

# Smart Site Safety System

To further enhance site safety, some smart-related technologies have been used in construction sites in Hong Kong over the past few years, e.g. wearable safety devices, incident reporting software, access control and alarm monitoring system etc. Development Bureau has recently issued a Technical Circular to set out the policy on adoption of Smart Site Safety System (SSSS) to strive for further excellence on the construction site safety performance. In this article, the components of SSSS are introduced and some applications that are relevant to our electrical and mechanical industry are discussed.

SSSS generally comprises three components, namely smart safety devices for monitoring activities and identifying safety hazards; a communication network for transmitting data collected from smart safety devices; and a centralized management platform for providing a one-stop hub for data analysis and alerts generation, as well as facilitating follow-up actions. The system enables the project team to grasp the safety situation of the entire construction site by collecting and transferring real-time data to a centralized management platform. Whenever a potential hazard is detected, the system will immediately alert the safety management staff and workers on site.

## Categorization of Digital Platforms and Smart Safety-Related Technologies

The digital platforms and smart safety-related technologies can be categorized in terms of their functions as follows :

### 1. Centralized Management Platform

The Centralized Management Platform (CMP) platform is used for responding, managing and recording signals / alerts received from the SSSS components used in the construction site. It provides a direct means of monitoring the site safety performance online. The signals / alerts, in form of video, audio, image and data received from the SSSS components, are displayed in the CMP on the corresponding CMP monitors, and the data can be used for subsequent analysis, if needed.

### 2. Digitized Tracking System for Site Plants, Powered Tools and Ladders

The system is used for real-time online tracking of site plants, powered tools and ladders with respect to the up-to-date status and records of test certification, examination, checking and maintenance. A unique digital identification code is attached to the plants, powered tools and ladders used in the site. A mobile device is used to scan the digital identification code, and information from a database platform on certification, examination, checking and maintenance records of the equipment being scanned is displayed on the mobile device.

### 3. Digitalized Permit-to-work System for High Risk Activities

The system is used for real-time online tracking of site plants, powered tools and ladders with respect to the up-to-date status and records of test certification, examination, checking and maintenance. A unique digital identification code is attached to the plants, powered tools and ladders used in the site. A mobile device is used to scan the digital identification code, and information from a database platform on certification, examination, checking and maintenance records of the equipment being scanned is displayed on the mobile device.

### 4. Hazardous Areas Access Control by Electronic Lock and Key System

This system is used to prevent unauthorized opening of locked cover, doorway and barrier to hazardous areas within the site (e.g. electrical distribution board cabinet, floor opening equal to or larger than 500mm x 500mm, entrance to confined space area; lift shaft opening, etc.) The system is provided with an electronic lock and key system for locking down access to hazardous areas in the site, which is only openable to authorized electronic keys with key owners' identity electronically embedded in the key.



### 5. Unsafe Acts / Dangerous Situation Alert System for Mobile Plant Operation Danger Zone

In this system, adequate number of sensors are installed on the mobile plant chassis and movable plants (e.g. excavators, crawler cranes, mobile cranes, etc.) to ensure a full 360° coverage around the mobile plant danger zone perimeter. Mobile plant operator and any site personnel encroaching the mobile plant danger zone perimeter of the risk of being run over or hit by the plant moving components will be alerted by the system.

### 6. Unsafe Acts / Dangerous Situation Alert System for Tower Crane Lifting Zone

In this system, adequate number of sensors are installed on or around the tower crane to ensure a full coverage of all loading/unloading areas danger zone perimeter at all floor levels involved. Tower crane operator and any site personnel encroaching the tower crane loading / unloading danger zone perimeter of the risk of being hit by the moving load under the crane hook will be alerted by the system.

### 7. Smart Monitoring Devices for Workers and Frontline Site Personnel

These are smart devices provided to every workers and frontline site personnel deployed for the works, such as smart safety helmets, smart wristband, etc. The smart devices are connected through cellular, WiFi, NBLoT, LoRa networks, etc. These smart devices have the following functions, among others: (i) outdoor and indoor location tracking and recording of workers' and frontline site personnel in different area and time of working; (ii) real-time detection of any standstill; (iii) real-time detection of body temperature and heart beat rate; (iv) detection and sending alert to workers and plant / machinery operators of moving plants or vehicles; and (v) detection and sending alert to workers and frontline site personnel of unauthorized entry to restricted area.



### 8. Safety Monitoring System Using Artificial Intelligence

The system, comprising Internet Protocol (IP) cameras and associated Artificial Intelligence (AI) processors, is designed to detect, identify and classify the different types of unsafe scenarios in the site, including but not limited to the following: (i) unauthorized access to restricted zones, danger zones, lifting zones and no-parking zone; (ii) workers near site vehicles or plant; (iii) potential collisions between workers and site vehicles or other plant; (iv) monitoring of fatigue, distraction, inattentive behaviours of site vehicles drivers and plant operators during operation of site vehicles and plant; (v) workers and other personnel not wearing the required personal protective equipment (PPE), including safety helmet and reflective vest; (vi) heights of lifting in excess of the authorized limits; and (vii) workers working at height either without a proper working platform or wearing safety harness linked to a lifeline.



### 9. Confined Space Monitoring System

This system is used for monitoring the areas in the site defined as confined spaces. The system has the following functions: (i) real-time site worker counting and location tracking inside confined spaces; (ii) confined space environment monitoring including oxygen (O<sub>2</sub>) level, temperature, PM2.5 level, carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), hydrogen sulphide (H<sub>2</sub>S) and methane (CH<sub>4</sub>) level and combustible gas; and (iii) real-time alert if any monitoring parameter exceeds the pre-determined safety levels or any anomaly of workers' conditions is detected.



### 10. Safety Training with Virtual Reality Technology

This is a safety training using virtual reality (VR) technology for workers engaged in the following high risk activities: (i) heavy lifting operation; (ii) heavy machinery operation; (iii) working in confined space; (iv) erection / alteration / dismantle of bamboo scaffolds; and (v) electrical and other works with potential electrical hazards or chance of coming into contact with live electrical parts.

## Smart Safety-Related Technologies Applied in the Industry

Some of our members have developed their smart safety-related technologies and the following are some examples applying in an E&M contracting company:

### 1. Digitalizing Safety Processes

By using digitized electronic forms for document approval, site safety inspections and the issuance of work permits for high-risk processes, this can facilitate proper and timely review by relevant personnel, and make improvement action plans and follow-up actions. In addition, the system allows the site supervisor to submit work permit applications for high-risk procedures such as working in confined spaces, electrical work, hot work, work-above-ground, and working on lift car top, etc. Electronically by mobile phones, the approval processes are streamlined and time required is reduced for effectively improving work performance.



### 2. Bluetooth Padlock

Bluetooth padlock can be installed in the temporary or permanent doors of E&M facility rooms, storage rooms, construction site offices, and electric switchgears or equipment that needs to record the opening / closing time and position. Users must download the smart lock Apps developed by the company in advance, and make application to the person-in-charge before using the smart lock. The smart lock Apps will activate the lock according to the approved qualifications and working hours of individual applicants. In addition, the Apps can record the opening / closing time of the smart lock and the location where the smart lock is used, which can facilitate the operational arrangement and monitoring of various equipment and facilities.



### 3. Smart Safety Harness

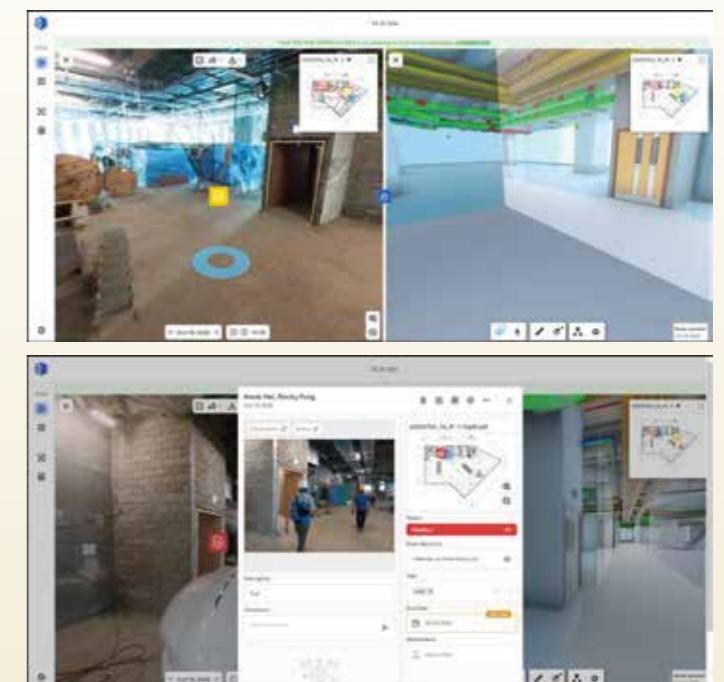
A smart safety harness integrates the Internet of Things (IoT), artificial intelligence (AI) detection software, and mobile applications. The system uses wireless remote control to monitor whether workers are attaching safety harness correctly on the anchor point during work on the lifting platform. The system will operate within a specific range, height and time. In case a worker has not properly secured his or her safety harness to an anchor point, the system will immediately issue an alarm on the spot and notify the project-in-charge. After receiving alarm signal by foremen or safety practitioner, corrective measures can be taken immediately.



### 4. Reality Capture Platform

By recording or capturing the scene of the construction sites, the project team can clearly grasp and compare work progress, work environment, housekeeping, and work conditions of the workers. Relevant engineering teams can view the recorded data and analyze data reports from the Reality Capture Platform by using mobile phone or tablet. Project progress can be discussed among various stakeholders based on the real-life data report effectively to resolve project delays or poor communication. Meanwhile, the project team can conduct dynamic risk assessment through the actual situation of the project in order to find out additional risks and more suitable work solutions and mitigation measures.

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## Policy of Development Bureau for SSSS

The Development Bureau issued a Technical Circular (Works) No. 3/2023 on 27 February 2023 to set out the policy on adoption of Smart Site Safety System in public works contracts with immediate effect. All capital works contracts with an estimated contract sum exceeding HK\$30 million to be tendered on or after the date of the Circular shall adopt SSSS. Project teams of Government Departments are also encouraged to adopt SSSS in other types of public works contracts with a contract sum exceeding HK\$30 million, such as maintenance and term contracts. The estimated cost of SSSS would normally not exceed HK\$10 million or 1% of the estimated contract sum, whichever is lower.

## CITF Subsidy SSSS

For the construction sites of private sector, the Construction Innovation and Technology Fund (CITF) launched a new funding category on 1 April 2023 to provide subsidies up to HK\$7.5 million per contractor / subcontractor to support their adoption of SSSS, a list of SSSS products available under the CITF Pre-approved List is provided at the CITF website for reference. <https://www.citf.cic.hk/?route=register>