Next-Gen Industrial AI
Urban Infrastructure Sector

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Next-Gen AI in Urban Infrastructure: Bringing Data to Life

It is the age of the Internet of Things (IoT) and urban infrastructure is more connected than ever. New technologies are driving innovation in design, development, and management: cloud computing, edge computing, 5G, sensors, and connected devices are all important components of the city of the future.

However, you could argue that artificial intelligence (AI) is the most transformative ingredient in the mix. AI is the element that makes digital smart, makes automation intelligent, and can turn incremental modernization into ground-breaking innovation.

To see why, consider what the IoT trend is doing to cities around the world: "An environment in which individually addressable devices communicate, via the internet, using a set of commonly understood communications standards and protocols; sharing data, responding to commands and even acting autonomously."

Together, those devices are generating staggering volumes of data. And it is AI that can help planners, construction firms, and policymakers to make sense of that data, get value from it, and build devices that can act autonomously.

So how are leaders in the infrastructure industry thinking about AI? What progress have they made? And what new challenges are emerging?

To answer these questions, we conducted a survey of 515 senior leaders, including 118 from organizations involved in the design, development and management of urban infrastructure (which we are calling the 'infrastructure industry'). Each respondent is responsible for, involved in, or knowledgeable about their organization's existing or planned use of AI. Here, we discuss what we learned from those 118 infrastructure industry respondents; the findings for all industries are in our Next-Gen Industrial AI report.

The infrastructure industry embraces AI

Our infrastructure respondents say that their organizations have only yielded modest benefits from AI to date, but they are significantly ahead of the other industries we surveyed.

The top three areas they say are currently offering their organizations major or moderate benefits are the automation and/or improvement of quality control (cited by 46%), the automatic optimization of systems (45%), and the automation of responses to emergencies, accidents or market shocks (45%). This compares with 21%, 22%, and 18% respectively for energy industry respondents, and 30%, 30%, and 20% for manufacturing and heavy industry respondents. That is a big difference.

However, all the industries we surveyed have quite similar levels of enthusiasm for AI in general: 59% of all respondents say their organizations are eager to use as much AI as possible. That proportion is only a little higher (62%) for infrastructure respondents. So the reason for the differences we've seen in benefits achieved could be down to the relatively lower intensity of barriers to AI development reported by infrastructure respondents.

The barriers to implementing AI at greater scale appear to be high across the board, but respondents to our survey expect many of these obstacles to drop sharply in significance over the next three years.

For infrastructure respondents, the barrier expected to fall away the sharpest is data integration and quality issues. Just 22% expect this to be a moderate or major barrier in three years' time, down from 63% currently. In fact, respondents have it falling from the fourth-ranked barrier today to the bottom-ranked barrier (of 11) by 2022.

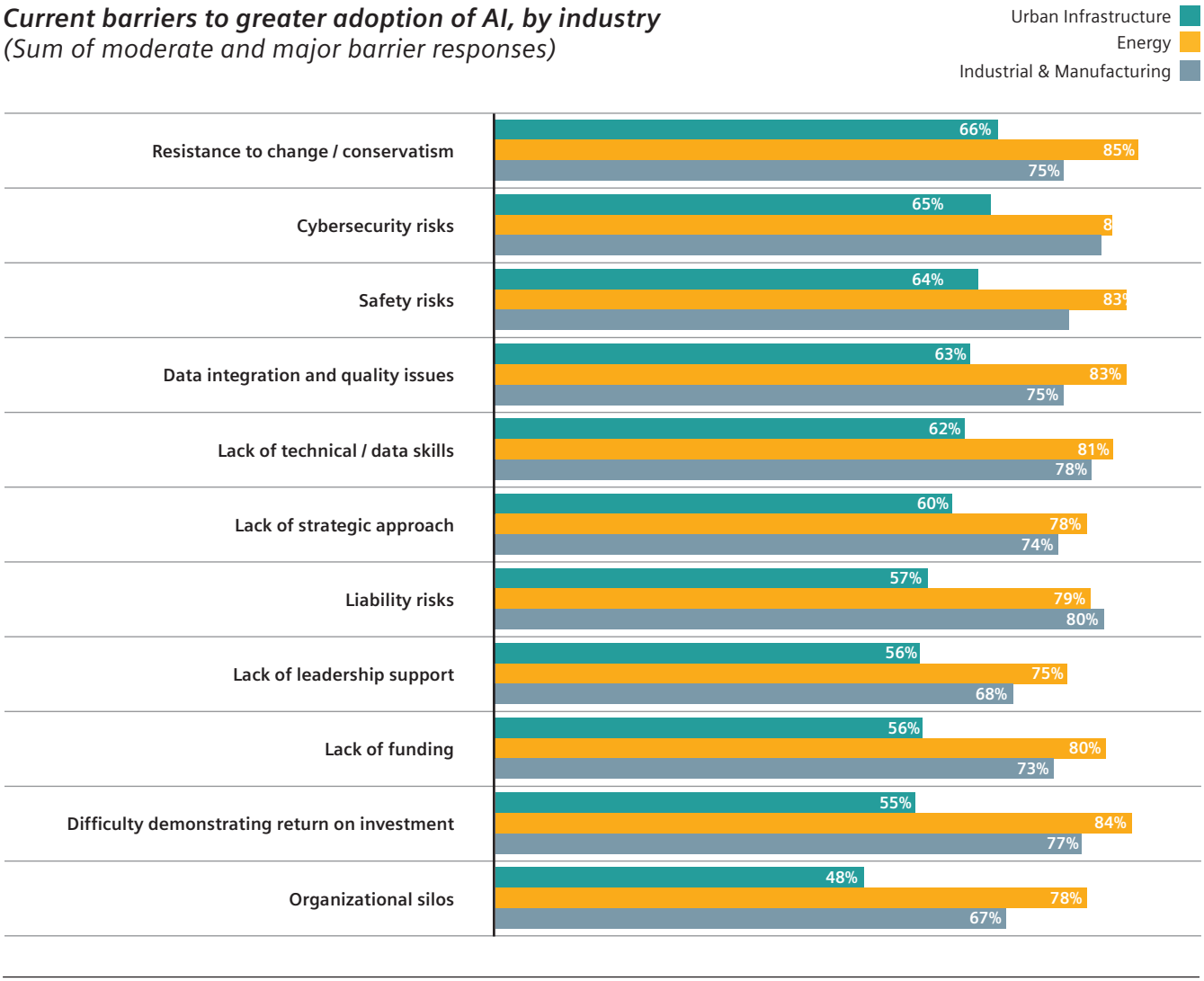
Why is the challenge of data integration and quality expected to ease off so rapidly? Much of it comes down to advances

AI in a post-covid world

When this research was commissioned, there was a lot of hype around the potential of consumer AI, and fewer insights available on industrial AI. While we at Siemens, with over 30 years' experience in industrial AI, are no strangers to this field, we wanted to learn more about the experience of other organizations. This research sought to uncover the benefits and barriers of industrial AI applications, and to highlight its potential, especially when combined with other technologies like IoT and digital twin. Suddenly the world is a different place. However, as organizations seek to recover, rebuild and adapt in a post-covid environment, the potential of industrial AI is more relevant than ever.

[1] https://new.siemens.com/global/en/products/buildings/contact/smart-building-whitepaper.html

Current barriers to greater adoption of AI, by industry
(Sum of moderate and major barrier responses)



in the performance and availability of computing power and storage, but there are also likely to be shifts in our thinking about data management and analytics.

"Over the past 10 to 15 years there has been a trend of pulling all data together in one data warehouse and building a dashboard on top to get an overview of everything," says Gerhard Kreß, Vice President for Data Services at Siemens Mobility. "This can take years to achieve, because you need to normalize the data while you assemble it. It has never really worked because it takes too long, costs too much and does not cope well with change."

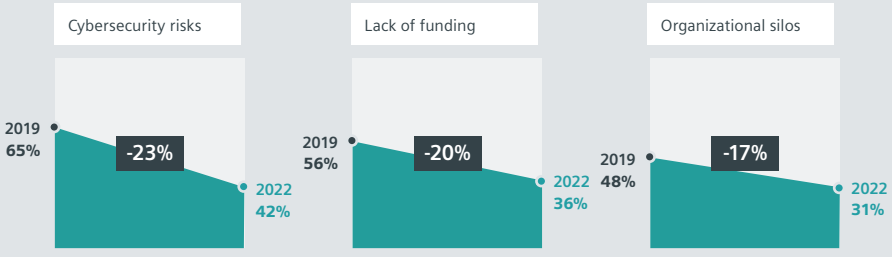
Instead, we will increasingly leave datasets where they are, and in their existing format. "You don't integrate it in the traditional sense, but add a layer on top that glues it together and makes it accessible," says Kreß. "This is attractive, because it saves a huge amount of time and effort, and data-owners do not need to give away control of their databases or make big changes to their data management models." This approach speeds up application development dramatically. The cost? It demands more computing power. But that is increasingly cheap and sustainable, so the trade-off makes business sense.

AI IN URBAN INFRASTRUCTURE

What are the significance of barriers (combined moderate and major) today and in three years time?

Major barriers, such as data integration and resistance to change, are expected to fall much more dramatically.

While cybersecurity is expected to be less of a barrier in three years, it will remain the top barrier relative to the others we investigated.



Awareness, anticipation, and autonomous action

AI can help the infrastructure industry to find important – often hidden – patterns in the growing torrent of IoT data from sensors, machines, assets, and all manner of devices located across our cities. This can lead to new insights, better decisions, more accurate predictions and more effective services.

AI can support greater automation by generating and executing intelligent responses to events in real-time. So assets such as power grids, bridges, pipes, and street lights will be able to autonomously adapt to conditions, communicate with the infrastructure around them, and optimize their own maintenance, safety, and resource consumption.

One example of AI creating value from multiple disparate datasets is in air-quality analysis and prediction systems. These draw on past weather and pollution data, plus live feeds from the city's IoT fabric (which provides, for example, data on moisture, sunlight, cloud cover, temperature, and levels of key pollutants).

Some systems also incorporate data that helps them adapt their predictions according to patterns recorded on different days of the week, months or years, including major city events, while continuously updating based on live data[2]. Why is all this useful? In some cities, forecasting air quality is critical to managing public health. And for all cities, understanding what affects air quality helps us to plan and regulate cities based on objective patterns, which should ultimately help us achieve cleaner air.

The smart city's data decoder

To what extent can AI help us improve urban infrastructure? It is already helping the industry to better understand and monitor urban systems, predict important changes, and deploy more intelligent and autonomous machines, assets, and devices. These benefits can support the major goals of any city – from reducing emissions to boosting economic competitiveness.

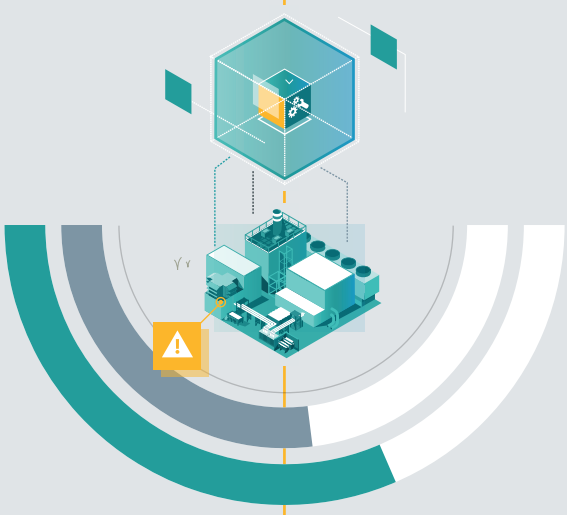
Ultimately, AI's transformative potential is limited only by the infrastructure sector's capacity to innovate, and that makes it the IoT era's most transformative technology.

What is AI?

In this report, and the research that supports it, 'artificial intelligence' and 'AI' refer to a broad spectrum of methods or technologies that perform tasks which would normally require functions of human intelligence such as learning, judging, and problem-solving. This is more in keeping with the contemporary business understanding of AI than any technical or academic conventions.

[2] https://new.siemens.com/global/en/company/stories/infrastructure/artificial-intelligence-improves-air-quality.html

Within the next five years, will an AI system autonomously control some of my organization's high-value assets?



63% Urban infrastructure

54% All industries

Overall, urban infrastructure respondents were found to be the best prepared (among the other industries surveyed) to access the benefits of AI, particularly in combination with existing IoT endeavors and developing Edge applications.

In fact, a strong majority...

62%

say their organizations are eager to use as much AI as possible (compared to 58% for all industries) and, with barriers falling, the next few years are likely to see many fascinating changes in how we manage, operate and automate infrastructure assets.

This is perhaps why, compared to other industries, significantly more urban infrastructure respondents are expecting some of their organizations' high-value assets to be autonomously controlled by AI systems within the next five years.

ABOUT THE RESEARCH: Siemens and our research partner Longitude conducted primary research into the uses of, attitudes to, and outlooks for AI in industrial organizations. We surveyed 515 senior business leaders in the energy, industrial/manufacturing, urban infrastructure, and transportation sectors. Of the 118 urban infrastructure respondents, 26.3% were from infrastructure construction/development; 24.6% from building or infrastructure management (e.g. facilities or real estate management); 23.7% from infrastructure-related professional services (e.g. engineering, consulting, architecture, planning, technology); 16.1% from public/government infrastructure development and/or management; 7.6% from data centers and industrial technology infrastructure; and 1.7% from water supply, sanitation, treatment, desalination, and flood defense. In order to qualify for the survey, respondents needed to be responsible for, involved in, or knowledgeable about their organization's existing or planned use of AI and related technologies, strategies, budgets, and applications. The research included respondents from North America, Latin America, Europe, the Middle East and Africa, and Asia-Pacific and was concluded in September 2019. All respondents were from organizations with an annual revenue of at least $100 million.