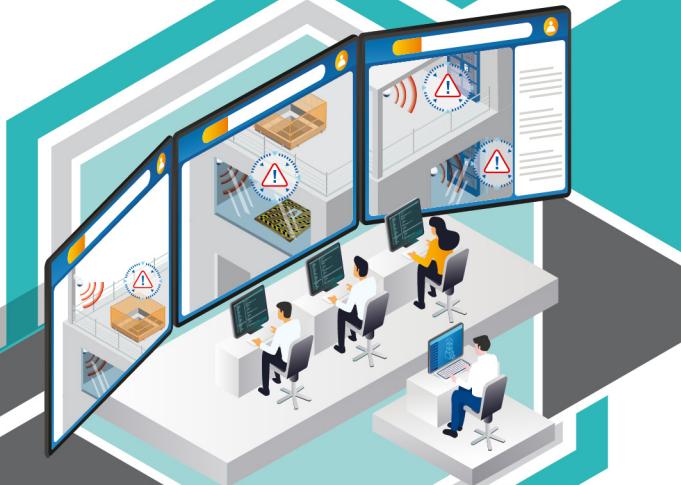
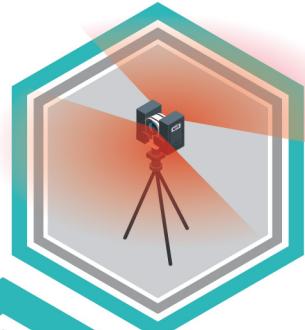


# REFERENCE MATERIAL

## GUIDE TO SMART SAFETY-RELATED TECHNOLOGIES FOR USE IN CONSTRUCTION WORKS



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# Preface

The Construction Industry Council (CIC) is committed to seeking continuous improvement in all aspects of the construction industry in Hong Kong. To achieve this aim, the CIC forms Committees, Task Forces and other forums to review specific areas of work with the intention of producing Alerts, Reference Materials, Guidelines and Codes of Conduct to assist participants in the industry to strive for excellence.

The CIC appreciates that some improvements and practices can be implemented immediately whilst others may take more time for implementation. It is for this reason that four separate categories of publication have been adopted, the purposes of which are as follows:

- |                     |   |
|---------------------|---|
| Alerts              | The Alerts are reminders in the form of brief leaflets produced quickly to draw the immediate attention of relevant stakeholders to the need to follow some good practices or to implement some preventive measures in relation to the construction industry.   |
| Reference Materials | The Reference Materials are standards or methodologies generally adopted and regarded by the industry as good practices. The CIC recommends the adoption of the Reference Materials by industry stakeholders where appropriate.   |
| Guidelines          | The Guidelines provide information and guidance on particular topics relevant to the construction industry. The CIC expects all industry stakeholders to adopt the recommendations set out in the Guidelines where applicable.  |
| Codes of Conduct    | The Codes of Conduct set out the principles that all relevant industry participants should follow. Under the Construction Industry Council (Cap 587), the CIC is tasked to formulate codes of conduct and enforce such codes. The CIC may take necessary actions to ensure compliance with the codes. |

If you have read this publication, we encourage you to share your feedback with us. Please take a moment to fill out the Feedback Form attached to this publication in order that we can further enhance it for the benefit of all concerned. With our joint efforts, we believe our construction industry will develop further and will continue to prosper for years to come.

# Abbreviations

BIM	Building Information Modelling
CDS	Crash Detection System
CITF	Construction Innovation and Technology Fund
DEVB	Development Bureau
DfMA	Design for Manufacture and Assembly
DfS	Design for Safety
LD	Labour Department
MEWP	Mobile Elevating Working Platform
NB-IoT	Narrow Band-Internet of Things
PPE	Personal Protective Equipment
PTW	Permit-to-Work
QR	Quick Response
RFID	Radio Frequency Identification
SSSS	Smart Site Safety System
SWP	Safe Work Procedure
UAS	Unmanned Aircraft Systems
VR	Virtual Reality

# 1. Introduction

The Construction Industry Council (CIC) is committed to creating a workplace that is safe and healthy, and has been organizing many functions and events to heighten the awareness of workers and the personnel involved in health and safety in the past. The "Life First" campaign was launched recently aiming to (i) raise safety standards on site; (ii) enhance safety awareness of the stakeholders in the construction industry; and (iii) urge them to take up their respective roles and responsibilities to enhance construction safety and "Say No to Danger".

There has been a huge advancement in smart safety-related technologies over the past years, in the areas of nanotechnology, robotics, data analytics, video and telecommunication, which can all help the construction industry to improve workplace safety in a variety of ways, such as in better monitoring workers' health, reducing physical stress, and keeping workers out of dangers. The construction industry now has access to a range of technology solutions to support the health and safety of the workforce. These include wearable safety devices, incident reporting software and alarm monitoring systems, incidents and task management software, etc.

The costs of workplace accidents are high, involving not only higher premium costs and claims handling, but also intrinsic costs, such as loss in morale and productivity, increase in turnover and absenteeism, etc. In comparison, the costs for acquiring and using the smart safety-related technologies are small. Besides, use of the smart safety-related technologies on the CITF<sup>1</sup> pre-approved lists<sup>2</sup> enjoys a 70% reimbursement of the equipment costs used for the project. The CITF is managed by the CIC.

In this reference material, a description of the digital platform used for storing the data/records obtained from the smart safety-related technologies and its data structure, is given. The ten items applicable to a smart site safety system are described. A guide to the CITF pre-approved digital platforms and smart safety-related technologies, categorized in terms of the ten items, is given.

- 
1. CITF is a funding scheme established by the DEVB of the HKSAR that aims to provide the impetus to transform the local construction industry through automation, industrialisation and digitisation; and to enhance the capability of existing and prospective practitioners to harness technology for the continuous improvement in Hong Kong's construction industry.
  2. The pre-approved lists were established to let CITF applicants have hands on reference to innovation and technology. The products and technologies were reviewed by the Vetting Sub-committee. Currently, there are three lists established: BIM software, BIM training courses and Advanced Construction Technologies. Please see the CITF's website on the pre-approved lists: <https://www.citf.cic.hk/?route=search>

## 2. Digital Platform for Monitoring

It is recommended that the data/records obtained from the smart safety-related technologies are stored in a digital platform, which is a centralised project and site activities information hub (Figure 1). The digital platform usually comprises a dashboard, from which users can get access to the information obtained from one or more projects, which could be images, videos, drawings, BIM models, different types of documents in different formats, data received from sensors or IoT equipment, etc., and perform analysis.



Figure 1 - Digital Platform

A typical data structure of a digital platform for Progress Monitoring, Safety Monitoring and Site Monitoring is given in Table 1.

**Table 1 – Data Structure of a Digital Platform for Progress Monitoring, Safety Monitoring and Site Monitoring (After CIC, 2022<sup>3</sup>)**

Progress Monitoring			
Site Record	Inspection Checklist	Defect / Outstanding Work Monitoring	
<ul style="list-style-type: none"> <li>Request for Inspection / Survey Check (RISC) Form</li> <li>Site Diary / Site Record Book</li> <li>Labour Return Record</li> </ul>	<ul style="list-style-type: none"> <li>Site Safety Inspection Records</li> <li>Cleansing Inspection Checklists</li> <li>Quality Inspection Checklist</li> <li>Environmental Inspection Checklist</li> </ul>	<ul style="list-style-type: none"> <li>Site Defect / Outstanding Work Inspection</li> <li>Automatic comparison of site image and design</li> <li>Drone for external inspection</li> </ul>	
Safety Monitoring			
Personal Protective Equipment (PPE) Checking	Well-being Monitoring	Workers' Behaviour Monitoring	Hazardous Area Zoning / Access Control
<ul style="list-style-type: none"> <li>Safety Helmet</li> <li>Reflective Vest</li> <li>Life jacket</li> <li>Safety shoes</li> <li>Wrist band / smart watch</li> </ul>	<ul style="list-style-type: none"> <li>Workers' location tracking</li> <li>Body temperature</li> <li>Heartbeat</li> <li>Blood pressure</li> <li>Sudden fall</li> <li>Motionless</li> </ul>	<ul style="list-style-type: none"> <li>Smoking</li> <li>Driver sleeping</li> <li>Driver using mobile phone</li> <li>Driver motionless</li> <li>People count based on different vests and helmets</li> </ul>	<ul style="list-style-type: none"> <li>Truck license plate detection</li> <li>Truck delivery and analytics</li> <li>Face recognition for access control</li> <li>Anti-collision / Machinery safety distance - Sensor-based</li> <li>Anti-collision / Machinery safety distance - AI-based</li> <li>Restricted zone / Danger zone - Sensor-based</li> <li>Restricted zone / Danger zone - AI-based</li> <li>Fall from height prevention</li> <li>Fire hazard detection and alarming</li> <li>Crane for working platform and crane operation CCTV</li> </ul>
Site Monitoring			
Site Environment Condition Monitoring	Building Element Monitoring	Equipment Status Monitoring	
<ul style="list-style-type: none"> <li>Noise</li> <li>Vibration</li> <li>Titling / Inclination</li> <li>Displacement</li> <li>External sensor compatibility</li> <li>Dust / Air quality</li> <li>Harmful gas</li> <li>Water level and / or leakage</li> <li>Gas leakage</li> <li>Electricity leakage</li> </ul>	<ul style="list-style-type: none"> <li>Loading</li> <li>Concrete maturity</li> <li>Drainage piping assessment</li> </ul>	<ul style="list-style-type: none"> <li>Equipment data</li> <li>Equipment location tracking</li> <li>Equipment operating data</li> <li>Fuel consumption</li> <li>Power system fault</li> </ul>	

3. CIC (2022). CIC Beginner's Guide on Construction Digitalisation – Digital Platform for Construction Work Management (in preparation).

### 3. Categorization of Digital Platforms and Smart Safety-related Technologies

The digital platforms and smart safety-related technologies can be categorized in terms of the ten items applicable to a smart site safety system (SSSS), as described in the sections below. A guide to the digital platforms and smart safety-related technologies, categorized in terms of the above ten items, is given in Appendix A.

#### 3.1 Centralized Management Platform

The Centralized Management Platform (CMP) platform (see Figure 2) is used for responding, managing and recording signals / alerts received from the smart SSSS components used in the 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 smart SSSS components, are displayed in the CMP on the corresponding CMP monitors, and the data can be used for subsequent analysis, if needed.



Figure 2 - Centralized Management Platform

### **3.2 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 up-to-date status with respect to the record of test certification, examination, checking and maintenance. A unique digital identification code is attached to each and all 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.

### **3.3 Digitalized Permit-to-work System for High Risk Activities**

The system is used for real-time online application, issuance and tracking of permit-to-work / permit to move and operate for the following high risk activities using a mobile device: (i) work in confined spaces; (ii) work with electrical hazard; (iii) work in lift shaft; (iv) mobile crane, heavy machinery and piling rig operating or moving on site; (v) hot work; (vi) use of ladder for work above ground; (vii) lifting operations by tower cranes, mobile cranes, crawler cranes, or cranes alike or lifting operation by mechanical means. The real-time information on the corresponding permit-to-work / permit to move and operate status is displayed on the mobile device.

### 3.4 Hazardous Areas Access Control by Electronic Lock and Key System

This system is used to prevent unauthorised 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.) (see Figure 3). 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 authorised electronic keys with key owners' identity electronically embedded in the key.



Installation of Four leaf of lift shaft gates as an essential safety measure for lift shaft



Installation of NB-IoT senor on the inner side of the door



Detection by the NB-IoT sensor and triggering a alert signal to the control office and officer-in-charge for follow-up action when there is unauthorised opening of the gate.

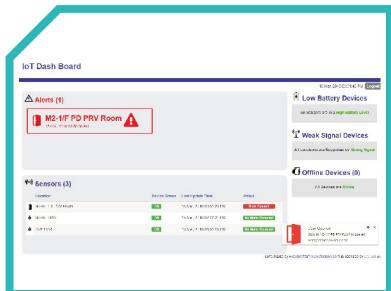
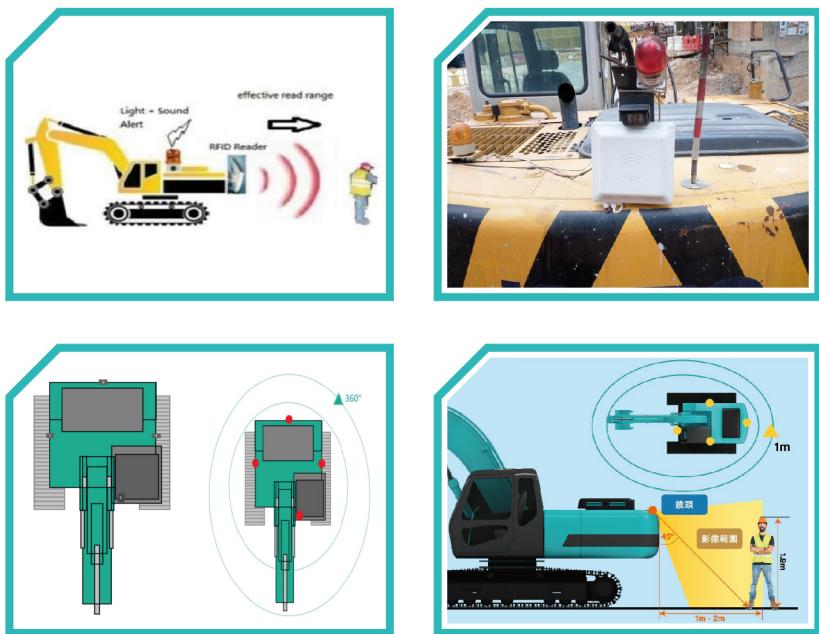


Figure 3 - System for Controlling Hazardous Areas Access

### 3.5 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 (See Figure 4). 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.



By combining images captured with cameras mounted at four locations (front, back, left and right of the machine), a 3D bird's eye-view through a full 360° around the machine is displayed in the system.

**Figure 4 - System for Monitoring Unsafe Acts / Dangerous Situation for Mobile Plant Operation Danger Zone**

### 3.6 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 (See Figure 5). 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.

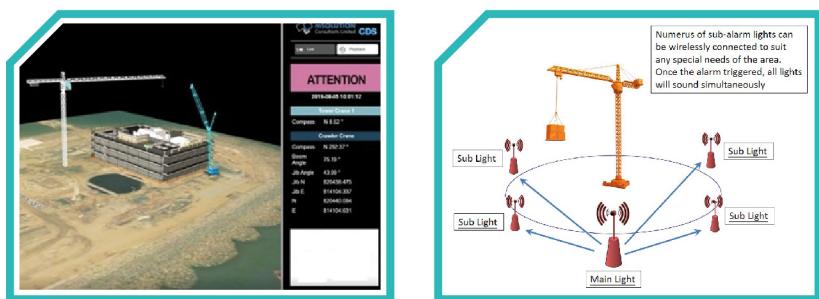


Figure 5 - System for Monitoring Unsafe Acts / Dangerous Situation for Tower Crane Lifting Zone

### 3.7 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 (see Figure 6), smart wristband, etc.



Figure 6 - Smart Monitoring Devices

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 unauthorised entry to restricted area.

### 3.8 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) unauthorised 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 (see Figure 7).



Figure 7 - Safety Monitoring System Using Artificial Intelligence

### **3.9 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 sulfide (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.

### **3.10 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.

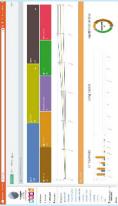
## Appendix A – A Guide to Digital Platforms and Smart Safety-related Technologies Applicable to Smart Site Safety System (As Extracted From Cfif Pre-approved Lists)

PA Code	Product Type	Smart Site Safety System Categorisation	Product name	Vendor	Contact	Product Descriptions
PA19-042	3D Reality Simulation / Data Management (CDE-related)	1. Centralized Management Platform	CHAIN Hybrid Reality Platform 	Chain Technology Development Co., Ltd.	Tel: 3746 3788	Hybrid Reality Platform (HRP) is a unified cloud management platform for managing 3D models, such as BIM, Reality Meshes, Point Clouds and other 3D formats, in a single web platform. Apart from providing 3D visualisation to users, the platform also provides functions for manipulating 3D model and optimizing the spatial information, such as integrating 2D file management with 3D models, 4D progress management and simulation, asset management, facility management.
PA20-021	3D Reality Simulation / Data Management (CDE-related)	1. Centralized Management Platform	Varadise Twin 	Varadise Limited	Tel: 2312 3880	Varadise Twin is a Digital Twin platform that serves as a Digital Construction Management Hub. All construction progress and data will link with BIM for monitoring and collaboration. With built-in BIM analytic engine, engineers will receive notifications if progress is delayed or manufacturing progress is behind.
PA20-072	3D Reality Simulation / Data Management (CDE-related)	1. Centralized Management Platform	AlphaBIM Project Management and Control Platform 	isBIM Limited	Tel: 2382 8380	AlphaBIM is a project management and control platform which provides a centralized platform for recording, tracking, statistical analysis, visualization, sharing and documentation of issues relating to construction progress and workflow management, cost management, and safety and quality problems found on site.

PA Code	Product Type	Smart Site Safety System Categorisation	Product name	Vendor	Contact	Product Descriptions
PA19-025	Asset Management Software	2. Digitized tracking system for site plants, powered tools and ladders	ONITrack 	Hilti (Hong Kong) Limited	Tel: 8228 8118 (update 10.9.2021)	ONITrack is a digitalised asset management solution designed for construction industry. It uses cloud-based server for information storage and can be retrieved or updated with two interfaces which are web portal and mobile app. User can attach a robust 2-D barcode / QR code on the asset for unique identification purpose and the information can be retrieved by scanning. Asset information include picture, documents, location, purchase information, warranty expiration date and scheduled services.
PA18-033	Project Management Software (DWSS-related)	3. Digitalized permit-to-work system for high risk activities	VHSmart 	VHSoft Technologies Co. Ltd	Tel: 2836 0099	VHSmart is a cloud base field management platform. With the engagement of Cloud Platform and Advance Mobile Technology, VHSmartTH provides an integrated construction life cycle solution which facilitate end-user from access control, field safety management, progress monitoring, quality control, asset management, material tracking & inventory in every stage.
PA18-034	Project Management Software (DWSS-related)	3. Digitalized permit-to-work system for high risk activities	Digital Record of Works (dROW) 	Build I.T. Ltd	Tel: 2752 7508	Digital Record of Work (dRow) is a site record information system. Featuring a user-friendly, versatile interface and a flat learning curve, dRow is the system for construction projects with its compatibility with a wide variety of site records, which includes Document, NEC Contract, Drawing, Design Management Systems, Safety, QMS, tests registry, etc.

PA Code	Product Type	Smart Site Safety System Categorisation	Product name	Vendor	Contact	Product Descriptions
PA18-035	Project Management Software (DWSS-related)	3. Digitalized permit-to-work system for high risk activities	Novade	Spatial Technology Ltd	Tel: 2636 6102	<p>Novade is a full range of solutions for project - Manage Quality, Safety, Logistics, Maintenance, Workforce &amp; Activity. The Mobileready Platform Includes Key Functionalities: Forms &amp; Checklists - Drawing Mark-ups - Digital Signatures - Map Locations - QR Codes &amp; NFC Tags - Picture Annotations.</p>
PA19-024	Project Management Software (DWSS-related)	3. Digitalized permit-to-work system for high risk activities	SnagR	SnagR Ltd.	Tel: 6055 4002	<p>SnagR is a cloud-based quality management system, designed to monitor the progress of complex projects. The system can capture onsite data, automate reporting, visualise the process and analyse data.</p>
PA19-034	Project Management Software (DWSS-related)	3. Digitalized permit-to-work system for high risk activities	Inspecto	Digital G Limited	Tel: 9202 5335	<p>Inspecto is a digital solution for site inspection process among contractors, consultants and clients. It is a mobile App which enables the performing of all Request for Inspection and Survey Checklist process tasks including RISC status monitoring, on-spot inspection, result endorsement etc.</p>

PA Code	Product Type	Smart Site Safety System Categorisation	Product name	Vendor	Contact	Product Descriptions
PA20-024	Project Management Software (DWSS-related)	3. Digitalized permit-to-work system for high risk activities	SiMple 	Cerebro Strategy Limited	Tel: 2272 3670	SiMple is an innovative app making site management simple and sustainable. It digitalises three major aspects of site management including site diary, site inspection checklist (Request for Inspection / Survey Check Form) and site safety management records.
PA20-049	Project Management Software (DWSS-related)	3. Digitalized permit-to-work system for high risk activities	Jobs Approve Application Flow Management System 	Epic Comm Company Limited	Tel: 2320 8160	The system have three levels of authentication. The user may use the mobile app to submit application form with photo, the supervisor or management grade to approve. All application forms have the detailed information such as time stamp, user, status, result remarks, user in charge with detail flow information.
PA20-078	Project Management Software (DWSS-related)	3. Digitalized permit-to-work system for high risk activities	Construction Resource Planning 	Yonyou (Hong Kong) Co. Ltd	Tel: 3907 3052	This product is a project management platform with the major functions of form digitization, instant issuance and approval of forms, approval flow management, task tracking and data visualization to facilitate effective collaboration. It includes various modules such as safety, environmental, site and asset management and RFI.

PA Code	Product Type	Smart Site Safety System Categorisation	Product name	Vendor	Contact	Product Descriptions
PA20-088	Project Management Software (DWSS-related)	3. Digitalized permit-to-work system for high risk activities	InnoShare - Digital Works supervision System (DWSS) 	Innovative Associate Technology Limited	Tel: 2466 9566	InnoShare – DWSS provides a secured platform with mobile app and web portal that supports the entire process of site activities, including (i) Electronic Request for Inspection System (E-RISC), (ii) Electronic Site Diary & Labour Return Record System (E-Diary), and (iii) Electronic Safety & Environmental Checklist System.
PA20-120	Project Management Software (DWSS-related)		Jarvis freeFORM 	isBIM Limited	Tel: 2382 8380	This product is a project management platform with the core functions of form digitization and approval, approval flow management, data visualization and analysis, and report generation. It support real-time and multi-project management. Users can collect and update site data record with mobile devices through customized forms and approval workflow. This system has 50+ standard forms including Request for Inspection / Survey Check (RISC) forms, site diary, site cleanliness, labour return and site safety, etc. Through dashboard and reports, users can closely track and monitor the site and project status.

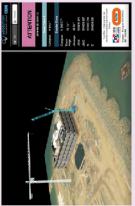
PA Code	Product Type	Smart Site Safety System Categorisation	Product name	Vendor	Contact	Product Descriptions
PA20-127	Project Management Software (DWSS-related)	3. Digitalized permit-to-work system for high risk activities	Construction Information Anywhere (CIA)	Contech Point Company Limited	Tel: 3990 1990	This product is a web-based online data management platform and mobile APP for construction workflow including Request for Information (RFI) and drawings and document submission etc.. It standardizes and centralizes project workflows and documentation management. This platform could provide certain functions as a Digital Work Supervision System (DWSS), such as inspection form.
PA20-128	Project Management Software (DWSS-related)	3. Digitalized permit-to-work system for high risk activities	Varadise DWSS	Varadise Limited	Tel: 9034 3844	Varadise DWSS is a cloud-based project management platform with web portal and web app, designed to optimize workflows in construction. The 5 core modules allow site supervisory staff to standardize approval workflow, customize forms and automate reporting. The system also supports 4D BIM integration and synchronize with Varadise Twin platform as an optional add-on.
PA21-016	Project Management Software (DWSS-related)	3. Digitalized permit-to-work system for high risk activities	Cerebro Inspection	Cerebro Strategy Limited	Tel: 2272 3670	The product is a project management software for the management of inspections and work orders under four inspection categories namely Site, Quality, Environmental and Safety. A cloud platform stores all relevant data and offers multi-project management capability.

PA Code	Product Type	Smart Site Safety System Categorisation	Product name	Vendor	Contact	Product Descriptions
PA21-033	Project Management Software (DWSS-related)	3. Digitalized permit-to-work system for high risk activities	DWSS Version 1	MES Services Limited	Tel: 2180 6144	The product is a Digital Works Supervision System (DWSS), which is a web-based centralised portal for the digitisation of various construction workflows and collection of construction works data.
PA21-039	Safety Risk Assessment Software	3. Digitalized permit-to-work system for high risk activities	Risk Assessment Conduct Everywhere (RACE) Mobile App	Ideas & Technology Company Limited	Tel: 9313 6043	This is a mobile app for onsite safety-related staff to carry out risk assessment effectively and share relevant information to the electronic platform with the project team.
PA22-008	Project Management Software (DWSS-related)	3. Digitalized permit-to-work system for high risk activities	ESIA (DWSS)	Bex Solutions Limited	Tel: 3469 9699	A Digital Works Supervision System (DWSS) that digitises inspection and site monitoring processes like RISC management, Site Diary, Safety and Cleansing Inspection and keeping of Labor Return record.

PA Code	Product Type	Smart Site Safety System Categorisation	Product name	Vendor	Contact	Product Descriptions
PA20-033	Safety Monitoring System	4. Hazardous areas access control by electronic lock and key system	SmartWorks – Safety Alert System for Temporary Lift Shaft Gate	SmartTone Mobile Communications Limited	Tel: 9451 4017	"SmartWorks – Safety Alert System" can provide alerts for unauthorised access to the restricted equipment and areas like lift shaft, which reduce the chance of injuries and accidents at construction site.
PA20-073	Safety Monitoring System	5. Unsafe acts / dangerous situation alert for mobile plant operation danger zone	I-Vision Smart Monitoring System	Kong Chun Construction Machinery Services Centre Limited	Tel: 2475 1083	This product is a safety monitoring system installed on heavy construction plant for obstacles detection and real-time acquisition of surrounding environment. It provides synthesized image with 360° bird's-eye view, panoramic detection of obstacle within 1 metre, and siren and signal light when there are obstacles in the detection range, thus improving workers' safety when plant is in the operation.
PA20-032	Safety Monitoring System	5. Unsafe acts / dangerous situation alert for mobile plant operation danger zone	Ultra-wide Band Wireless Positioning Safety System	Transcendence Company Limited	Tel: 2862 1724	The product is a "Worker Real-Time Positioning System" which incorporates smart watches and a central monitoring platform. By applying ultra-wide band positioning technology, it can track workers' locations and health parameters even in sealed off space.

PA Code	Product Type	Smart Site Safety System Categorisation	Product name	Vendor	Contact	Product Descriptions
PA20-020	Safety Monitoring System	5. Unsafe acts / dangerous situation alert for mobile plant operation danger zone	BLAXTAIR Pedestrian / Machinery Anti-collision Camera 	EBSL	Tel: 2345 1882	The BLAXTAIR® System allows users to set detection zone and provides audible alarm and flashing signals on the driver's screen if there are pedestrians or objects within the set zone. A monitor installed in the cabin provides continuous footage captured by the sensor head. It can ensure the safety of the pedestrians nearby the work site.
PA20-055	Safety Monitoring System	5. Unsafe acts / dangerous situation alert for mobile plant operation danger zone	UWB Collision Warning System 	Beinventor Limited	Tel: 9757 2952	Collision warning system could provide real-time safety alert for workers and plant operator by using UWB technology. Many accidents happening on site involve workers being hit by moving plant and machines. An accurate collision warning system can prevent this kind of accidents in a cost effective way. The system adopts the latest UWB - Ultra Wide Band technology. The plant with a UWB detector sets a virtual working perimeter and any worker with an UWB tag entering the perimeter will trigger the alarm to warn workers and the operator to stop the plant so as to prevent collision accidents. The accuracy is up to centimeter level and in all directions.

PA Code	Product Type	Smart Site Safety System Categorisation	Product name	Vendor	Contact	Product Descriptions
PA20-119	Safety Monitoring System	5. Unsafe acts / dangerous situation alert for mobile plant operation danger zone	Karta-X AI Assisted Construction Safety Analytic (KACSA) 	Karta-X Technologies Limited	Tel: 3619 0620	This product is a construction site safety monitoring platform. It has an AI analytical tool for determining workers behavior captured by CCTVs with functions including workers' attendance and PPE identification, machine identification and suspicious personnel detection for better site management. Alert could be delivered by web, emails or APPs.
PA21-031	Safety Monitoring System	5. Unsafe acts / dangerous situation alert for mobile plant operation danger zone	Driver Status Monitor System 	Transcendence Company Limited	Tel: 2862 1724	The product is designed to analyse machine operator's behaviour via an infra-red camera. The captured images are interpreted by artificial intelligence (A.I.) and big data to recognise unsafe and abnormal behaviours. An instant alert will be issued to both the driver and site management when unwanted operator behaviour is spotted.
PA21-044	Safety Monitoring System	5. Unsafe acts / dangerous situation alert for mobile plant operation danger zone	Package A: Advanced Driving Assistance System (ADAS) + Drowsiness Monitoring System (DMS) Package B: Advanced Driving Assistance System (ADAS) Package C: Drowsiness Monitoring System (DMS) 	GreenSafety Technology Limited	Tel: 2662 6460	<b>Advanced Driving Assistance System (ADAS)</b> is a dual-camera device that provides real-time driving assistance by alerting the driver of possible dangerous driving situations. The detection is made possible with the use of video analytics technology. <b>Monitoring System (DMS)</b> uses sophisticated face recognition technology to provide audible and vibrating alerts when fatigue or bad driving behavior is detected.

PA Code	Product Type	Smart Site Safety System Categorisation	Product name	Vendor	Contact	Product Descriptions
PA22-035	Safety Monitoring System	6. Unsafe acts / dangerous situation alert system for tower crane lifting zone	Construction Machines Crash Detection System 	Hong Kong Telecommunications (HKT) Limited	Tel : 2883 6577	The Crash Detection System (CDS) uses sensors to measure positions of machineries and compute a 3D model with machineries and structures real-time positions to determine if there is a potential risk of collision. Alert will be given to the operators to take immediate action to prevent accidents. The solution can be deployed to a site with multiple machineries and will function in adverse weather conditions.
PA18-007	Safety Monitoring System	7. Smart monitoring devices for workers and frontline site personnel	Construction Stage Tunnel Access Control System (TACS) 	ATAL Technologies Limited	Tel: 9488 0410 (updated 31.12.2020)	The system, incorporated RFID Technology, 3G telecommunication, custom-designed software is used for real-time safety monitoring of on-site human resources and incident management.
PA19-031	Safety Monitoring System	7. Smart monitoring devices for workers and frontline site personnel	Dailoop IoT Smart Helmet with Cloud Based Management Platform 	Beeinventor Limited	Tel: 9757 2952	This system could track and locate workers in both outdoor and indoor environment. Information can be visualised in 3D BIM model in the cloud based management Platform. Real-time monitoring could improve the efficiency in site supervision and management. The heartbeat rate and body temperature sensors could provide instant alert through SMS if abnormal readings are detected. The accelerometer sensor could detect accidental fall and motionless condition so that quick actions could be taken. Users could also press the panic button to call for help in emergency. Collision warning could also be given to workers to minimise injuries.

PA Code	Product Type	Smart Site Safety System Categorisation	Product name	Vendor	Contact	Product Descriptions
PA19-047	Safety Monitoring System	7. Smart monitoring devices for workers and frontline site personnel	InfoSMART™ Attend – Real Time Manpower Attendance in-site Record System  	Infotronic Technology Ltd.	Tel: 9106 7801	InfoSMART™ Attend is a real-time construction worker activity tracking and management system. This product not only provides workers' gate-in/gate-out records via worker-card reader and biometric device at turnstiles, but also enables real-time visibility and tracking of workers in sites, provide reliable attendance record to reduce disputes over wages and injuries, and generate workers' work/trade report for fleet management.
PA20-025	Safety Monitoring System	7. Smart monitoring devices for workers and frontline site personnel	SmartWorks  	SmartTone Mobile Communications Limited	Tel: 3128 2467	SmartWorks is an integrated platform to enhance construction workers' health, safety and operational efficiency. The platform incorporates five modules to promote and manage worksite safety, namely Smart Helmet for worker's real-time condition sensing, SmartHealth Station for workers' health surveillance checking, Environmental Station for environmental monitoring, danger radar concerning of Safety Triggering System and Dump Truck Management.
PA20-085	Safety Monitoring System	7. Smart monitoring devices for workers and frontline site personnel	BLE Material & Attendance Tracker  	Hornbird Technology Limited	Tel: 6705 0848	This product is a location and attendance tracker called "meTrack" which consists of "Nearby", "realTime" and "SafetyMeter" modules. This Bluetooth based product will help keep track of the exact locations of workers, thereby maximising safety.

PA Code	Product Type	Smart Site Safety System Categorisation	Product name	Vendor	Contact	Product Descriptions
PA20-116	Safety Monitoring System	7. Smart monitoring devices for workers and frontline site personnel	EverHigh Precise Positioning & Safety Management System 	Xense Tech Limited	Tel: 5616 6382	This product uses Ultra-wide Band (UWB) technology to achieve positioning with an accuracy of 10 cm, effectively managing the labor force, monitoring the status and distribution of workers, ensuring worker safety and improving management quality. At the same time, the system provides high-precision alarms through different configurations to reduce common accidents in construction sites and improve site safety.
PA18-032	Safety Monitoring System	8. Safety Monitoring System using Artificial Intelligence	Visual Intelligence Safety Compliance system 	VHSoft Technologies Co. Ltd	Tel: 2619 8034	The VISCMon system comprises with the sensor and sensing technologies. In collaboration with artificial intelligence technologies and the latest telecommunication technologies, it provides a solution to meet the needs on safety. Specialized cameras operate like the CCTV system when monitoring work area. The cameras monitor workers and check if the required safety standards are met. Once the required safety gear is not detected, a message will be sent to site safety officer via telecommunication network.

PA Code	Product Type	Smart Site Safety System Categorisation	Product name	Vendor	Contact	Product Descriptions
PA19-045	Safety Monitoring System	8. Safety Monitoring System using Artificial Intelligence	Artificial Intelligence Computer Vision Cloud viaAct	Custommindz Limited	Tel: 9125 3390	<p>This product is a one-stop artificial intelligence and video surveillance platform for equipment, safety and quality detection. This product uses API and graphical user interface, and can perform custom detection and predefined detection. Predefined detection includes detecting: (i) people and facial and body attributes, (ii) objects and (iii) actions.</p>
PA20-090	Safety Monitoring System	8. Safety Monitoring System using Artificial Intelligence	Danger zone Alert Sensoring System	Custommindz Limited	Tel: 9125 3390	<p>This product is a sensoring system installed on construction vehicles to provide both visual alert on monitor and audio sound alert to the operator when there are pedestrians walking or standing nearby the vehicle, thus ensuring workers' safety during plant operation. This product allows users to adjust the zoning distance. It can also detect default objects (e.g. vehicles) to avoid false alarms.</p>
PA22-005	Safety Monitoring System	8. Safety Monitoring System using Artificial Intelligence	A.I. Surveillance System for Construction Site Safety	iSafety Limited	Tel: 2408 8008	<p>A safety management system incorporating artificial intelligence (A.I.) and 5G Internet of Things (IoT) technologies. It can provide real-time monitoring and issue instant warnings for unauthorised entry to dangerous zone and workers without safety helmets. Supervisory staff members can receive real-time alert notifications for timely response.</p>

PA Code	Product Type	Smart Site Safety System Categorisation	Product name	Vendor	Contact	Product Descriptions
PA22-011	Safety Monitoring System	8. Safety Monitoring System using Artificial Intelligence	Raspect-ACE-Safety	RaSpect Intelligence Inspection Limited	<a href="https://raspect.ai/en/about/contact-us">https://raspect.ai/en/about/contact-us</a>	This product is a platform aimed at monitoring onsite activities and moving equipment to improve safety. Sensors and cameras on site allows computer analysis on the collected data for the detection and alert of safety issues. The analyzed data is shown on a web dashboard with alerts for timely response.
PA22-033	AI Inspection software	8. Safety Monitoring System using Artificial Intelligence	A.I. Unmanned Aerial System for Scaffolding Inspection	RaSpect Intelligence Inspection Limited	Tel : 3978 8425	The system offers overhead power line and metal scaffolding inspections through image analysis powered by A.I. technology. It records the conditions of the overhead power line and scaffold which is able to identify abnormal conditions, e.g. safety net damages, accumulated debris, deformation of scaffold, defects of overhead line tower & etc.
PA19-004	Force, Underground Water Level, Inclination, and Environmental Monitoring Sensor	9. Confined Space Monitoring System	Automated Internet of Things (IoT) Construction Monitoring Devices and Monitoring System	LR Construction Technologies Ltd	Tel: 2137 0877	IoT monitoring devices measure force, underground water level, inclination, and also environmental quantities such as temperature, humidity, barometric pressure, and air pollutant concentrations. Readings can be automatically measured at 1-minute intervals round-the-clock regardless of weather conditions, and are stored on the cloud. The monitoring system's multi-platform user interface allows users to view readings in real time. Instantaneous risk analysis can also be carried out and warnings can be instantly issued according to user configured safety thresholds.



## Feedback Form

### [Guide to Smart Safety-related Technologies for Use in Construction Works (December 2022)]

Thanks for reading this publication. To pursue improvement in our future versions, we appreciate your valuable suggestions.

(Please put a "✓" in the appropriate box)

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2. Does the publication enable you to understand more about the use of smart safety-related technologies in construction works?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	No Comment <input type="checkbox"/>		
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5. Overall, how would you rate the publication?	Excellent <input type="checkbox"/>	Very Good <input type="checkbox"/>	Satisfactory <input type="checkbox"/>	Fair <input type="checkbox"/>	Poor <input type="checkbox"/>
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