

The benefits of smart spaces go far beyond security—they drive more efficient operations; reduce environmental impact; and provide a seamless, responsive experience.

Keeping pace in a smarter world





It is an exciting time as the “factory of the future” emerges at a certain Japanese chemical company. The benefits are becoming clear: factory workers are better at their jobs, productivity is on the rise, equipment is better maintained, people are safer, and product quality continues to improve. With a new view of its business, this company can now identify and seize opportunities for improvement beyond the factory floor and bring a new level of confidence to decision-making.

These types of sweeping changes are being ushered in to virtually every industry by a suite of complementary technologies, including video intelligence, Internet of Things (IoT) sensors, artificial intelligence (AI), and powerful analytics software, that combine to allow organizations to gather, blend, analyze, and visualize data like never before. Similar solutions are being used to improve everything from airports and retail stores to entire cities and states that touch the lives of millions of people.

“Taking data from multiple sources and bringing that to a single pane of glass to apply analytics and AI to make communities and entities safer and more efficient, that is what we mean by smart spaces,” says Mark Jules, global vice president, Smart Spaces and Lumada Video Insights for Hitachi Vantara. “We look at three outcomes: enhanced safety and security, operations, and business.”

The safety and security outcomes can include environmental factors like reducing pollution or the health risks it causes. Smart spaces are environments that are equipped with intelligent video and other sensors that gather and process data with advanced technologies to enhance operations. When video data is transformed into intelligence through a combination of computer vision and machine learning (ML) and blended with other data streams, insights are revealed that help all types of spaces – whether an entire city, an industrial site, a college

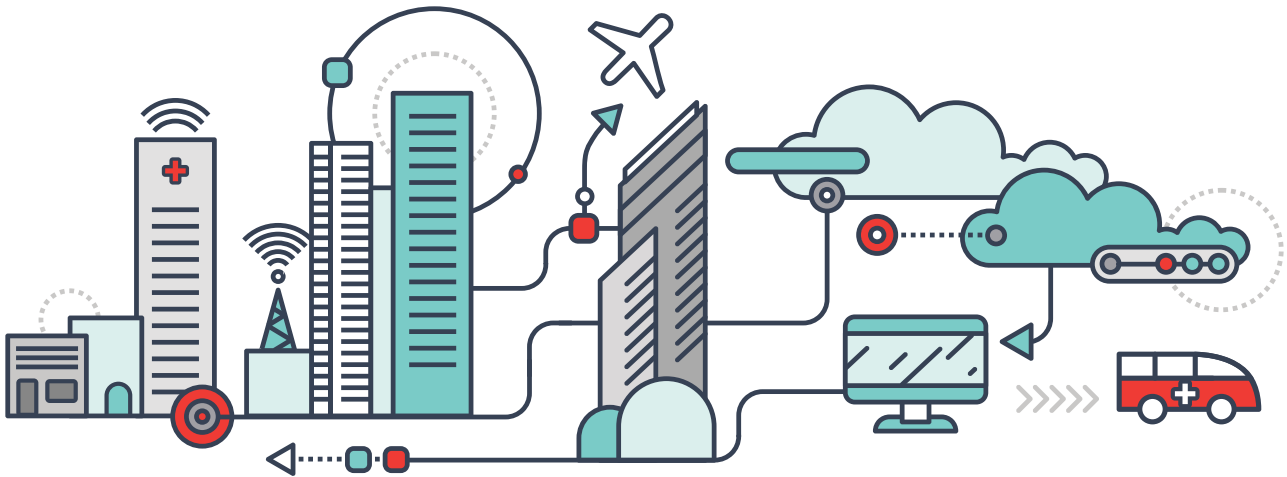
Key takeaways

- Smart spaces take data from multiple sources and apply AI and predictive analytics, to improve communities and entities.
- The benefits of smart spaces are safer, more efficient operations, reduced environmental impact, and responsive human experiences.
- Technologies like video and lidar, IoT, AI, and ML are converging to enable smart spaces.

“The future will be characterized by smart devices delivering increasingly insightful digital services everywhere.”

David Cearley, Vice President and Distinguished Analyst, Gartner

campus, an office building, or a manufacturing plant – adapt in real time and improve future planning and operations management. For example, data-driven approaches based on video analytics can help improve traffic flow in cities, increase a building’s operating efficiency, or help airlines improve on-time performance.



“Retailers, manufacturing and industrial organizations, college campuses, and hospitals are all looking for the same outcomes of safety and security, while operating more efficiently and effectively.”

Justin Bean, Director of Smart Spaces Marketing, Hitachi Vantara

“Smart spaces are uniquely responsive to the people inhabiting them,” says Praveen Subramani, director of product management at car-sharing company Turo, a platform infused with AI and other advanced technologies.

And, smart spaces are a growing trend. Gartner lists smart spaces as one of the [Top 10 Key Strategic Technology Trends for 2019](#). The smart spaces concept is being driven by advancements in video intelligence and IoT and the manner in which that data can be analyzed by AI and ML, and then combined with enterprise business data to deliver holistic insights.

Market researcher MarketsandMarkets estimates the global smart space market will grow from [\\$8.5 billion in 2019 to \\$19.9 billion by 2024](#). Other factors driving that growth include the cost-effectiveness of the sensors and solutions, increased capacity of network and edge computing, advancements in ML, the pervasiveness of video data, and the ability to protect the privacy of this data.

Connected intelligent environments, like smart buildings, can link their data with other intelligent environments and operate in concert. “Cities are complex ecosystems,” says Justin Bean, director of Smart Spaces marketing for

Hitachi Vantara. “Retailers, manufacturing and industrial organizations, college campuses, and hospitals are all looking for the same outcomes of safety and security, while operating more efficiently and effectively. At the same time, whether someone is a citizen, passenger, or customer, they want to have a great experience.”

Improving efficiency of infrastructure, service delivery, business operations, and the physical environment can have significant impact on the human experience and sustainability of our societies. “When deconstructing modern life and analyzing where time is spent, you realize we are spending a lot of time on tasks that could be done autonomously if we lived and worked in a smart space/ smart city,” says futurist Thornton May.

“The future will be characterized by smart devices delivering increasingly insightful digital services everywhere,” says David Cearley, a Gartner analyst, speaking at the [Gartner 2018 Symposium/ITxpo](#) in Orlando, Florida. “We call this the intelligent digital mesh.” Gartner sees emerging advanced technologies such as IoT and AI bringing together an intelligent and connected “digital mesh” of people, services, products, and devices. The architecture of this digital mesh will be built on connectivity, security, and participation of those involved.

Enabling technologies

A convergence of several technologies is enabling smart spaces, primarily video and lidar (similar to sonar, but using lasers) signals, the IoT and all connected sensors, AI, ML, and advanced data analytics. Video data is emerging as the most significant source of insights, thanks to advancements in the ability of computer vision and AI to transform it into intelligence, the growth of available data, and the ability to combine it with other data types. “I do see video as the ultimate IoT sensor data. There’s so much data you can capture – size, direction, speed, manufacturing defects,” says Jules. And multiple outcomes can often be driven by the same data. “Airlines, for example, could detect left-behind bags, and also measure the volume of bags to predict when overhead bins will overflow to help make the boarding process more efficient.” Right now, video data is being added to the overall data stream at a rate of 2.5 exabytes per day

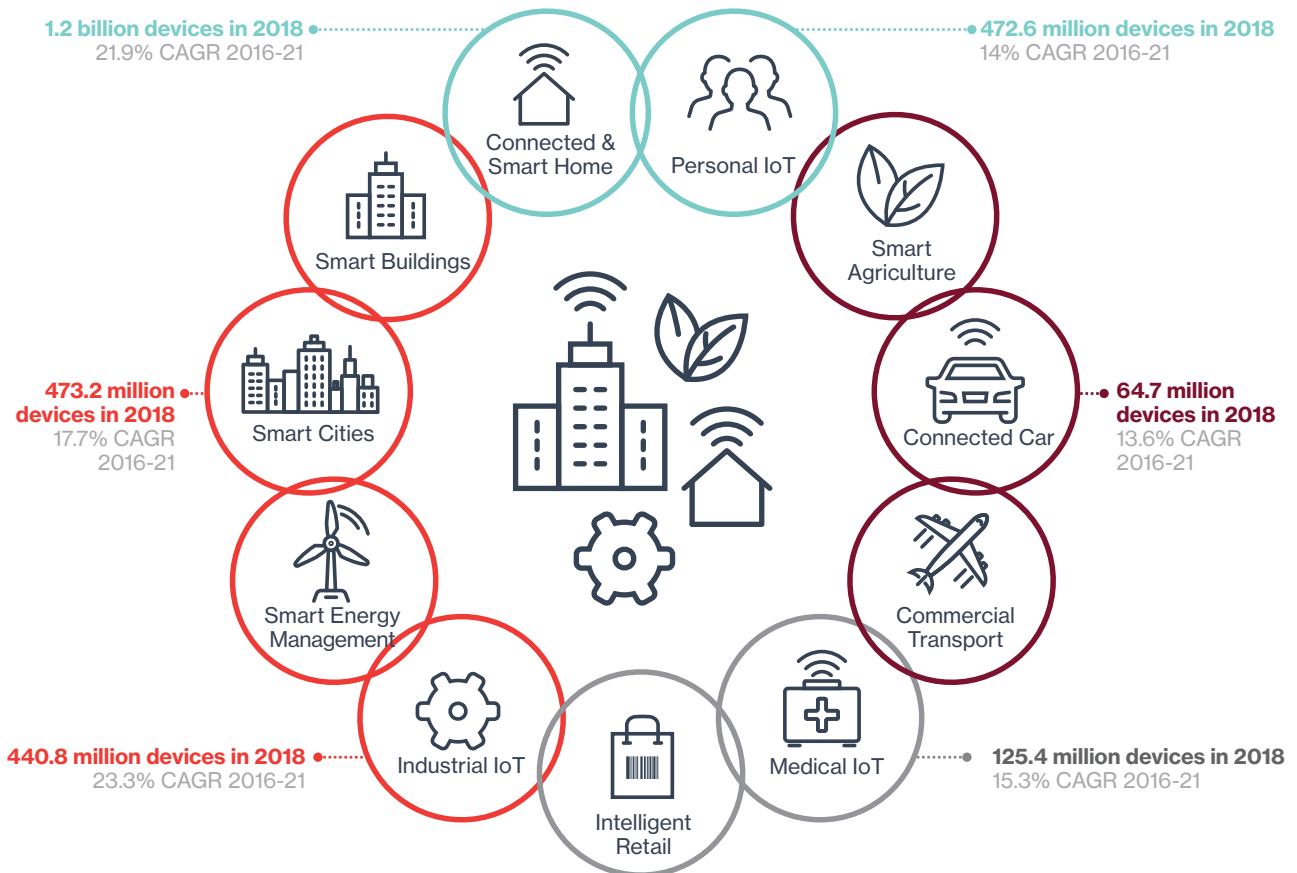
(according to IHS Markit), and in 2015, computer vision surpassed human vision in terms of accuracy (according to the [AI Index Report](#)). However, as much as 98 percent of video data is currently underutilized.

Smart spaces solutions are increasingly capable of processing data at or near the network edge, which provides several key benefits. Moving analytics processing to the edge reduces the need to store or transmit high volumes of data or private information. “Systems are constantly analyzing in real time and then dumping data. Video analytics can analyze a city street to gain traffic or parking insights without exposing or storing images of people,” says Bean.

“You can create models of human behavior to generate much greater efficiency. Using the example of a smart city where you control the stoplight, you don’t want any traffic

The IoT connection

The global installed base of internet of things devices is colossal and growing – the sum is projected to increase from 27 billion in 2017 to 73 billion in 2025.



congestion, so you can determine optimal amount of time to spend at a stoplight,” says Larry Ponemon, chairman and founder of data privacy think tank the Ponemon Institute.

And it is possible to measure the value of the multiple outcomes coming from that data. According to a recent white paper, organizations deploying smart spaces at any scale can actually create a collaborative framework to determine the true economic value of the data and analytic assets involved. There are three critical theories to consider when applying value to data streams:

- data as a corporate asset
- data as the modern currency
- data as an asset that can be monetized

Privacy and other challenges

The massive amount of video and other data gathered by cameras and sensors raises important privacy concerns. Governance processes associated with smart space operations need to address those concerns and there are ways to manage privacy challenges.

When gathering video data from public spaces, for example, solutions are available that can mask or pixelate people in the frames automatically, keeping individuals from being identified. 3D lidar data provides granular, real-time alerts and operational insights based on laser measurements without capturing any personally identifiable information, making it ideal for General Data Protection Regulation-protected spaces or other privacy-sensitive environments, such as hospitals or schools.

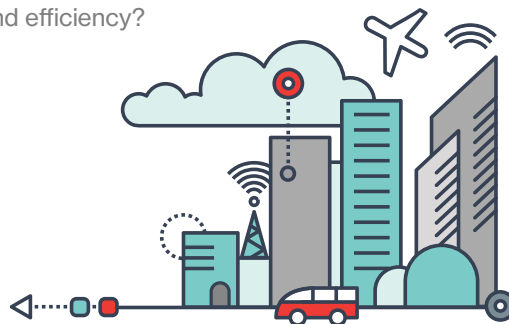
In terms of analytics, aggregated data can sometimes be more anonymous, which improves privacy. “Most data analytics don’t care about the individual. They care about the aggregated view,” says Ponemon. “But even when data is aggregated at a level higher than the ability to identify an individual person, you can still have privacy issues.”

The combination of the right tools in the right places can help provide insights without risking privacy. “You can have rich insights without capturing or exposing personal information,” says Bean. “That’s great for hospitals and schools, because these insights can save lives, even in places where privacy is very important.” In a hospital, for example, lidar systems can detect a fall, or the onset of a seizure, without needing a video camera in the patient’s room.

Smart ROI

When data is analyzed and visualized to produce actionable insights, possible performance indicators begin to emerge from smart spaces everywhere:

- In airports, for every additional minute that passengers spend in a security line, how many fewer dollars do they spend in the terminal retailers?
- In cities, how do traffic, bike lane, and parking policy or infrastructure changes impact usage and improve safety?
- In retail, how do changes in store arrangement or displays affect sales conversions in the store?
- In manufacturing environments, what impact do assembly line changes and working times have on quality, safety and efficiency?



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Thornton May, Futurist

The technological challenges of creating smart spaces include managing and integrating myriad data sources, sharing and processing that data, storing and managing large video files, and establishing a “single pane of glass” view to best inform operational decisions. “Being able to visualize all your smart spaces data in one place is a big challenge,” says Bean. “You want to get views of all data together to compare apples to apples and reveal insights.”

Getting smarter

The emergence of smart-spaces technology has led to a wide range of deployment types all over the world. As the convergence of technologies increases, so will the rate and complexity of deployments. Examples include:

- **Smart city:** The city of Las Vegas uses smart spaces technology to look at the streets as an ecosystem – monitoring intersections for safety and managing and monitoring the traffic of vehicles, bikes, and pedestrians, as well as parking and public transportation.
- **Smart government:** In India, a state government uses smart spaces data to create real-time governance – bringing together data from 30-plus departments to deliver a wide range of services, such as providing severe weather alerts improving ration services and pension programs, tracking and measuring rainwater and cyclones, and using agricultural data to ensure consistent food production.
- **Smart campus:** Curtin University in Western Australia is using data from a network of cameras and facial recognition technology to understand study patterns, course attendance, and campus activity to develop a greater understanding of how students learn, respond to different learning styles, and improve the overall student success and experience.
- **Smart manufacturing:** A Japanese chemical and manufacturing company Daicel has developed an image analysis system to measure worker activity in order to improve product quality, work efficiency, and safety while reducing operational errors.
- **Smart transportation:** In Indonesia, an airport services company uses video analytics to improve operational management, increase awareness, and provide an excellent customer experience for over 100 million passengers annually.

2.5 exabytes per day

the rate at which video data is being added to the **overall data stream**

Source: IHS Markit



Accuracy of computer vision surpassed human vision for image labeling in 2015.

98%

the estimated amount of **video data** that is currently **underutilized**

Source: the AI Index Report

As smart space ecosystems share each other's data, the insights and benefits increase dramatically. For example, if video and sensors in a stadium show how many people are flowing into the nearby transit system, the transit system can adjust frequency and capacity to accommodate peak flow and taper when flow ebbs. This makes transit operations more efficient and delivers a better experience for event attendees.

The potential of smart spaces is truly realized in these instances – when different systems share data and analytics are applied, the insights can have profound impacts across industries and will lead to smarter, safer, more efficient and enjoyable environments in all areas of cities and society.

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