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Maximizing Health & Safety:

Digital Transformation and the Introduction of Smart Spaces in Factory Settings

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Executive Summary

Industry 4.0 technology is transforming how health and safety standards are optimized in manufactory through technology and automation. The term Industry 4.0 represents the new fourth technology revolution utilized in production and supply chain lines. Throughout this whitepaper Industry 4.0 will be used interchangeably with smart machines. Smart machines also have an impact on the Industry Internet of Things (IoT) for new software system communication and capabilities. Utilizing Industry 4.0 technology usually results in:

- Ability to forecast and expertly analyze trends with real-time data

- Early detection for issues in factory operations

- Complete, up-to-date data for equipment and their functionality

- Increased profits and cost-saving through maximized product output

With Industry 4.0 technology, production management and their teams can now optimize their networks with machine learning capabilities and receive information quicker than ever before. In addition, monitoring and data reporting is evolving within the IoT and machine learning to improve previously utilized reporting and data processing standards, significantly enhancing the manufacturing industry and supply chains.

These smart machines are creating complete smart spaces, which are "physical locations equipped with networked sensors to give owners, occupants and managers more and better information about the condition of those locations and how they're used." As a result, companies taking advantage of incorporating smart spaces maximize their potential, creating more intelligent high operating factories.

- Smart spaces are implemented across multiple industries and factories to:
- Notify management for machine repairs and updates
- Maximize efficiency opportunities in the factory
- Early detection and response rate for incidents
- Safeguard workers from viruses spreading due to limited contact
- Use up-to-date information flows to manage incidents

Industry 4.0 utilizes artificial intelligence (AI), machine learning (ML), IoT, and automation to improve systems and protect workers by reducing risks and creating more efficient processes.

Overview

What Makes a Factory Smart?

Let's further discuss a smart factory and its importance in creating a safe environment for workers. Perhaps most simply put, a smart factory is "where physical production processes and operations are combined with digital technology, smart computing and big data to create a more opportunistic system," which aids in management decision making and advanced operational capabilities. Smart factories don't just innovate the way in which we protect workers but have energy and cost-saving potentials through sensors and their supporting functions.

Smart factories are made up of diver's technological capabilities through automation, sensors, machine learning, and industry IoTs. These improvements and communication capabilities not just between the machines themselves but their reporting capabilities to management provide the up-to-date information needed to make informed, safe decisions.

Creating smart spaces in factories creates multiple advantages, and several of them include:

- There are considerable budget reducing environmental advantages because of accurate internal factoring temperate adjustments to match surrounding weather
- Both management and their workforce can work in a secure safe environment with technology that has early threat detection capabilities and intelligent security systems
- With remote data updates on technology processes, management will have the information they need to keep systems up-to-date with accurate maintenance plans to avoid possible safety threats

Integrated Solutions Build the Digital Enterprise

To take advantage of Industry 4.0 potential, it's crucial to incorporate numerous smart machines to create smart factories and maximize industry technology. It is essential to consider the product lifecycle management (PLM) from research and development, design, and support services when incorporating smart machines to aid the PLM. Combining smart machine capabilities within the manufacturing execution systems (MES) will create true strategic cohesion for the development process and release of products to the supply chain.

Technological advances

Low-power wide-area Networks

Low-power wide-area network (LPWAN) is cost-effective and efficient for utilizing IoT technology for a wide range of areas that use battery-powered sensors. LPWANs are growing in use in telecom industries, with over 40 in use now and more projected to be utilized in coming years. Additionally, LoRaWAN, a "low-power, wide area networking protocol built on top of the LoRa radio modulation technique," is widely used in over 100 countries. These proficient technological networks are becoming key in this new standard of technology innovation.

5G Networks

5G networks are significant for industry 4.0 technology due to their efficient speed and accurate real-time data analysis proficiencies. In addition, 5G networks enhance IoT technology capacities for more intelligent manufacturing management.

Edge Computing

Edge Computing has become a valuable component of Industry 4.0 technology advances since it "is a system of micro data centers that are installed at the edge of the network," creating new opportunities for the IoT technological processes. In addition, edge computing is a proficient cost-saving way to collect and analyze data that has a more minor impact on the network it operates on and can maximize smart machine capacities.

Artificial Intelligence

One of the most impactful leading components of Industry 4.0 is Artificial Intelligence (AI) for its data collection and analysis capacities. The IoT technology incorporates AI capabilities such as machine learning to assess and decide process flows in impactful approaches. AI has numerous applications for smart machines to predict data trends and machine maintenance, monitor data flow and consolidate and organize data collection.

Use Cases

Machine Productivity Optimization

Another critical application within Industry 4.0 is overall equipment effectiveness (OEE) for granular data visualization. OEE is incredibly important for manufacturing analysis and for identifying performance indicators of smart machines, which is vital for the equipment's longevity. When granular visualization is used for OEE, there are more efficient capabilities such as early detection, data analysis, and problem causality identification for better overall machine maintenance.

Operational monitoring, alerting, and anomaly detection

Production line monitoring with AI capabilities, like machine learning, is valuable to Industry 4.0 abilities for factory operations with smart machines. Management and teams can utilize early problem detection technology, machine maintenance predictions, and real-time machine data to respond to issues on the production line before they arise. In addition, operational threshold monitoring can provide insight into smart machines where potential anomalies may exist even if they are working within set constraints.

AI Powered Production Optimization

There are three primary communication standards that create the cohesive ability for communication between machines and provide data back to industry workers and management: MTConnect, MQ Telemetry Transport (MQTT), and Open Platform Communications United Architecture (OPC-UA).

When these technological capabilities are incorporated into the enterprise resource planning (ERP) strategy and applied to the MES through AI capabilities, it creates an intellectual stream of data for collection and analysis that can optimize factory production. This optimization through information and communication includes receiving valuable data for areas of opportunity and early detection of potential issues on the production line, creating more efficient production abilities to fulfill orders on time.

Maintenance Optimization

Industry 4.0 software can help to create the information availability and processing required. Machine and sensor data is recorded and displayed in real time, providing the basis for real-time condition monitoring. Data visualization is not restricted to the control station.

Consequently, Industry 4.0 solutions enable manufacturers to implement preventive maintenance in a targeted manner. Experts in the plant can continuously improve the maintenance cycle. Maintenance technicians can continue to tweak the condition monitoring parameters as time goes by and also add new parameters. The knowledge library of maintenance and repair hints and instructions can be constantly expanded and updated, leading to a continual improvement in repair times.

Improving Worker Safety

Worker's safety must be a priority when it comes to production line work since these workers endure strenuous and sometimes dangerous working conditions and environments to keep supply chains moving. Another benefit to incorporating smart machine technology, besides keeping workers safe, is the cost-saving potentials by avoiding injury or litigation expenses.

Improving industrial machines and their technology can help to alleviate stressors and make conditions safer for industrial workers. Some examples of how Industry 4.0 technology can make smart machines and factories safer for industrial workers:

- Safeguarding employee health with the resourceful informational flow and early detection for at-risk or dangerous situations
- With real-time data reporting and machine maintenance updates and sensors, there is better reliability for smart machines along production lines
- Immediate data and reporting capability for incidents that occur in the factory can quicken the response rates for emergency response operations
- More efficient temperature monitoring to provide comfortable, safe working conditions

Accelerators / PoCs / Demos

GL Intelligent Spaces Accelerator

Overview

Over the last thirty years, facility management has rapidly evolved alongside continuously changing technology capabilities. Technology has truly revolutionized facility management from automatic temperature control adjusting, equipment maintenance monitoring, and real-time data analysis by facility management. The COVID pandemic has only amplified the need for technology and automation for generally human-centric workplaces.

Industry 4.0 technology, AI, ML, and data analysis align to provide an easy and configurable solution to today's problems. This connected digital ecosystem constantly learns to fit the requirements of developers and satisfy the needs not only of facility management but their vitally important workforce.

Value Proposition

- Possibility to evaluate design intent against the real situation;
- Unobtrusive mechanism aimed to cope with rules limitations;
- Real information about the quarantine limitations compliance and insights based on it;
- Interaction transparency and predictability to lower stress and anxiety;
- Improved operations and energy management;
- Use technology that is already in place or available.

High-level Architecture
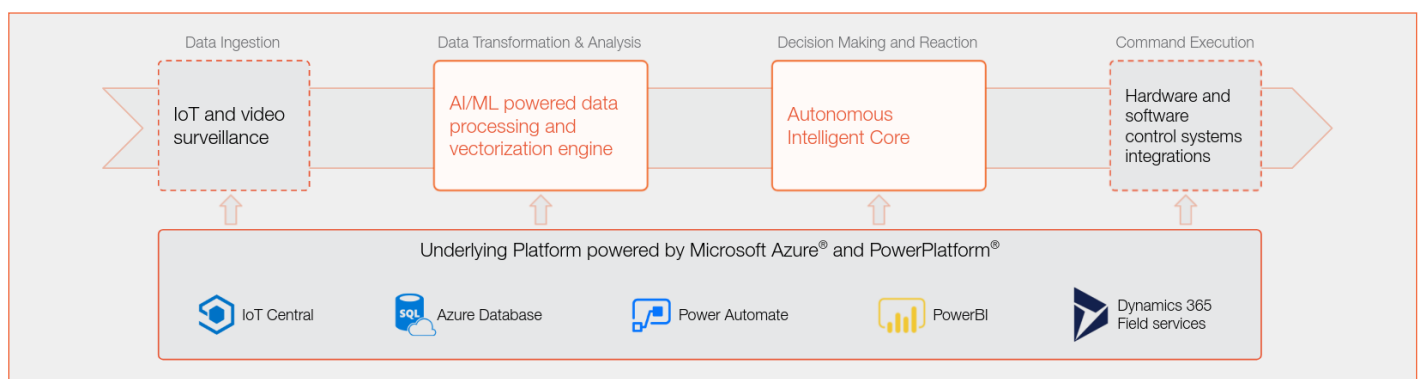
Data Ingestion
On the data ingestion layer the system collects data from different sources (video surveillance, IoT sensors etc, badge control systems, WiFi and Bluetooth beacons)

Data Transformation & Analysis
Once the data is collected the system analyzes it in order to understand if everything is on track.
Also, the collected data is published in a BI tool (in our case it's Power BI but any tool could be used) so an administrator can see the current state of different parameters.

Decision Making & Reaction
Flexible and Configurable decision engine provides the ability to build the flow of any incoming event. The big set of the predefined flows and rules allows to set up the system at any facility with the minimum configuration effort, at the same moment the possibility of creating custom rules and flows lets composing custom and flexible ways of facility events processing.

Use Cases (Scenarios)

Employees, managers and HR services get a lot using the Intelligent Spaces solution. Decreasing the costs via the flexible energy and heat management, increasing the convenience and making employee experience better, allowing the easy navigation and people location. Furthermore the HR and Administration managers are able to react to the COVID incidents via tracking the path and contacts of the infected visitor.
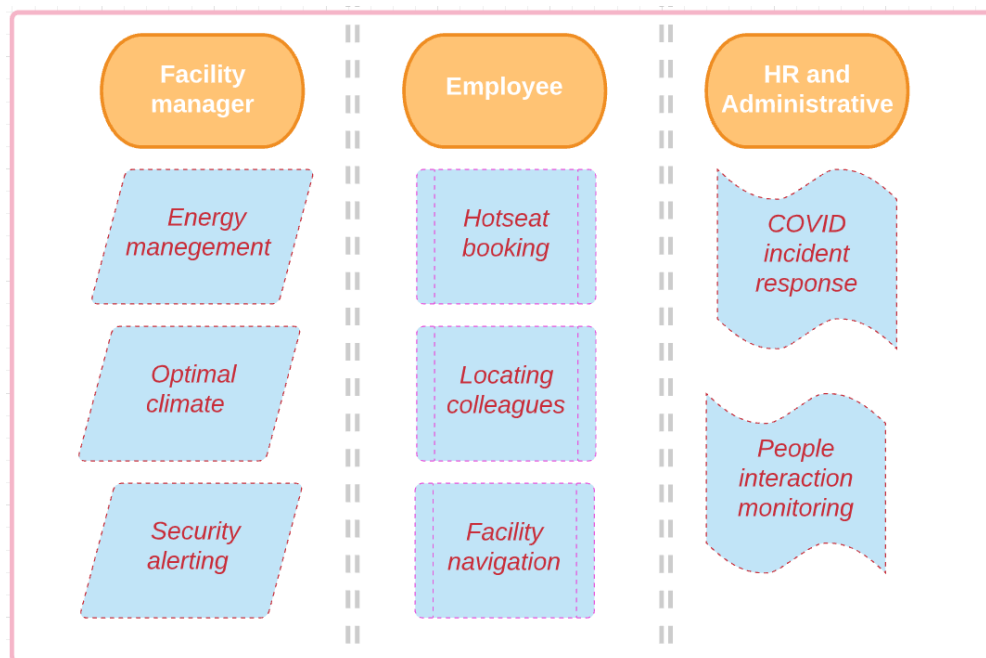
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