got it. That's helpful. Okay. I want to ask about adoption. Is everybody already using a version of digital twins? Is it only the biggest companies? Is it only the companies that have certain characteristics within manufacturing and industrials? And why those companies versus all companies? Your view on adoption and where we're at with this being applied in the field.

Ahmed: Yeah, so that's an excellent question, and it really speaks to the nuances of each industry. Because the application of digital twins is anomalous and unique to each industry. I would say the most commonly used digital twins are in the manufacturing and AEC industry. So the architectural engineering and construction industry. In fact, I think this whole thing generated in the architectural, engineering and construction industry, because they started with the actual modeling of the buildings and the physical assets, to be able to better manage it. Even the early designs concepts, to the actual designs, and then going into construction and management, kind of necessitated that we need to create this digital twin infrastructure to be able to understand and collaborate. Because we have different stakeholders and sometimes they don't talk to each other. And they need to talk to each other. And we had data issues because data does not flow from one system to another.

So you've got the architects using different systems than the contractors and the civil engineers, and the community development and local government, for permitting and all this good stuff. So they needed to collaborate on one single model that represents reality, and it's a single point of truth. So that's kind of where it's all generated. That's where the most implementation we see today. And then we've got the manufacturing industry of course, because of the complexity of their operation, that involves all kind of sensors that we talked about, the hardware components, the data components, and then the analytical and visualization components. So those are the two industries that I think we've seen very successful implementation of digital twins happen.

Max: But like in AEC, for example, we're at a hundred percent of companies using some version of digital twins? And in manufacturing, we're at 5% or 10%? Or what's your estimate there for how adopted it is within those sub industries?

Investment Opportunities & Risk

Ahmed: In the AEC industry, I would say pretty much everyone use a form of digital twin. Some of them use not a very sophisticated one. Some of them use sophisticated ones. But the matter of degree, right? But I would say every implementation of any project, they use a form of digital twin in the AEC industry. So probably a hundred percent I would say. For the manufacturing, it depends on the size of the organization. Large and medium-sized manufacturing, I would say 80% to 90% implementation. I've seen forms of it. Again, it depends on the sophistication of the model, and how extendable and how scalable it is within the organization, the level of penetration of that model. Is it one team only using it? That's the difference between that and the full implementation. One team, or is it across the enterprise? So it's a matter of degree really. But I would say AEC is the top industry where it's implemented everywhere. And then manufacturing probably, I would say 80 to 90... 80%, I would say.

Max: Got it. That's helpful. What are the biggest risks? So there's a data privacy component comes to mind based on everything you've described, but are there others? What would you say are the biggest impediments... Well, impediments to adoption, and then risks once adopted?

Ahmed: Yeah. Impediment to adoption is really understanding the full ROI. That's number one, right? Tying it to a challenge. Because really, this is not about technology. This is about people. It's about the efficiency of the workplace. That's the bottom line. And we have to keep this front and center in our conversations. It's not about the technology or AI, or how cool it is, it's about making our life easier and work more efficient. And so realizing the ROI and articulating ROI for a digital twin is sometimes challenging, because people look at it as just pretty models and it's a cool technology to use, but why should I use it? So at the level of executives people, or the buyers' personas, we need to understand what makes them tick and tie it to their organizational business objectives. That's number one impediment. So barrier to adoption is understanding ROI.

The other one is skillset internally. Usually, when people look at these things, they look at it from an internal lens. So they say, "Oh, we don't have the skillset, and it sounds complex or complicated to implement." So that's the other thing. So in my mind, they have to identify first, the challenge and the need for it, and then look at the buy, build, partner kind of discussion we looked at. What is the best development strategy for this organization in this methodical way? The risks, as you said, privacy, data privacy and regulatory issues. So data privacy and sovereignty can be a challenge, especially when we're talking about globally distributed teams that we talked about. We need to collaborate and share models across different geographies with different data compliance regulations. And so, data compliance standards can vary by industry even, or by region and by country, especially when it comes to handling and managing personal and sensitive data that are embedded within these kind of models.

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Ahmed: So it has to adhere to regulatory requirements and industry standards, and internal policies involving data security and privacy, for each organization. And we know some regions are more strict, in the sense they have more strict cybersecurity compliant expectations than others. So sharing, managing, storing data, as part of the digital twin models, can present a challenge, and it needs to be discussed and addressed early on in the project lifecycle. So whether it is on private clouds or public cloud, at the edge, or at the data center, or at the edge where staggering amounts of data is being generated, we need to protect the data and make sure that it is secure. Right? So we've got to balance the personal and private AI, public AI, and the enterprise AI, and ensure that we have a solid data privacy and governance strategy that ensures data is managed and used in a secure way. So sovereignty and privacy is maintained and protected.

Max: Got it. That's helpful. Ahmed, last question here, just as an industry expert, what is your view on the next sub industries that are the most likely to see successful adoption of digital twins, other than manufacturing and AEC?

Ahmed: Yeah, I think manufacturing will continue to expand the implementation of digital twins, and it would implement it in a more meaningful way. So instead of a point solution only in the factory, I think a lot of manufacturing organizations realize the full value of implementing complete ecosystem. That involves, like we said, the geospatial components of digital twins that expands outside. Not just the indoor orchestration, but also outside, in navigation and routing, and coding and geocoding and reverse geocoding. So these things are important, and they can connect the outside world with the indoors, and all facilities and physical assets that goes into successful manufacturing operations. So having that end-to-end, just in time supply chain, and supporting the whole supply chain lifecycle, is where I think that's the next frontier.

In terms of the industries, the next industry I think that would benefit the most is healthcare industry. We've seen digital twins implemented in limited places in healthcare industry to understand diagnostics and visualize patients' different kind of parts, and different kind of operations within the healthcare. And so I think that's another frontier that it will go into, along with AI. Because AI is critical, and it's already being used in healthcare for understanding and diagnosing diseases, and looking at the location of history and the family history, and kind of triangulating different datasets, and making decisions on what's next.

Max: Got it. That's super helpful. Well, Ahmed, thank you so much for your time today. I think this is a great place to wrap the conversation. This was extremely insightful and is exactly the kind of conversation we were looking to have on this topic. So thank you so much for sharing your time with us. We really appreciate it.

Ahmed: Yep. Thank you for your time as well. Thank you.

Max: All right. Thanks, Ahmed. Enjoy the rest of your day. Enjoy your weekend.

Ahmed: You too. Thanks. Bye-bye.