2020 Smart Buildings Challenge Summary Report

The Smart Buildings Challenge, organized by the Industrial Internet Consortium, was designed to help advance the digitalization of the smart buildings industry. The winners of the Challenge were announced on February 19, 2020 at Bosch Connected World in Berlin, Germany. This report provides a summary of the Challenge: why it was conceived, what Use Cases were considered, and how the contestants' submissions addressed the Use Cases.

OVERVIEW

Today's smart buildings are beginning to leverage the industrial internet for improved business outcomes, such as better energy efficiency, improved occupant experience and lower operational costs. They may contain thousands of sensors measuring various building operating parameters including temperature, humidity, occupancy, energy usage, keycard readers, parking space occupancy, fire, smoke, flood, security, elevators and air quality.

These sensors collectively capture massive amounts of data that must be transmitted, stored, analyzed and acted upon, often in real-time, to provide a truly smart building experience. These actions require thousands of actuators capable of exercising fine-granularity control over lighting, environment, security, safety and building systems. Some of this processing and actuating is extremely time-sensitive, but some applications are so bandwidth-intensive that they would swamp the building's fiber access bandwidth.

The Smart Buildings Challenge was designed to leverage this infrastructure to create an operationally efficient smart shopping center. The shopping center is owned by Deka Immobilien's Real Estate Management Division. ECE developed and operates the center. In the Challenge, smart building technology suppliers were provided the opportunity to collaborate with the Challenge Principals and Enabling Technology Partners to create targeted solutions. The goal of the Challenge was to help overcome existing technology barriers to address the market opportunities in space flow, energy efficiency, equipment control, and data analytics.

CHALLENGE PRINCIPALS & PARTNERS

The Principals of the Challenge were Deka Immobilien, ECE and TÜV SÜD. Principals are technology end users who define the Challenge entry requirements and technical parameters. The Principals award the winners the opportunity to prove out their design in a Proof of Concept within the Principals' facilities.

The Principals are supported by the Challenge Organizer and the Enabling Technology Partners. The Industrial Internet Consortium was the organizer of the Challenge. The Enabling Technology Partners for the Challenge were Bosch Building Technologies, Microsoft and Security and Safety

Things. Enabling Technology Partners offer their expertise and their technology as an option for the entrants to use in their solutions.

ECE - ECE has five decades of experience in the planning, realization, leasing and management of shopping centers. The company successfully transferred this expertise to the development of office buildings, company headquarters, hotels, residential projects, logistics centers and traffic properties. With their detailed knowledge about the shopping center market and their insights into the center assets, they can provide all participants with relevant technical and business information.

TÜV SÜD - More than 24,000 employees work at over 1,000 locations in about 50 countries to continually improve technology, systems and expertise. The TÜV SÜD team offered support to the start-ups with technical domain knowhow related to building parameters, quality and safety-relevant aspects of building operations and regulatory knowhow, such as GDPR compliance. Additionally, the TÜV SÜD team shared experience related to asset and property management, building automation topology, BIM management and sustainable building construction and operation.

Deka Immobilien - Deka Immobilien is one of Europe's largest commercial real estate investors with approximately €40 billion in assets under management, including 28 shopping centers worldwide. Through the Challenge workshops, they provided participants with the building owner's perspective, both in terms of the economics and risk of an investment and the technical challenges of implementation.

Bosch Building Technologies - Bosch Building Technologies is a leading global supplier of security, safety, and communications products and systems, also offering solutions and services for building security, energy efficiency and building automation in selected countries. As an Enabling Technology Partner of the Smart Buildings Challenge, Bosch offered consultancy and domain expertise in the fields of technology, business case validation and product development.

Microsoft - Microsoft is one of the leading cloud providers, globally. With Azure, Microsoft provides an ever-expanding set of cloud computing services to help organizations meet their business challenges. Azure gives users the freedom to build, manage, and deploy applications on a massive, global network using preferred tools and frameworks. In the Challenge, Microsoft provided technical guidance and architectural reviews, development support for cloud migration and initial cloud setup and resources to host contestants' applications.

Security and Safety Things - Security and Safety Things is a Bosch IoT Start-up, accelerating innovation by building the first truly open platform for security cameras to establish a strong open ecosystem. In a nutshell: What Google has done in the smartphone market with Android and Google Play, Security and Safety Things is striving to do in the market for security cameras, advanced analytics and beyond. Security and Safety Things provided participants with cameras for prototyping and a development environment as well as documentation to realize video-based analytics for the retail, transportation and commercial buildings industry.

USE CASES FOR THE 2020 CHALLENGE

The following four Use Cases provided the competitive playing field for the Smart Buildings Challenge:

Use Case 1 - Smart Space Flow Analytics

This Use Case covers tracking, zones and anonymized tracking.

Use Case 2 - Smart Metering in Multi-Tenant Commercial Buildings

Includes smart metering, energy consumption, with a focus on electric energy.

Use Case 3 - Smart Automated Building

Featuring smart solutions for HVAC, control technical equipment, demand-oriented control of equipment, and sustainability.

Use Case 4 - Smart Building Cockpit

Includes management tools, sales tools, dashboards, digital twin, and AR.

CHALLENGE MILESTONES

The Smart Buildings Challenge presented contestants with a set of smart building problems faced by building operators and investors, as well as a set of parameters required of the solutions. Technology suppliers developed solution proposals, alone or with partners, and competed to deploy pilot implementations to fulfill the requirements outlined by the challenge. A jury selected the winners from a pool of 39 entries from 26 contestants.

The deadline for initial entries was September 6, 2019 and the competition began the following week. On September 17 the first Challenge workshop was held in Hamburg, hosted by ECE. All of the contestants were invited to present at the second workshop, hosted by Bosch in Munich on November 19. After these presentations, the field was reduced to 11 finalists.

Those finalists were invited to give their final presentations at the third workshop which was hosted by Bosch in Berlin on January 14, 2020. The jury met shortly after and decided the winner for each Use Case, which were presented at Bosch Connected World in Berlin on February 19. Additional details and photographs can be found on the 2020 Smart Buildings Challenge web page.

2020 FINALISTS

The 11 Finalists for the 2020 Smart Building Challenge were Aedifion, BuildingMinds, Cloud Studio, Cubelizer SL, G2K Group, Holisticon (with its subsidiary Markenwerk), Limitless, Moeco, Oriient New Media, Thing Technologies, and Umajin. The following figure shows the Finalists grouped according to their Use Cases:
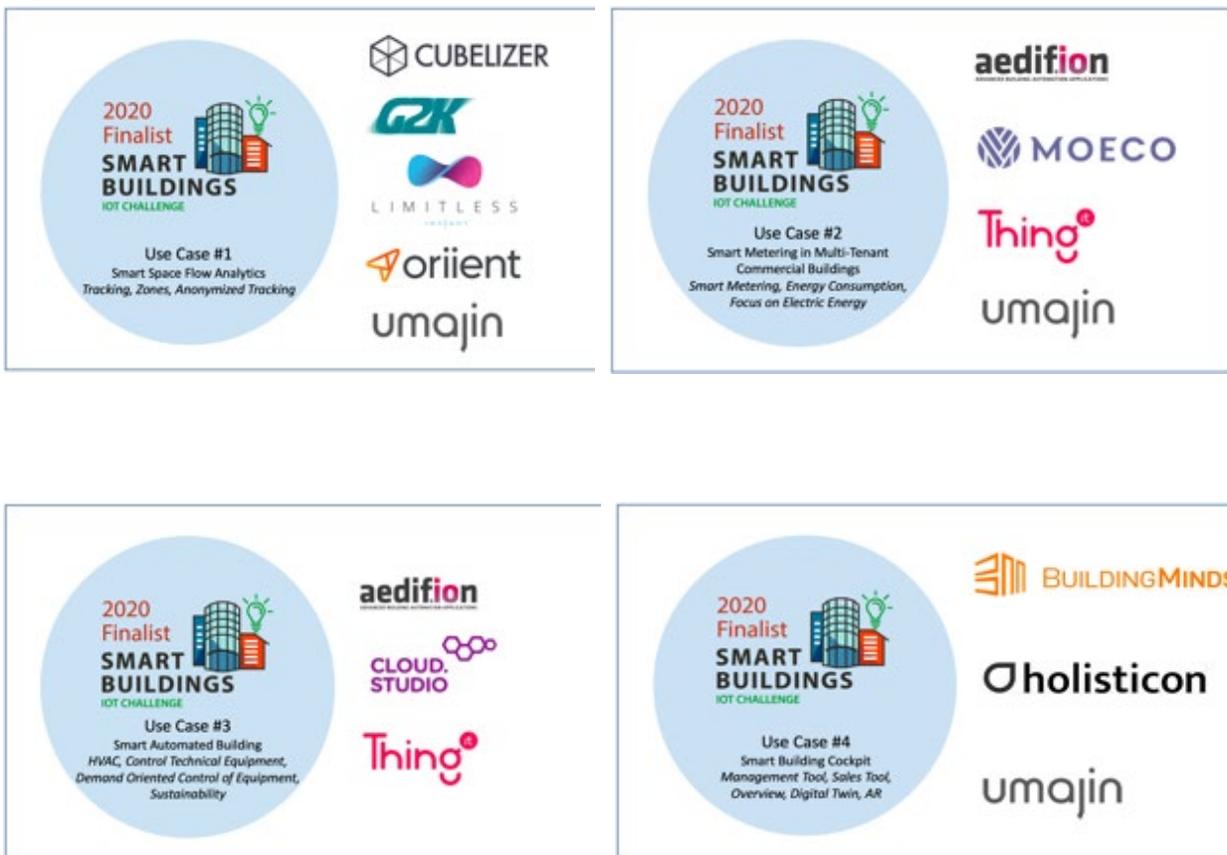
Following are descriptions of the Finalist companies and summaries of their submissions, grouped according to Use Case.

2020 SMART BUILDINGS CHALLENGE WINNERS

Here are the winners for each Use Case with a link to their final submission. Each has begun working with ECE and its partners to develop a Proof of Concept for a smart shopping mall.

- **Use Case 1:** Smart Space Flow Analytics - Cubelizer.
- **Use Case 2:** Smart Metering in Multi-Tenant Commercial Buildings - Aedifion, Thing Technologies.

- **Use Case 3:** Smart Automated Building - Aedifion, Thing Technologies.
- **Use Case 4:** Smart Building Cockpit – Holisticon.

Aedifion and Thing Technologies submitted a joint proposal but each has a business focus on one use case.

The final entries of each of the winners and the remaining finalists are summarized below.

USE CASE 1 FINALISTS

Cubelizer S.L.

Cubelizer helps shopping center operators and owners understand the use of the space to improve commercial mix design, operation and marketing, helping them to achieve higher efficiency and savings. Cubelizer uses accurate and consistent information gathered in an anonymous way from an in-house developed, real-time image processing solution that includes hardware and software.

The solution is based on an infrastructure of multiple IoT optical devices that detect and track visitor's movements anonymously and their activity inside the shopping center. The per-device tracking, which uses a variety of machine and deep learning algorithms running locally, enables gathering of data. Then, data is consolidated and uploaded to the cloud to be processed in order to build full path trajectories that describe patterns of movement inside the premises.
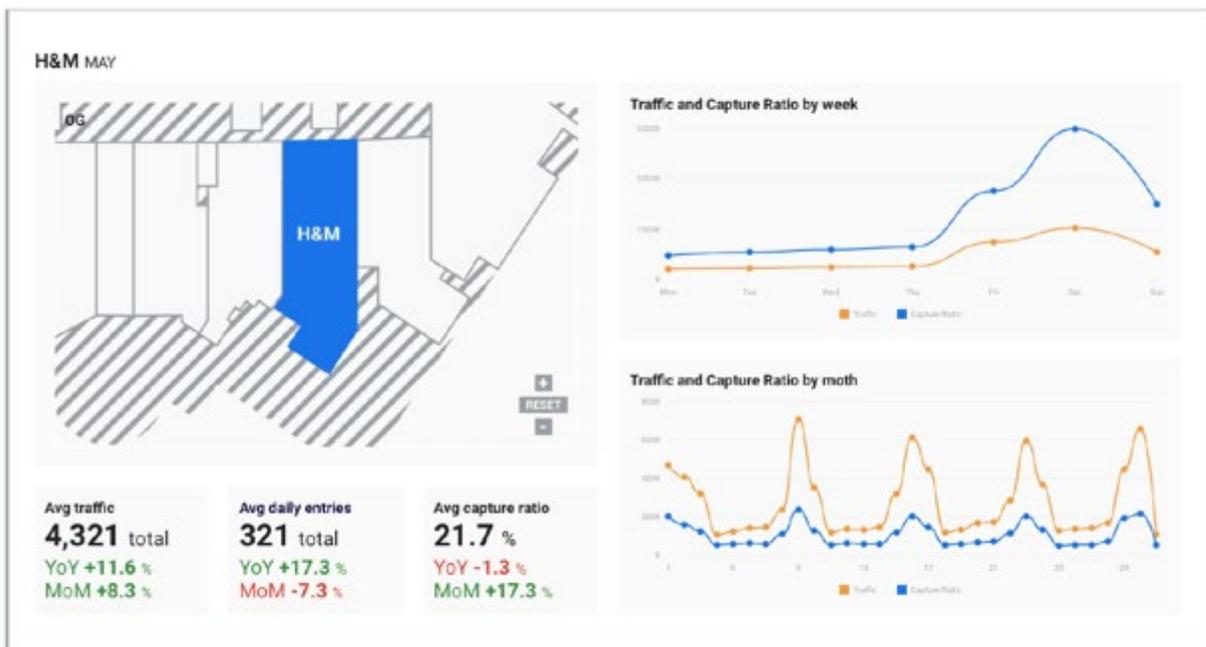
Cubelizer tenant information sample screen

This is then further analyzed to provide a variety of quantitative metrics. The information is made available via dashboards that provide real-time and historical visualization capabilities. An API is also available to feed into complimentary analysis tools and systems as needed.

The insights provided by the solution are driven by the results of the analysis conducted to glean information around customer traffic, flow, origin and destinations, occupancy, store capture rates and dwell times, among other information.

This information can be used in a variety of ways to improve the efficiency and utilization of assets in the shopping center:

- Real time alerts and information point out anomalies that might need to be addressed in a proactive manner.
- Customer trajectories provide information into the actual shopping sequence of visitors.
- Operator and space performance analysis provides insight into utilization and effective use of facilities.
- Cluster analysis is used to study synergies and provides data on previously unrealized affinities between vendor stores.

Once the solution is deployed across multiple sites, the resulting information provides a whole new level of insight into benchmarking by comparing across premises over time. This information has the potential to transform the design of future malls by taking advantage of traffic flow studies and even the affinity between complimentary vendor categories.

It is important to note that the Cubelizer solution is based upon computerized video processing as against camera-based real-time image analysis. This makes the solution GDPR compliant since it does not store or images, video either any kind of sensitive information.

The Cubelizer solution provides mall operators and tenants deeper insights into customer behavior in order to maximize the potential of assets in entirely new ways based on smart-flow analytics.

G2K Group

G2K's Software Platform Situational Awareness Builder is a scalable IoT platform that connects structured and unstructured data from all relevant systems. This enables comprehensive shopping mall management and a positive customer experience.

It provides the mall operator essential insights including the ability to determine the best mix of stores, i.e.: which combinations of stores or categories yield the highest collective mall sales. In addition, they can thoroughly understand and plan store adjacencies that drive higher consumer spending and longer mall visits. In short, pick the right tenants and place them in the strongest location.

The G2K platform solution entails four basic modules (e.g. Maps, Alarms, BI Dashboards, Historic Trails) which are then extended with add-ons specific to the required Use Case. Key technologies in our proposed solution are video analysis and WiFi tracking. In both solutions, that collected data is correlated by an AI engine and analyzed by business intelligence mechanisms to derive most valuable insights. All this is delivered as Software as a Service, eliminating capital expenditures for back-end infrastructure.
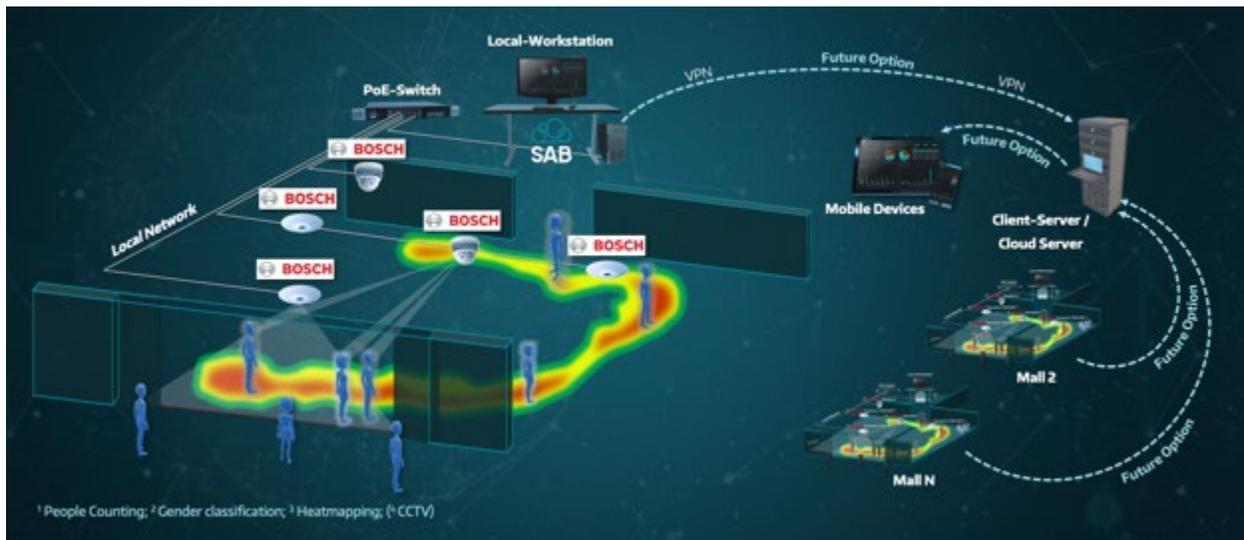
Proposed G2K configuration

All information and decision templates are in one holistic platform delivering a single point of view. This platform provides centralized management for different IoT sensors, WiFi, temperatures, and air quality among others.

G2K offers a sustainable, future-proof platform through simple extensions with additional Use Cases. The mall operator can rely on the fact that this is already proven technology based on recognized technology and security standards.

The solution incorporates overall building automation and control systems to achieve potential savings for heating energy of approx. G2K regularly see savings on the order of:

- 55 - 50% for heating
- 10% - 80% for cooling
- 20-50% of total lighting energy consumption by the use of occupancy sensors, daylight sensors, dimmers, etc.

This achieves the added benefits of thermal comfort and safety, ensuring a pleasant customer experience and lengthening their stay on the premises.

G2K's partnership with the most advanced companies in the world enables the delivery of our three-layer architecture: Get – Know – Act. With underlying AI, G2K's mapping modules and

alarm stacks learn over time so coverage gets more sophisticated. This is a huge win since, as the buildings age, we can learn more about them and what to expect from them, and are able to immediately spot any trending discrepancies.

Limitless Insights

By combining sophisticated consumer knowledge and leveraging existing under-utilized hardware, Limitless Insights provide a light to no-touch cloud platform that dramatically increases customer involvement and drive increased sales and margin.

The platform combines various data streams from location, stores, and social data to provide similar analytics as Google and Amazon combined. It is a highly effective recommendation engine.

Limitless builds a consumer's profile around age, gender, postal code and can connect with them via email or Facebook. Location, in-store data, geo fencing, category data and previous behavioral patterns are used to create behavioral segments, targeting, content and targeting at micro-persona level.

While shopping, the Limitless platform can generate specific recommendations based on the shopper's in-store location, highlighting marketing opportunities that they are adjacent to. For the retailer, the platform ensures that the product placement is correct to typical traffic flows. Limitless utilizes Amazon's robust cloud to analyze the date which includes dwell time, whether the consumer is a new or returning customer, frequency of visits and areas visited. That is coupled with edge computing to aggregate data for real-time marketing opportunities.

The Limitless dashboard can display heat maps, travel maps, capture rate. It monitors the health of the infrastructure and accept alerts from access point in distress. Limitless stands out from a crowded field by the simple fact that the solution has been designed, built and driven by retail property and loyalty experts with deep domain expertise.

The platform directly engages with the end customer without the hinderance of a dedicated app. Our interaction measurably increases dwell time, frequency of visit and overall spend.

Limitless can layer other data sources such as CenterGutschein, Mastercard or a facility's parking card. It provides the ability to allow the retailer to connect with their customers with specific insights based on their specific gender, age bracket, persona. With these tools, the retailer can custom tailor the sales experience with targeted promotions and other devices to ensure that the customer stays engaged and ultimately spends.

Limitless's light to no-touch cloud platform

Oriient

The Oriient solution for Smart Flow Analytics is based on the use of IndoorGPS, a proprietary indoor positioning system that can determine location data within specific spaces. The solution is provided as an SDK that can be integrated with an app and deployed via smartphones.

The app uses the smartphone's built-in sensors to determine location data with an accuracy of one meter. The SDK integrated into the smartphone app communicates with the Oriient cloud service. The backend analyzes the data and a web dashboard provides visualization into the resulting insights. An API is also provided to interface with other management systems as needed.
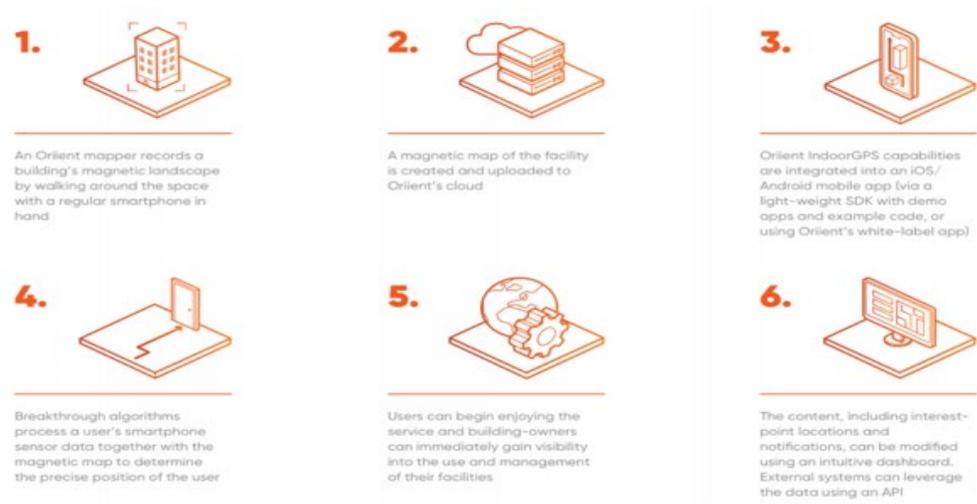

6-step description of the Oriient solution

Once the system is in place, it can provide significant benefits to both facility operators and visitors. It should be noted that visitors who do not use the app are outside of the scope of benefits that this solution provides. From a facility operator standpoint, the system is extremely easy to deploy and highly scalable.

There is no CAPEX and all expenses are OPEX, based on actual usage. Since it uses magnetic mapping rather than GPS, it needs absolutely no additional hardware such as beacons, sensors or cameras. The data that is generated can be used to provide full visibility into the customer journey through the premises.

This can provide valuable information about flow patterns and dwell times that can provide insights to both facility operators and tenants. Since these insights are tied to the app on the visitor's smartphone, it can also provide information on buying patterns and return visits. From a visitor's perspective, the system has some interesting retail possibilities.

Outside of just providing navigation through the facility, it can be augmented to work with shopping lists to optimize in-store visits to directly access products. It is important to note that all tracking is done anonymously. The system can track visitor location but not who they are. It also does absolutely no tracking outside of the facility.

All data is transmitted using encrypted interfaces. It is a pure software solution, so there is no hardware to secure. This makes the solution fully compliant with all data privacy regulations including GDPR.
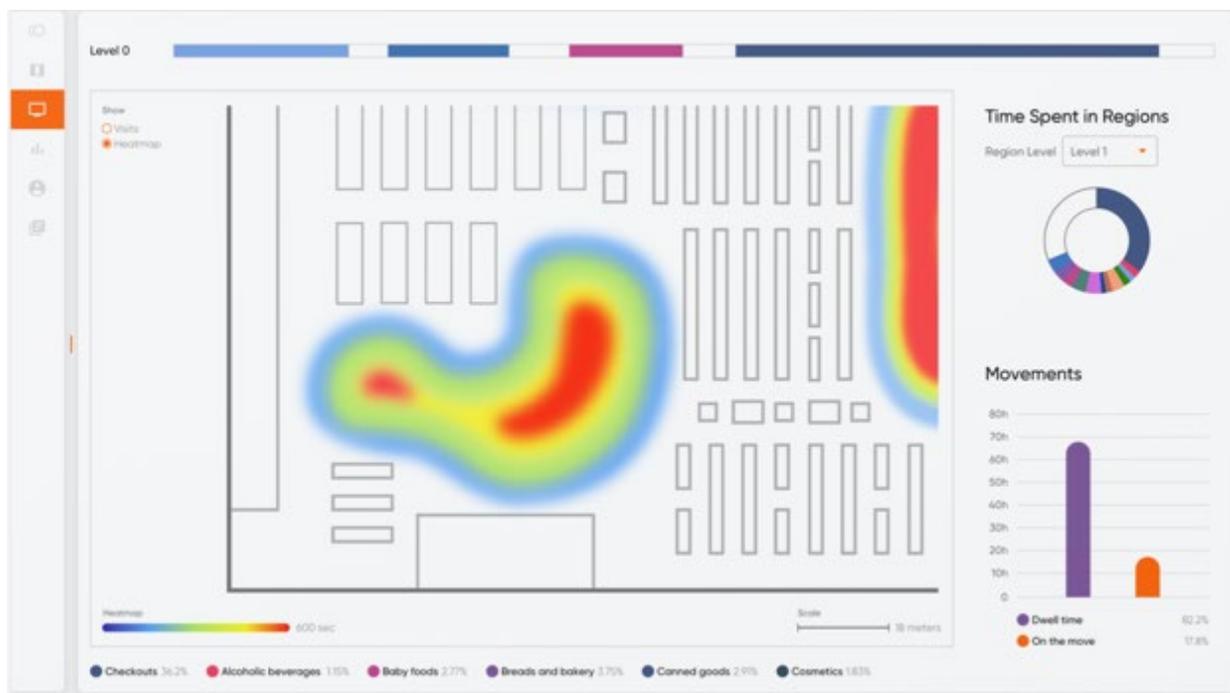
*Heat map analytics for the Oriient solution*

Umajin

The Umajin solution for Smart Space Flow Analytics provides a low-cost, highly accurate, anonymous method to count people entering and exiting spaces. It can do this under a very wide range of conditions, crowd levels and lighting situations.

The solution is completely GDPR compliant and eliminates any concerns around the breach of personal data.

Cameras are located at strategic locations such as major entry and egress points. Along with each camera a low powered computer is installed to provide localized processing of data. This provides the ability to use machine vision processing in real time to detect and track movement of people to generate strings of time-series data. The cameras track people strictly from the top-down without capturing or storing any recognizable or identifiable facial personal information.

In addition to providing highly accurate counts of people, the system has the ability to utilize Wi-Fi tracking in order to collect data on Wi-Fi usage. This provides useful data around the percentage of visitors that are using Wi-Fi.

The time series data is then aggregated and can be utilized by downstream business intelligence management systems for further analysis.
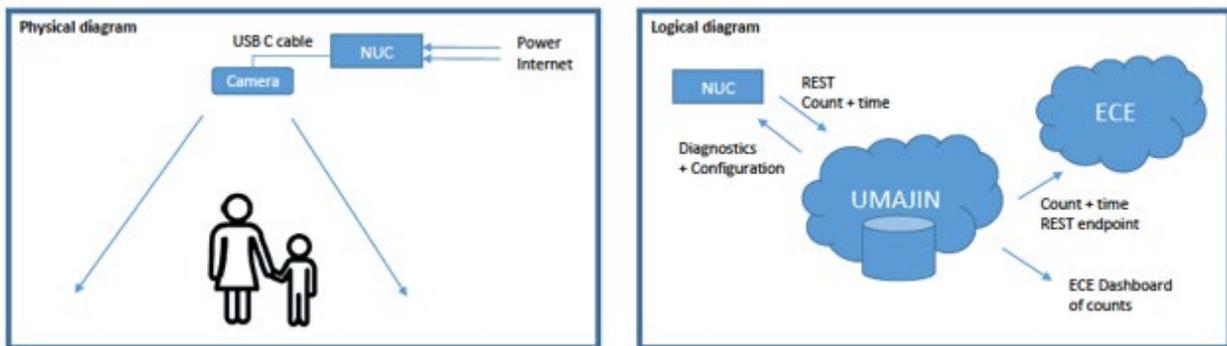
Layout of the Umajin solution

Data from multiple cameras can be stitched together to measure flow through the venue. Additional analysis such as dwell time within spaces can also be performed.

The solution has significant benefits from a health, safety and risk management standpoint. The ability to know just how many people are in a specific place makes it possible to take proactive action. For example, if a space is rated for a max occupancy rate of 2,000 people, the system can set an alert to raise a notification once the count reaches a preset threshold such as 1,900.

The Umajin solution is highly scalable, low cost and extremely resilient. Since the image processing is local to the camera and its associated computer, temporary Internet outages do not result in a complete loss of functionality. The system has the ability to retain information locally that can then be processed once connectivity is restored.

USE CASE 2 FINALISTS

Aedifion & Thing Technologies

This co-submission integrates a comprehensive suite of data acquisition, data aggregation, data analysis and results delivery. The plan recognizes that the reliable and accurate acquisition of data is core to any Smart Building's success.

A comprehensive data acquisition profile includes:
- Aggregation/monitoring of data points via calibrated Smart Meters
- Ability to scan a buildings BACnet for automation components
- Support for industry standards such as Mbus, EnOcean (S0) and metering cloud services (Disovergy, Zenner, …)

The data aggregation component includes access to both live and historic component data. The data are continuously collected and aggregated and sent securely to the cloud for processing. There is no need for sophisticated computing resources at the building itself.

Results can be delivered to both the technical and business teams via a variety of methods and at any level of granularity. They are also available via an API, and can be pushed directly to an invoicing system.

The end results benefit everyone involved in the facility. The Tennant will be receiving higher quality data about utility costs leading to increased transparency into their expenses. Overall, the increased efficiency of the environment will lead to reduced utility cost.

Technical Management will gain efficiencies common to automation in other industries, including:
- Real-time, fine-grained insight into current and historic consumption at arbitrary detail to identify optimization potential.
- The ability to accurately measure the results of implemented optimizations.
- Time saving and error reduction by automating reading of metering data.
- Anomaly detection to identify issues faster and allow faster remediation.
- Ongoing, automated real-time optimization of utility processes.

Commercial Management will see a much smoother business process given automated meter readings and data transport to downstream systems, e.g. via ECE BI or direct SAP interface. The will also enjoy the ability for higher frequency of metering-based utility cost invoicing ensuring smoother cash flows.

The solution is based on existing products of Aedifion and Thing-IT, which provide the majority of functionality needed. Some per-site development is required to integrate the solutions according to the Use Case and that is part of the normal deployment process.

The solution will be sold as additional module for all Aedifion and Thing-IT customers through the companies' existing sales channels and supported via standard support. The solution is ready for customer pilot production and in use already.
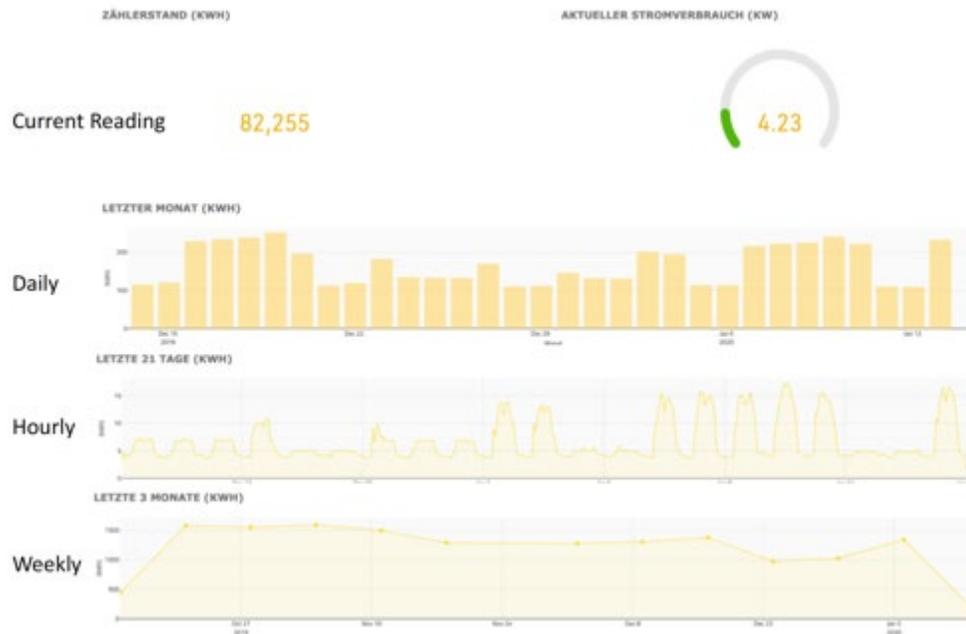
*Aedifion-Thing aggregation example for Use Case 2*

Moeco

The Moeco solution for Smart Metering consists of a software platform working in close conjunction with programmable sensors in order to securely and accurately collect information.

The platform supports multiple connection protocols to communicate with a wide variety of sensor types. The collected data is transferred from the end-points to client systems via the platform and a user-friendly interface is provided for working directly with the data or for flexible integration with other analysis tools.

The sensors used to gather data are programmable smart devices that are cost-effective and power-efficient. They can be used to either complement existing meters or retrofit then entirely. When used in the complementary option, the entire installation is done in a non-intrusive fashion.

The Moeco platform is connectivity protocol agnostic. This enables the solution to work with a wide variety of sensors including those that communicate using Bluetooth, LoRa or NB-IoT technologies. Sensors feed into the Moeco gateway that validates the data and feeds into the data platform. Master nodes aggregate data from the gateways and submit it into storage using blockchain technology. Blockchain is used extensively to secure the data and maintain integrity and trust of the overall system.

Finally, the Moeco applications server provides data access for the customer's WEB app. A set of APIs are also provided to feed into data browsers, external apps and for other downstream integration possibilities. The following figure provides an overview of the complete solution.
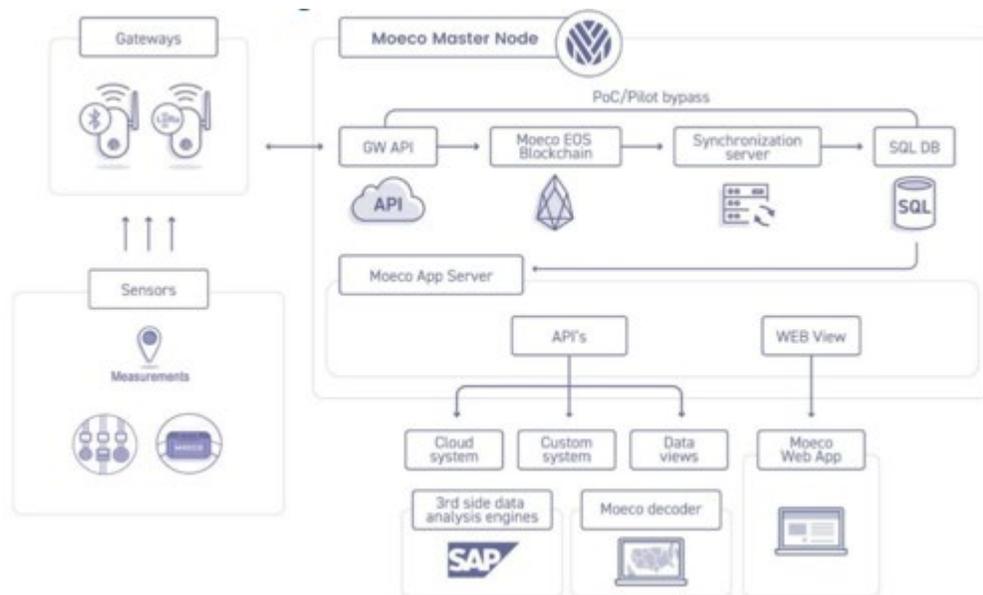
Inside the Moeco architecture

The solution is designed to be extremely scalable and the platform can include as many nodes as are needed. Due to the distributed, blockchain based architecture, it is possible to rapidly add or remove nodes.

From a security perspective, the entire transmission of data is protected with end-to-end encryption based on AES and elliptic curve cryptography. Additional protection is provided using authentication based on electronic signatures.

The Moeco solution for Smart Metering is focused on the efficient collection and dissemination of data, rather than analysis. It allows building owners to dramatically reduce the time, effort and cost of collecting data in a secure and accurate manner and to feed this information downstream for further analysis.
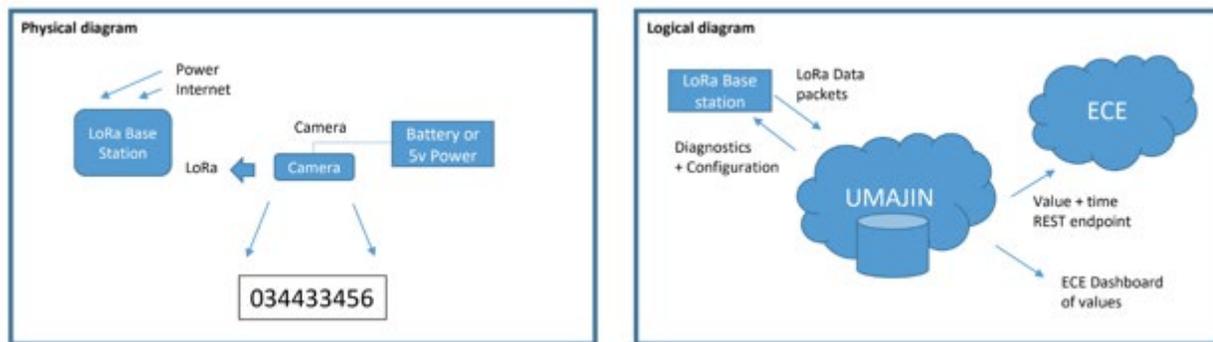
Umajin

The Umajin solution for Smart Metering is based on leveraging the existing monitoring infrastructure that is already in place at the facility. Each meter is provided with a low-cost camera that uses OCR technology in order to provide snapshots of readings.

The meters could be of almost any type including water, power, gas, pressure, temperature. The cameras are connected to a base station that then provides aggregation and forwarding to a

wider set of analysis and visualization tools. The base station also monitors the cameras at the endpoints to ensure they are operating properly.

The information can then be used for Business Intelligence, real-time control and environmental analysis depending on the needs of the user. The data is time series encoded and can be shared via REST APIs for pulling or endpoints for pushing to other repositories. There is also a web dashboard that can present the information on a computer or mobile device.


Depiction of the Umajin solution for Use Case 2

The Umajin solution completely eliminates the massive cost of having to replace existing meters with smart devices in order to gain access to the readings. This is of paramount importance in situations where the meters are owned by the utility company and not subject to replacement.

The system is highly scalable, since the cameras are low-power-low-cost and can be easily installed and integrated into the overall system. Resiliency is very high since these cameras can be battery powered to mitigate power outages or to even fit into locations that do not provide power. The communication network is redundant with the capability to either use LoRa or WiFi systems for the backhaul.

The Umajin solution has the potential to go beyond just smart metering. The technology is intrinsically flexible and well suited to a variety of use-cases such as recognizing if doors and exits are open or close, or even if the trash has been picked up. It can check for broken windows, if lights are on or off, and even be used to supplement security and safety protocols.
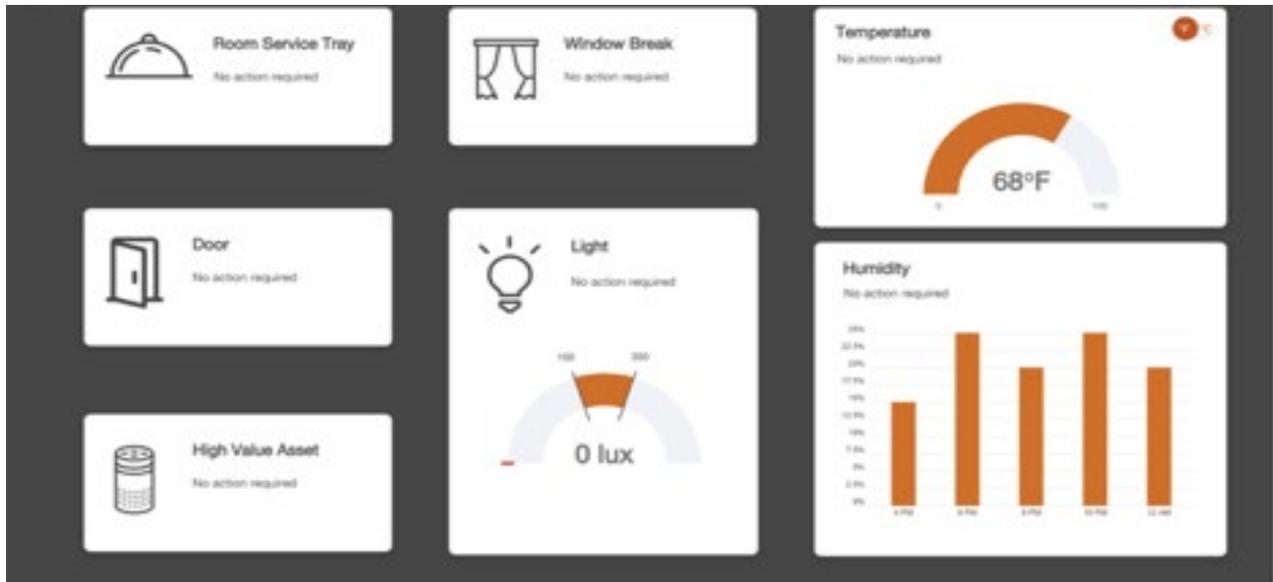
Sample Umajin dashboard

USE CASE 3 FINALISTS

Aedifion and Thing Technologies

The Aedifion and Thing Technologies co-submission integrates a comprehensive suite of data acquisition, data aggregation, data analysis and results delivery to ensure that the building under management is operated at the highest level of efficiency. Their solution utilizes established and proven processes to connect to arbitrary existing building automation systems.

A gateway computer is installed in the center and connected to the building's automation network and to the internet. A BACnet (e.g.) scan to collect meta data and send it to the cloud is conducted. Other desired data sources are connected as desired. All are subsequently tracked.

Initial deployment includes classification of assets using automated analysis of relevant data points into components. Technical Managers then approve / review the analysis and provide additional data for components. They also identify the location of respective components in the
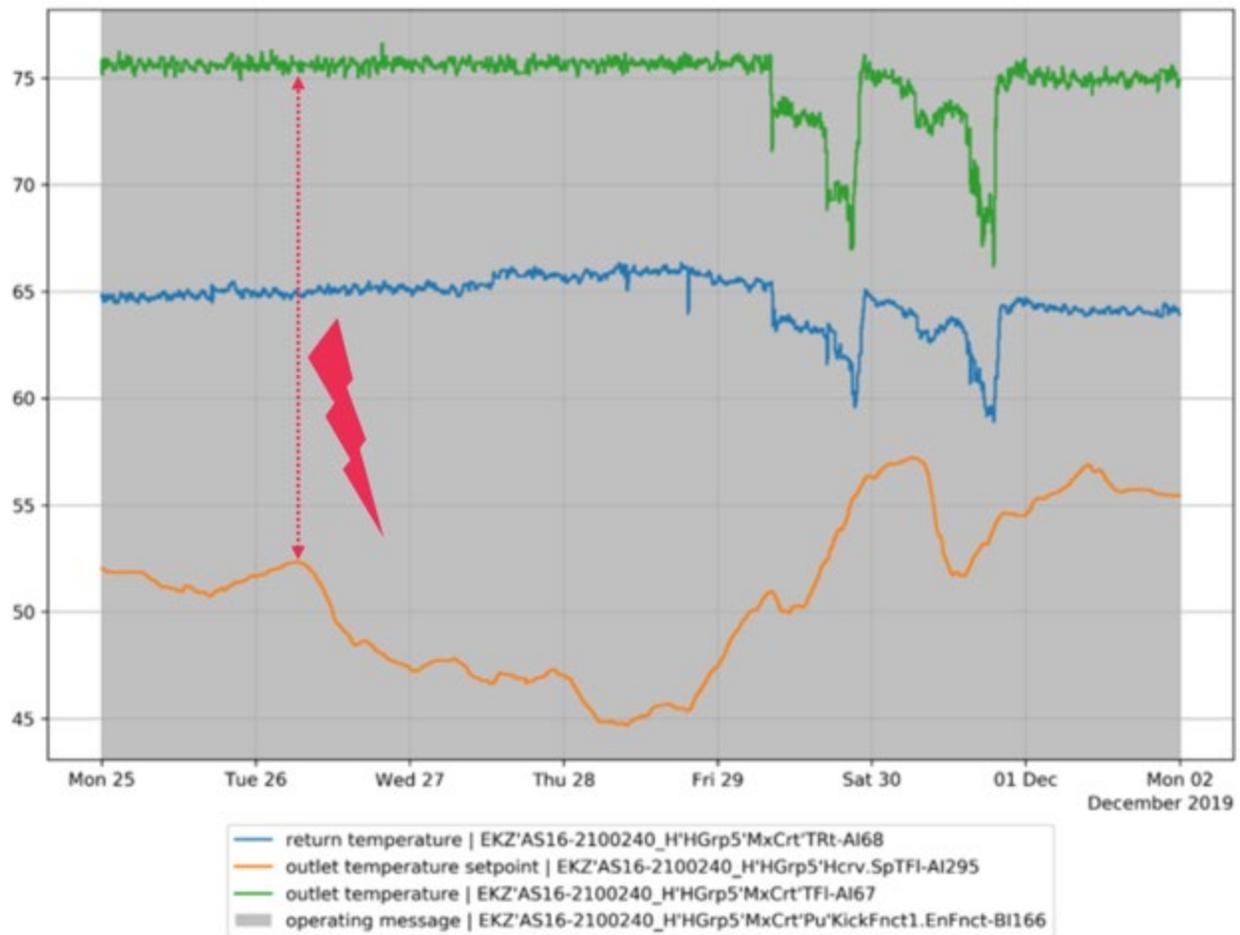
Aedifion-Thing automated analysis (ongoing)

Building Information Model (BIM), ensuring compatibility with existing standards. These data comprise heating circuits, circulation patterns, tens of thousands of data points for various parameters.

Mapping adds meta-information that aids AI in analytics. The AI used utilizes field-trained neural networks to ensure that the analysis maps to the real world.

Subsequent data analysis is highly automated and conducted in real-time. Multiple approaches include:

- Schedule Analysis - is the equipment operating according to an expected duty cycle?
- Setpoint Deviation Analysis - deviation of operating parameters from an optimal setpoint is a powerful metric and drives real-time remediation.

The Use Case 3 business perspective is, at its core, about reducing utility costs and increasing sustainability. With this solution, all involved will see value. Technical Management will see constant, automated analysis of high consumption components in the center and highly specific optimization suggestions, fault detection on technical building equipment, and additional forecasting of system behavior.

The solution will deliver improved process management to ensure recommendations are being followed-up, integrated with overall center technical workload management. Commercial Management will be able to offer better service to tenants that greatly increases the attraction of center to prospective tenants. The tenant will enjoy reduced utility costs and increased sustainability.

Aedifion and Thing Technologies provides an established and proven process to connect to arbitrary existing building automation solutions and deliver all collected data to the cloud.

The solution employs AI supported identification of relevant data points in sets of tens of thousands. It utilizes algorithms that systemize engineering knowledge and allow for automated execution and identification of energy optimization potential over these large data sets.

In addition, it can leverage existing mobile phone apps and web dashboards to support the mobile workforce in the center during issue detection, analysis, and resolution.

Cloud Studio

The Cloud Studio solution focuses on making all of the managed premise's technical equipment controllable from within the center in order to create a system for reducing energy consumption and maximizing infrastructure availability.

It utilizes the best-of-breed Gear Studio Smart Studio platform to provide an energy management solution via platform as a service (PaaS). It delivers intelligent plans for lighting, HVAC, real-time energy monitoring, ambient variable monitoring. The pillars of the solution are: Metering, Sensors, Intelligence, Lighting, HVA.

Cloud Studio is not tied to proprietary protocols and hardware - it supports a variety of meters and monitors, BACnet, Modbus, wireless and allows sensors and lighting control actuators of various types. The monitoring is displayed via customizable dashboards – which can be defined on a per-tenant level if desired.
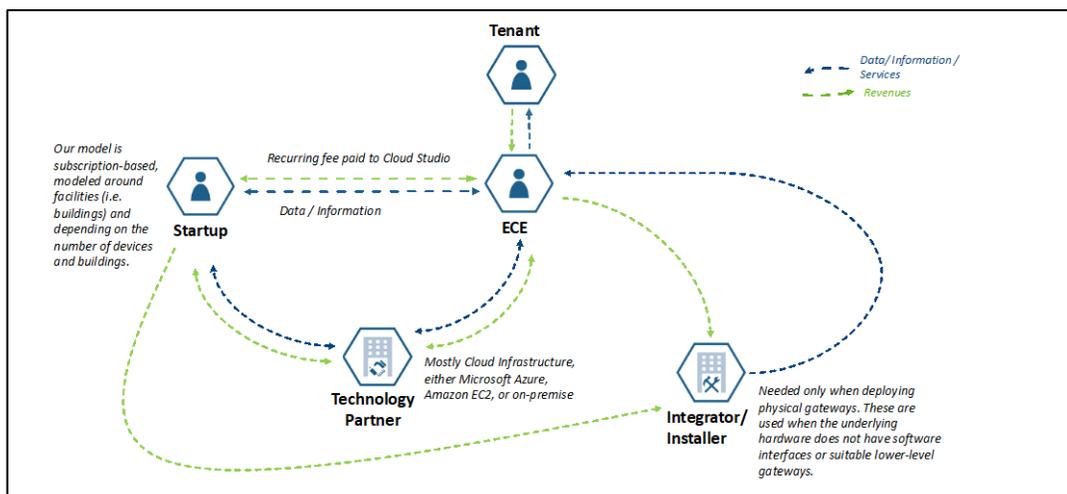
Cloud Studio subscription model

Cloud Studio support local and global hardware, and are compatible with all popular protocols, such as: MQTT, Modbus, LoraWan, Zigbee, WiFi, and SigFox. The rules-based intelligence incorporates tenant and customer occupation, objectives, thresholds that allow precise management of the entire facility.

Uniquely, Cloud Studio can accommodate non-IoT assets as well, for example general inventory, including things such as chairs, tables, things that can break.

The platform can be configured to provide automatic delivery of pertinent reports which can be scheduled as needed. Cloud Studio provides the GEAR.STUDIO platform to operators and charges them a recurring per-facility fee. In most cases, the company also provides them with hardware – DIN-rail and in-wall actuators and 5-in-1 sensors – to deliver a turn-key solution.

The Cloud Studio solution is different from others in the market in several ways:

- It's multi-tenant out of the box. Most solutions out there (mostly BMSs) are not.
- It's not hardware-bound. The company develops its own gateways, but has gone to great lengths to make sure it can use anybody else's hardware, as long as it's based on a reasonably open standard.

The platform is licensed as a service enabling Cloud Studio to offer an active upgrade/evergreen path. The whole range of applications is covered, from monitoring, metering, and sensing, to actuating and executing carefully-designed energy-saving plans.

The cloud-based infrastructure leverages either AWS EC2 or Microsoft Azure which provides availability and data protection.

USE CASE 4 FINALISTS

BuildingMinds

The BuildingMinds solution for the Smart Building Cockpit Use Case consists of a data-driven management platform delivered using the SaaS model.

The solution provides integrated full-scale performance analytics using standardized and custom dashboards. These dashboards can provide a portfolio level view or a stakeholder view. The portfolio view that has the ability to drill down across facilities right down to the building-floor-space or device level. The stakeholder view provides insights that can be tailored to the category of users, for example different information for C-Level management vs that for Facility managers.
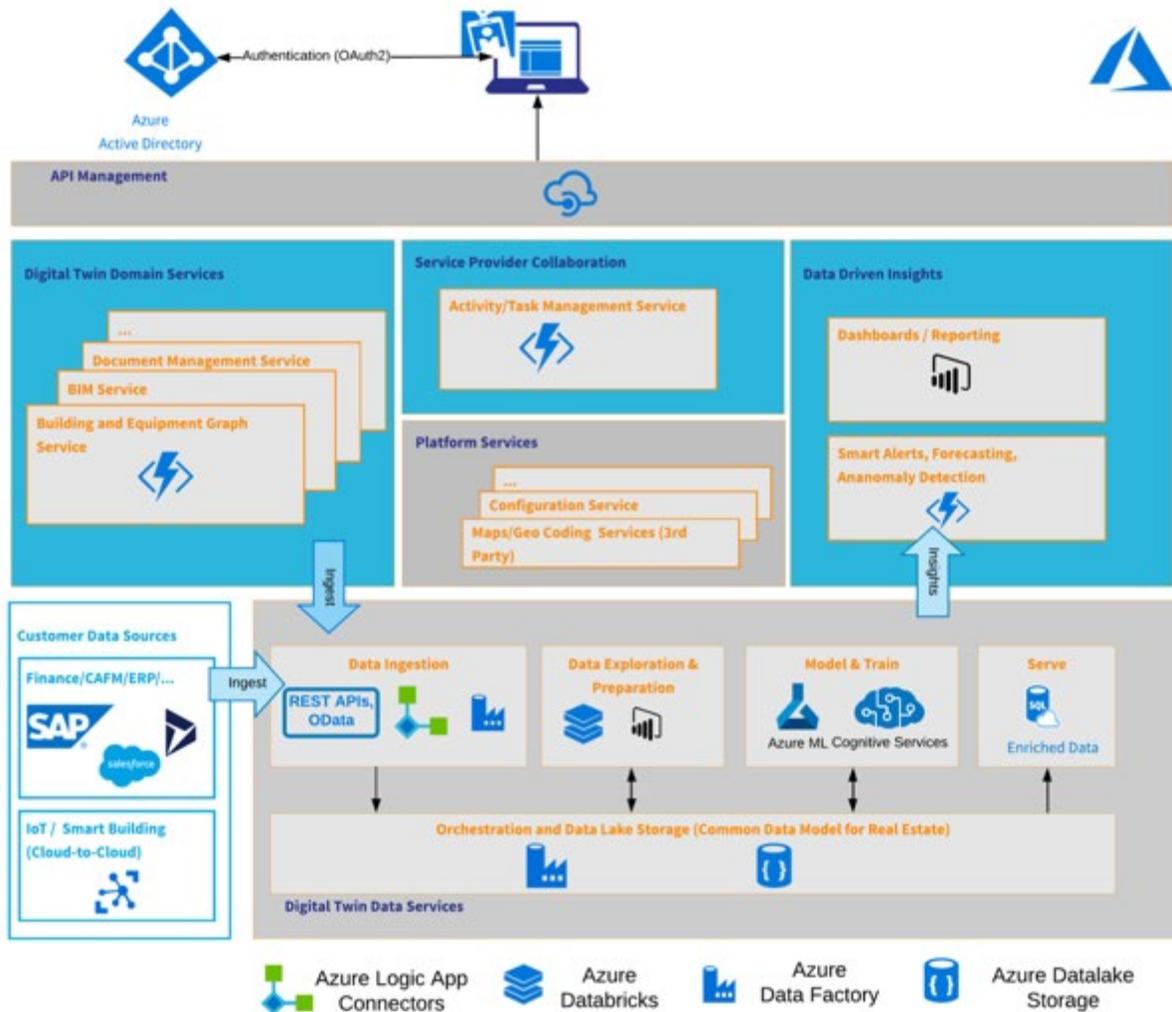
BuildingMinds technology architecture

The solution is based on the ability to collect data from just about any source that has an API. The collected data is then normalized and augmented in an integration layer. Outside of the presentation and integration layers, the solution is based upon a system that consists of a Digital Building Twin (DBT), a Common Data Model and Closed-loop Operations.

The DBT is the foundation that integrates all the systems and data sources within the business to work as one living ecosystem. It feeds the analytics engine to deliver data-driven insights, and supports the workflows that enable closed loop service provider collaboration.

The DBT generates insights based on key data about area, space, documents, equipment and sensors. The Common Data Model is constructed around the Digital Building Twin by connecting data from various silos to it. As the DBT matures and evolves with each added data source, the more robust and meaningful the visibility, insights, and benefits generated.

Closed-loop Operations leverage new data-driven insights to increase efficiency and quality of the collaboration and help the operator to control process from end to end.

The system is capable of generating Smart Alerts. These alerts are threshold based and can be configured to trigger downstream process flows.

It is important to note that the BuildingMinds solution is completely software based, and as a result highly customizable. The platform can be tailored and shaped to suit the evolving requirements of the customer and new features can be rapidly added as the need arises.

Holisticon (and its subsidiary Markenwerk)

The Holisticon solution for the Smart Building Cockpit Use Case defines a framework that capitalizes upon the intelligence of the mall in order to provide customized reports to diverse end users. It does this by consolidating information into a reporting pipeline and then tailoring the subject matter for delivery to the appropriate audience.

The solution follows an iterative development model that starts with the definition of a minimal viable product (MVP) and then incrementally adds features and capabilities in order to realize an application ecosystem that meets more complex needs. The later phases of the solution talk to delivering a dashboard-based model that provides advanced visualization and the customized dispersion of information.
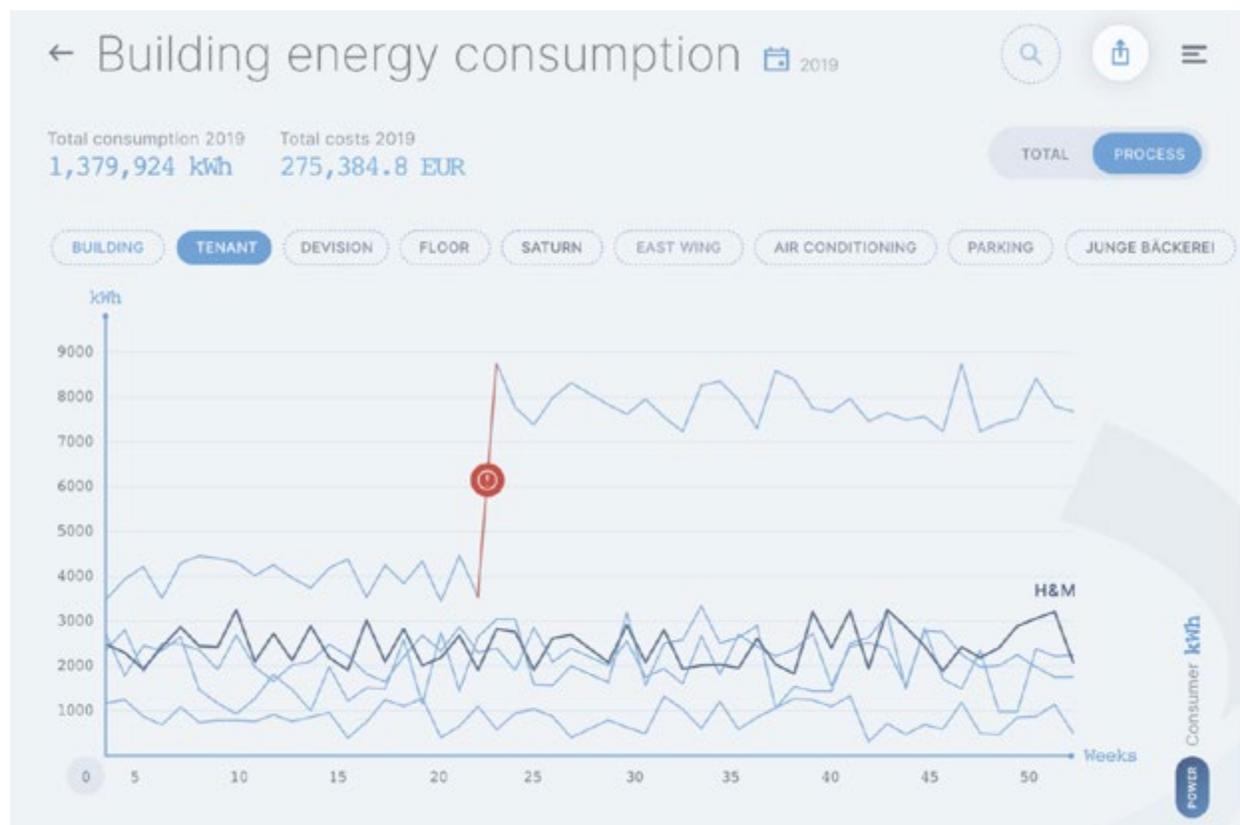
Holisticon report identifies energy consumption anomalies

The initial target audience is based around the two primary functional management aspects of the mall. These are the technical managers dealing with operational aspects and the facility managers dealing with management issues. The reporting data can be shared amongst audiences and customized as needed.

The initial reports are based upon the results of an extensive analysis phase in order to determine the most consequential data-points of interest. The operational and management reports provide for real-time monitoring as well as anomaly detection.

The core architecture of the solution consists of a backend that is focused on the collection of data, and a front end that organizes, enriches and presents the output data. The backend consists of a gateway that provides a secure connection to the bus that provides the primary data collection from the IoT sensors located across the mall. The frontend consists of scraper that organizes the data, a centralized repository and a monitoring system coupled with a dashboard.

The front-end has the ability to connect to multiple backend data generators in order to cater to multi-mall scenarios. Elements of the architecture can be deployed as cloud-based microservices, and the final product has the potential to include authentication and authorization mechanisms to provide security across the entire system.

Future enhancements to the system include the ability to incorporate workflow management to manage tasks, events and routines. With the inclusion of a mobile-app, the overall usability of the system can be enhanced to provide maps and useful information for technicians and managers on-the-move.

The Holisticon approach provides for an extensible, customizable framework that captures the intelligence of the mall in order to deliver a comprehensive reporting solution.

Umajin

The Umajin solution for the Smart Building Cockpit is a software only solution designed to run on laptops, tablets and smartphones to provide an extended 3D digital twin. The extended digital twin is built using powerful 3D rendering technology that ingests data from GIS or CAD building data in order to portray a visually realistic model of the facility under management. This 3D model then provides the basis upon which other information is overlaid.

The system interfaces with just about any other data source or live system in order to provide insights into the assets within the facility. Once the model is built, it provides for real time spatial analysis and queries in order to derive and portray insights in a highly sophisticated, easily understood manner.

Visualization can be customized based on any of the data sets that feed into the system. These could include any of the other systems that are providing data for space flow, metering and automations within the facility including the BuildingMinds data model, BIM, CAD, GIS and Laser Scanning systems.
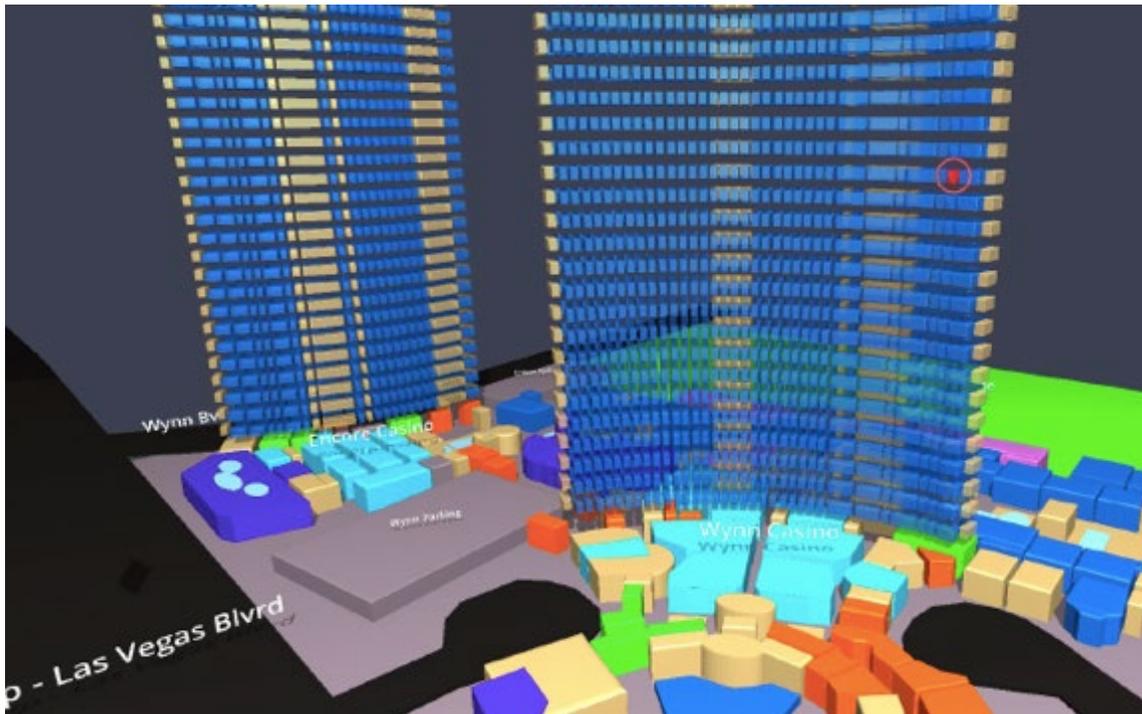
Umajin 3D rendering technology shows an asset visualized within a property

Due to the sophisticated nature of the visualization provided by the software, a GPU is required as part of the hardware that supports the solution. The rendering capabilities are extremely advanced and can even scale to provide real-time visualization for multiple facilities at a citywide level.

Cockpit is designed to be highly scalable and complementary to other data frameworks in use. As new data sets become available, they can rapidly be added to the model to supplement existing functionality.

The insights generated by the system are completely dependent on the quality of the inputs and it comes as no surprise that the solution is extremely flexible and customizable when it comes to interfacing with other systems and sources. Once data sources are setup, fresh data queries, visualizations and dashboards can be added and modified with ease.

The highly customizable nature of the solution means that reports can be provided on a real-time as well as historical basis for deeper analysis.

NEXT STEPS

If your organization would like to participate in the next round of the Smart Buildings Challenge, please click here to explore opportunities for Principals, Enabling Technology Partners and

Contestants. For an overview of the different roles and contributions of the challenge participants, review the descriptions on our IoT Challenges webpage.

We invite you to work with us to learn more and address this exciting opportunity. Please join us!

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