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Setting the Standard for Automation™

IMPLEMENTATION OF EMERGING TECHNOLOGIES IN FERTILIZERS INDUSTRIES

Presented By-

1. Anand Srivastava
2. Arun Ven
3. Pramod Gupta
4. Sheikh R. Manihar Ahmed

FLUOR®

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IMPLEMENTATION OF EMERGING TECHNOLOGIES

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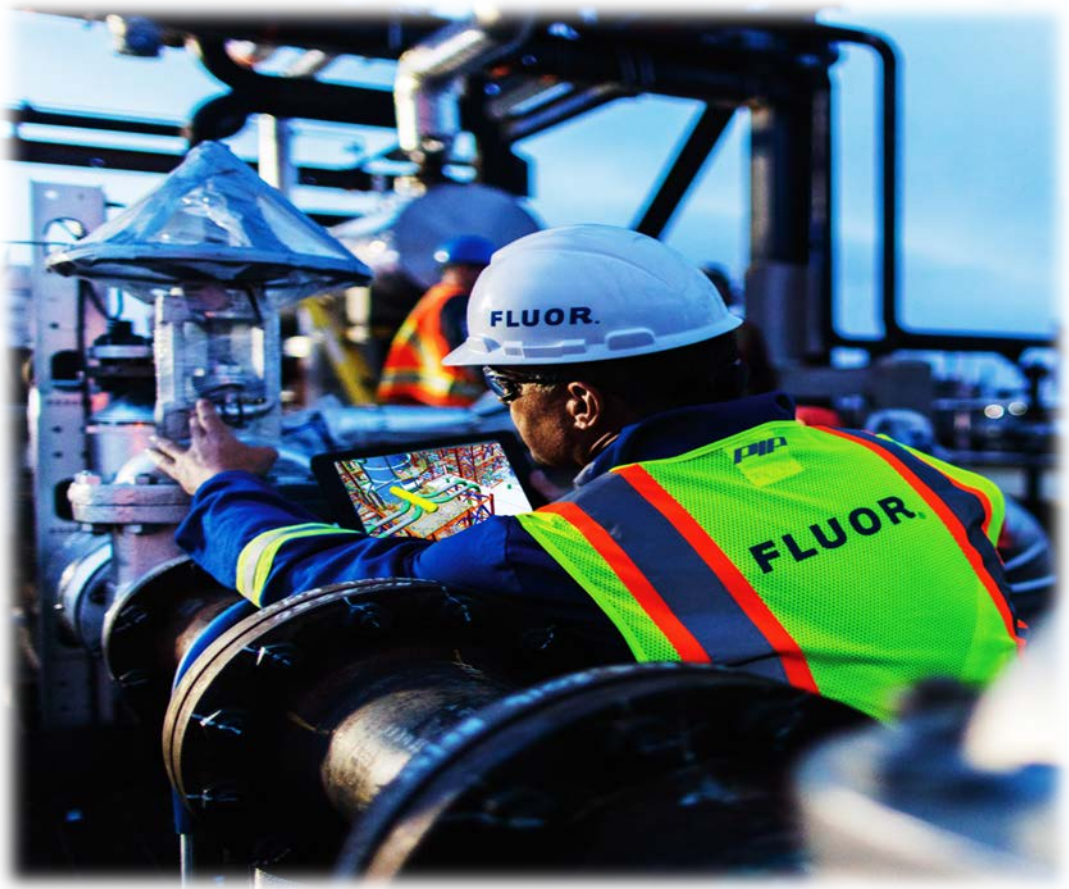
In today's business environment, organizations must deliver products and services to the global market place faster than ever *(which is clearly visible from the market outlook)*, yet efficiently planning and executing projects is often easier said than ever. With reducing profitability & margins, the organizations should now focus on replacing older technologies and complex work processes with latest digital technologies to *improves efficiencies*, *increasing time-up*, *cutting costs*, *increasing safety*, *enhancing recoveries*, *decreasing down time* and *increasing in environmental compliance*.

Digitalization has existed for decades and has been successfully implemented in other industries such as retails and healthcare, however manufacturing industry especially fertilizers have been neglected, probably due to higher initial investment. But with the recent enhancements *optimization in work processes* have made the digital technologies more viable for fertilizer industries.

This is an attempt to explore the areas where emerging technologies can be implemented.



APPLICATION OF EMERGING TECHNOLOGIES

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Application of emerging technologies in the fertilizer industries encompasses a wide range of innovation such as

1. **Automated Production Asset Operation.**
2. **Biometric Enable Devices.**
3. **Field Productivity.**
4. **Fully Immersed.**
5. **In-field Manufacturing.**
6. **Logistics Management.**
7. **Remote Asset Inspection.**

These emerging technologies enables fertilizer projects to deliver products and services to the national as well as global market place faster than ever economically.

1. Automated Production Asset Operation

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1. Automated Production Asset Operation:-

- ✓ **Drones, Robotics, or other automated equipment performing operating, assembly and maintenance tasks in continuous and safety-critical operating environments.**

2. Advantage:-

- ✓ **Machine intelligence allows equipment to sense conditions in their local environment;**
- ✓ **recognize and solve basic problems ;**
- ✓ **and operate independently of human direction.**

3. Example:-

- ✓ **Inspection at height.**
- ✓ **Data collection and analytics.**
- ✓ **Reporting.**
- ✓ **3D Modelling.**
- ✓ **Earthworks surveying.**

Figure.1 Global collaboration between Fluor's drone experts has accelerated the use and adoption of UAVs on Fluor projects.

2. Biometric Enable Devices

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1. Biometric Monitoring:-

- ✓ **Using wearable devices capable of continuously monitoring employee location, movements and other indicators in real time, to provide feedback to workers and detect dangerous situations such as gas leaks and accidents.**

2. Advantage:-

- ✓ **Increase worker safety and productivity by tracking worker location and basic vital signs, enabling advanced warning of hazards like gas leaks, decreasing emergency response times and fall detection.**

3. Example:-

- ✓ **Smart devices and emerging wearable technology provides field workers with instant access to information about equipment and facilities, optimizing inspection and maintenance activities.**

Fluor's Safety Pin℠ Safety Pin uses existing technologies and integrates them in a new way to provide enhanced worker safety. This is under development in North America.

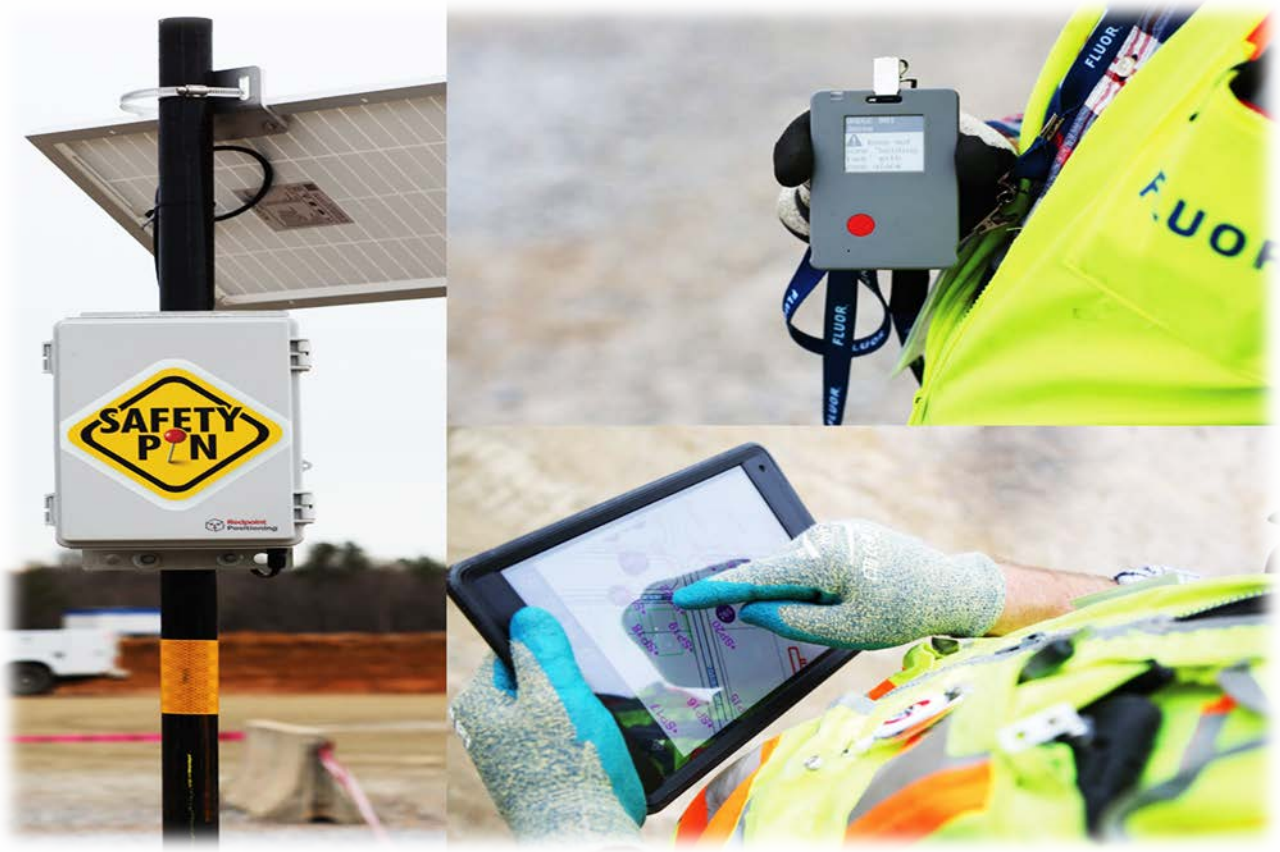

Figure.2 **Fluor's Safety Pin℠ makes critical real time information available at the touch of a finger.**

3. Field Productivity

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1. Field Productivity:-

- ✓ Maximizing worker efficiency by providing wireless mobility that enables on-demand access to field data, engineering drawings and inventory tracking, and communication with centralized operations experts.

2. *Advantage:-*

- ✓ Enable field staff to be fully connected to the head office and able to track and control assets remotely.
- ✓ Take insight from historical database of previous projects.

3. *Example:-*

- ✓ Using intelligent routing to coordinate field personnel and equipment movements based on factors such as skill sets, distance and inventory availability.

4. *Application in Fertilizers Industry:*

- ✓ During Instrument Loop checking.
- ✓ Before commissioning.
- ✓ During Maintenance.
- ✓ During Downtime.

Figure.3 Fluor's Virtual SME allows projects to search our entire workforce for the right expert and instantly connects them to site conditions.

4. Fully Immersed

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1. Fully Immersed:-

- ✓ **VR has burst into video gaming, designing, and architecture and has created a new experience for users. Fluor has been developing VR far before it entered the mainstream, helping our clients experience their facilities and walk through their plants before ever breaking ground.**

2. Advantage:-

- ✓ **Constructability, Operability, and Maintainability: Understanding the execution sequence and equipment, Operator training.**
- ✓ **Safety-Focused opportunities: Safety training and assessments, Assessment of space requirements for safe operation and maintenance of facility.**
- ✓ **Productivity enhancements: Execution equipment placement, Quality verifications**

3. Example:-

- ✓ **Craft training.**
- ✓ **Safety training.**
- ✓ **Model reviews and operability.**

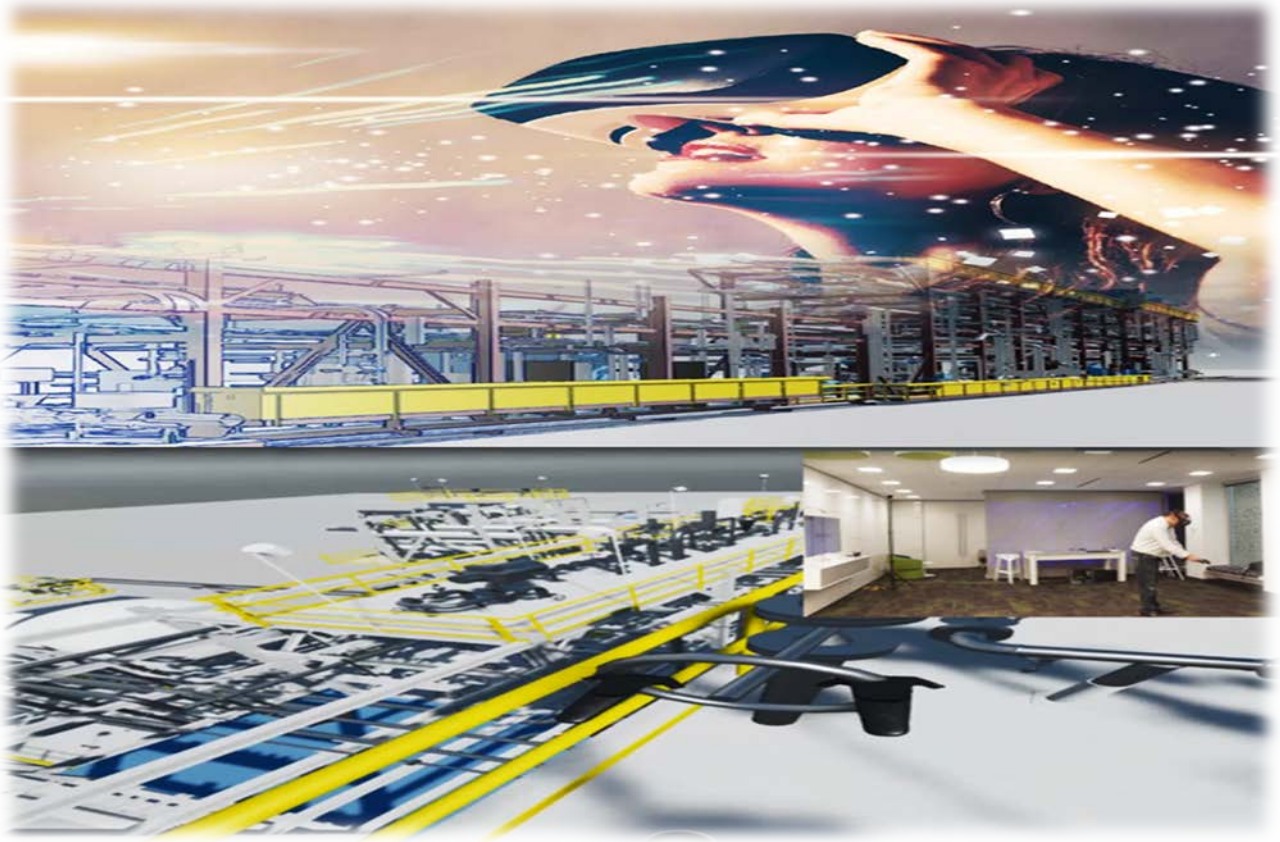

Figure.4 Fluor's virtual reality (VR) solution offers clients and employees an immersive and life-like experience for safety training, reviewing models for constructability and operability.

5. In-field Manufacturing

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1. In-field Manufacturing:-

- ✓ **Operating portable manufacturing equipment to reduce downtime from critical part failure by producing specialized components/parts on site and on demand.**

2. Advantage:-

- ✓ **Reduces downtime created by delays in moving parts and equipment, allows companies to reduce inventory needs for spare parts.**

3. Example:-

- ✓ **Enterprise 3-D printing technology enables the manufacture of replacement parts in remote locations eliminating costly delays in locating and transporting an existing piece of equipment.**

Figure.5 Images collected by 360-degree cameras are paying huge dividends in project communication and execution.

6. Logistics Management

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1. Logistics Management:-

- ✓ **Obtaining real-time data-through the use of wireless networks, GPS sensors and video analytics-from on-board sensors to improve asset identification, RFID tracking, utilization and logistics operations.**

2. Advantage:-

- ✓ **Optimize labor density based on material availability, optimum utilization of shipping volume, improve supply chain and procurement functions, minimize input material and energy costs, and tracking materials in real-time.**

3. Example:-

- ✓ **63% of the average craft laborer's time is spent off tools with the largest portion spent waiting on materials.**
- ✓ **RFID system improves receipts and tracking while eliminating manual yard checks and paper-based documentation.**

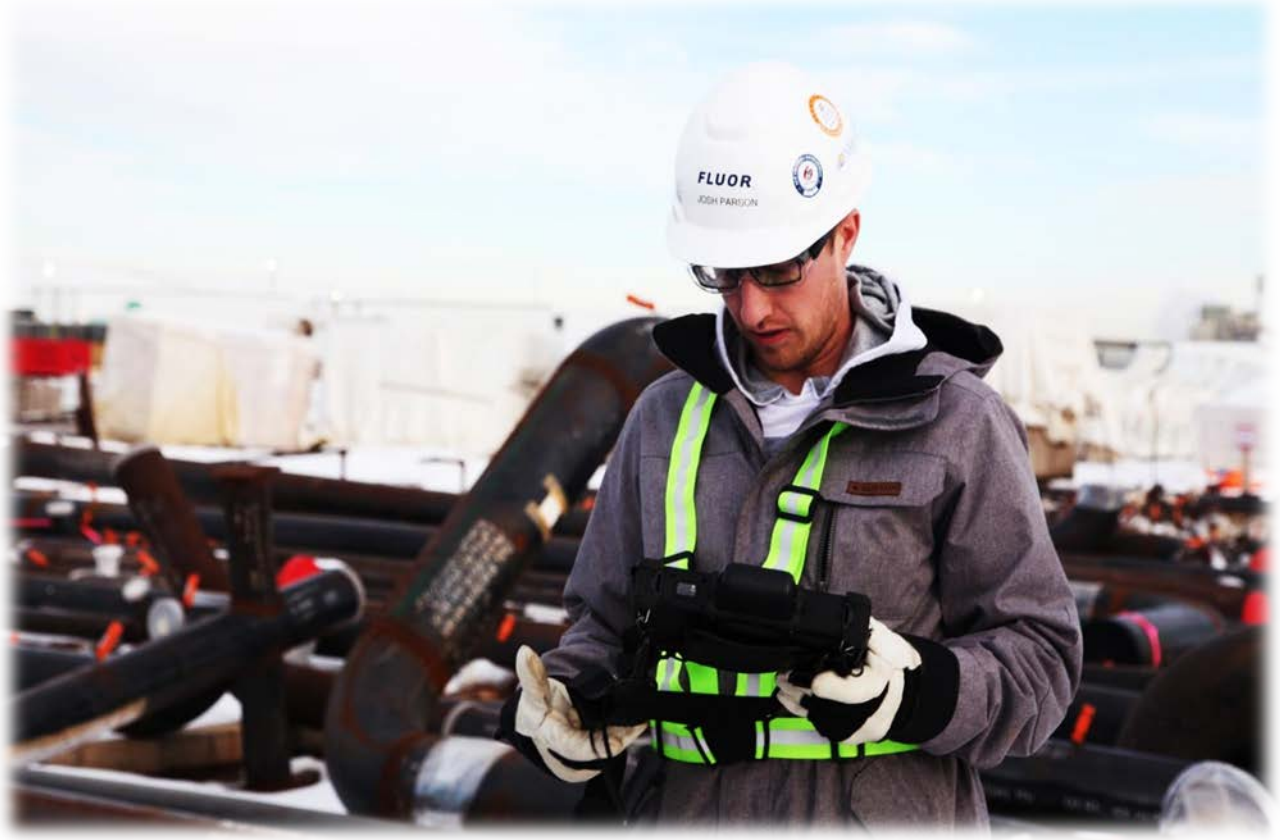

Figure.6 **Fluor's RFID solution improves operational control and tracking of assets leads to improved productivity**

7. Remote Asset Inspection

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1. Remote Asset Inspection :-

- ✓ **Collecting and analyzing sensor data related to flow, temperature, vibration and integrity to improve operational safety and performance-related decisions.**

2. Advantage:-

- ✓ **The seamless flow of information to the field via technologies like digital mobile telephony and satellite allows for real-time analysis and response.**

3. Example:-

- ✓ **The two-way flow of operations- critical data allows companies to remotely monitor and control equipment such as compressors and flow meters, detect and diagnose problems, and optimize operations.**

Remote Visual Inspection (RVI) virtually connects inspectors, project members, client representatives, and global SMEs in real-time to project inspection, testing and surveillance activities, providing a method for more effective and efficient results. RVI leverages Fluor's Virtual SME tool to livestream and capture material & equipment surveillance activities as they occur in a vendor location.

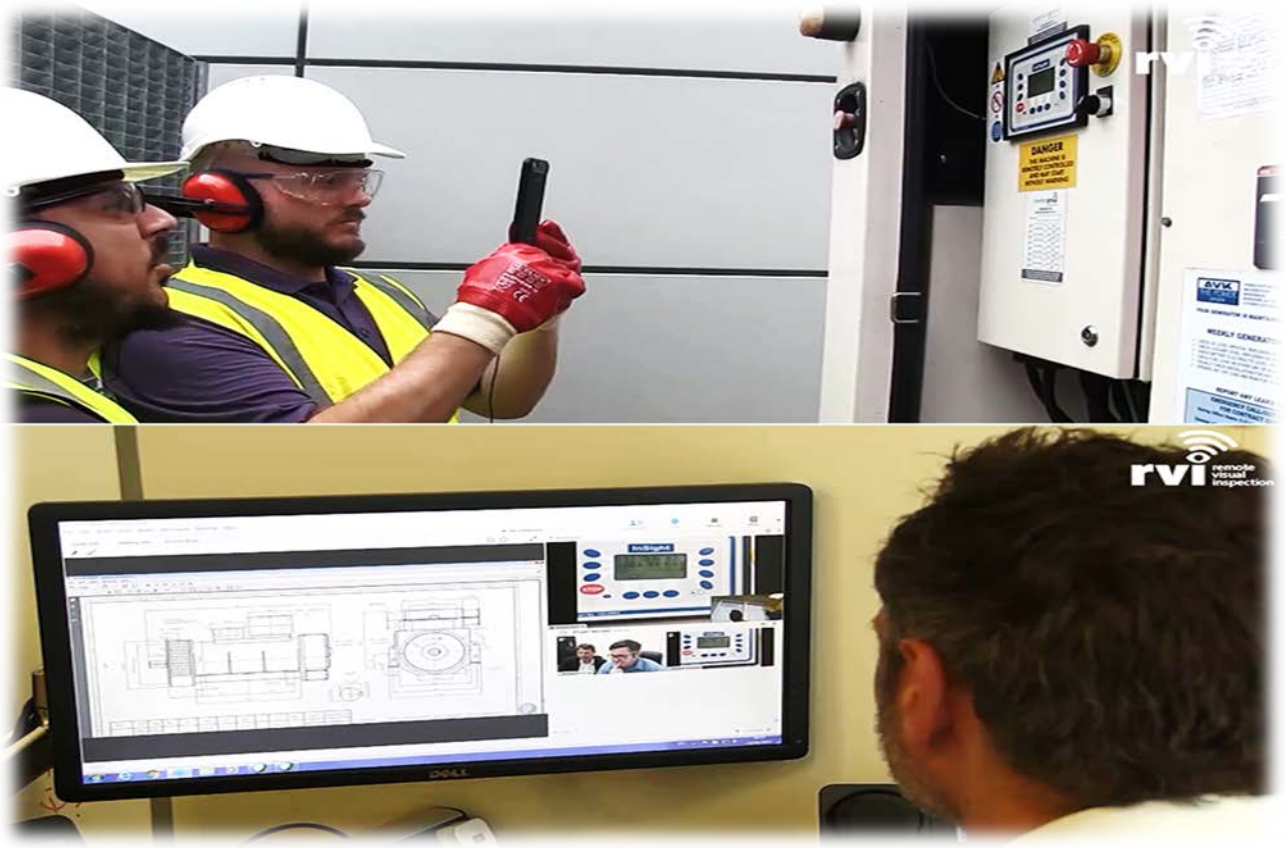

Figure.7 Remote Visual Inspection (RVI) deploys Fluor's Virtual SME tool, camera-enabled smart devices and Wi-Fi connectivity to stream surveillance activities live.

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Thank You