



Building a Safer Future

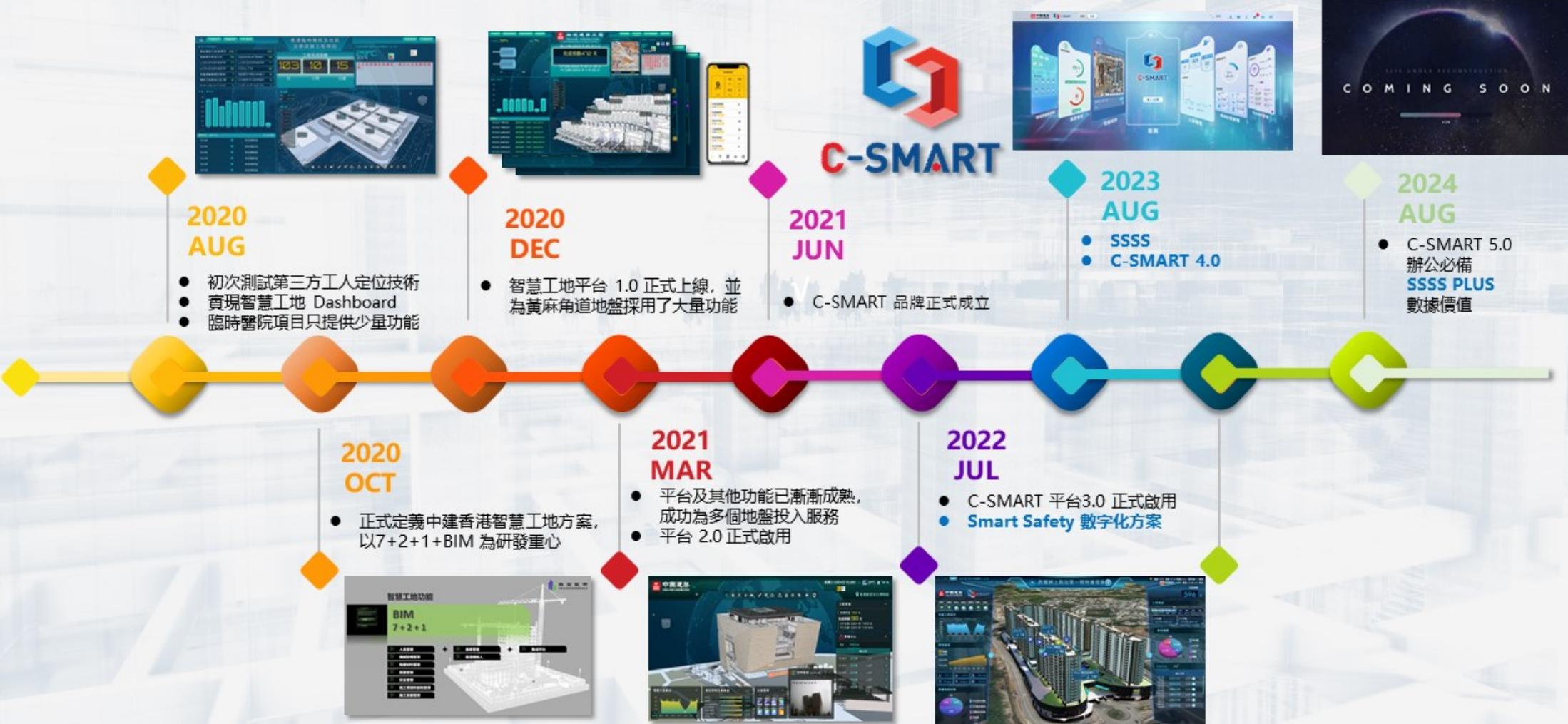
A Spotlight on 4S Implementation in Construction Sites

Presenter: Chris Guan
26/04/2024

CONTENT

- **C-SMART Blueprint** | System Development Course...
- **4S Functions** | CMP\E-PERMIT\Access Control...
- **Other Safety Related Functions** | AI Fire Monitoring, Robotics...

C-SMART's Development



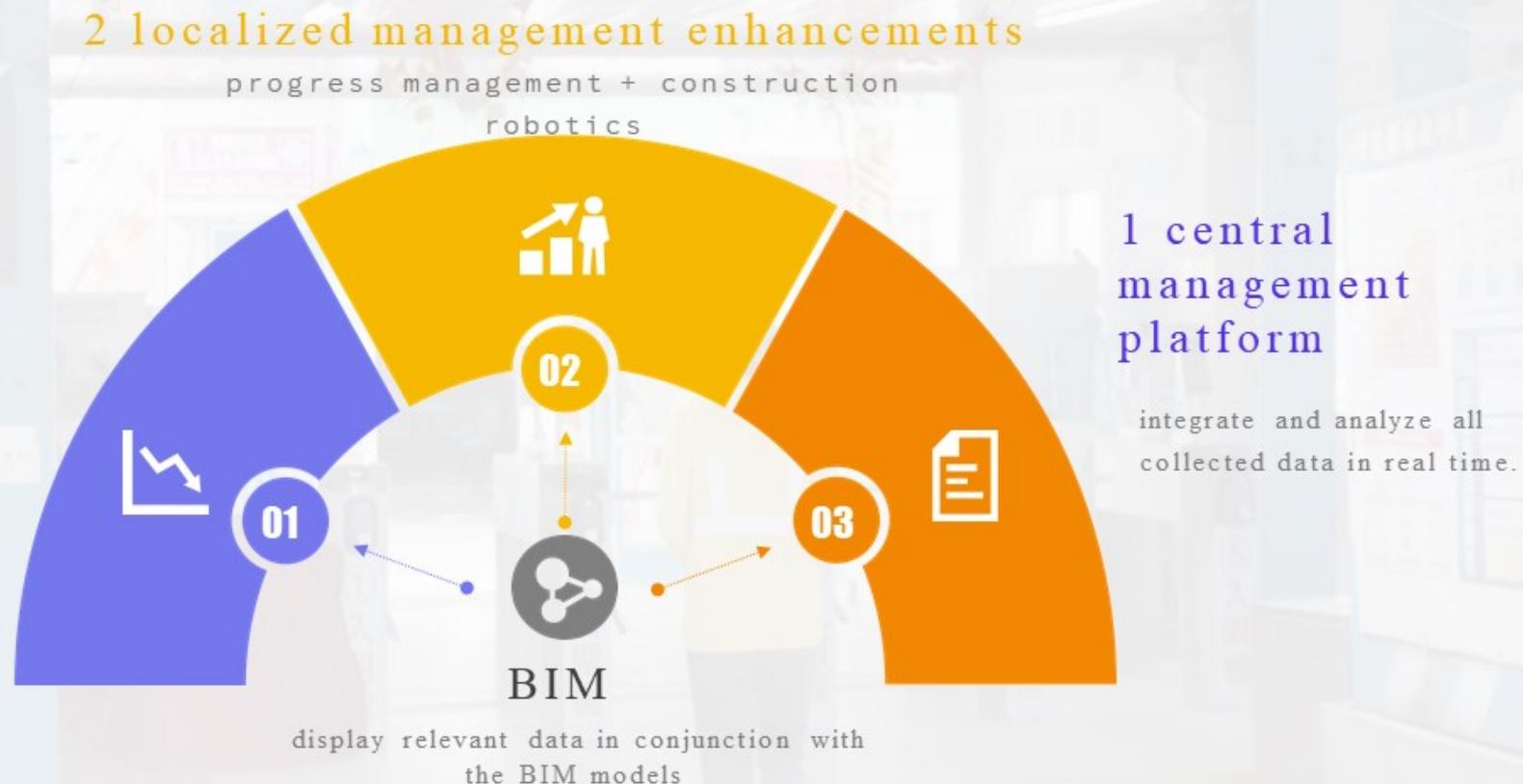
C-SMART System Introduction Blueprint & Vision



- **7+2+1+BIM**

The platform is based on Internet of Things (IoT), artificial intelligence (AI), cloud computing, and BIM technologies. It integrates data from various sources, enabling managers to conduct integrated supervision and achieve intelligent, digital, and informational management of the construction sites.

7 fundamental elements of smart worksites
people, machinery, materials, Survey, environment, safety, and quality



C-SMART System Introduction 4S Function



• Scope of Smart Site Safety System (DEVB)

The Smart Site Safety System shall provide and maintain but not limited to, the following features for daily site safety management during the contract period.

Item	Digital Initiatives
1	Smart Site Safety Centralized Management Platform (C-Smart)
2	Digitized Tracking System for site plants, powered tools and ladders (LALG System)
3	Digitalized Permit-To-Work system for high risk activities (E-PERMIT)
4	Hazardous areas access control by Electronic Lock and Key System (Smart Lock System)
5	Unsafe acts/ dangerous situation alert for Mobile Plant Operation Danger Zone (360 Anti-Collision)
6	Unsafe acts/ dangerous situation alert for Tower Crane Lifting Zone
7	Smart Monitoring Device for Workers and Frontline Site Personnel (Worker Management System)
8	Safety Monitoring System using Artificial Intelligence (AI CAM)
9	Confined Spaces Monitoring System (UWB)
10	Safety training with Virtual Reality technology

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Ref. : DEVB(W) 516/2023
Group : 2, 8
27 February 2023

Development Bureau
Technical Circular (Works) No. 2/2023
Smart Site Safety System

Scope
This Circular sets out the policy on adoption of Smart Site Safety System ("SSSS") to enhance our safety management system, with a view to striving for further excellence on the safety performance in public works contracts.

Effective Date
2. This Circular shall take immediate effect.

Effect on Existing Circulars
3. This Circular shall be read in conjunction with the Construction Site Safety Manual ("CSSM"), DEVB TC(W) No. 1/2020 on Score Card for Assessment of Site Safety Performance, DEVB TC(W) No. 2/2023 on Digital Works Supervision System and their subsequent updates.

DEVB TC(W) No. 2/2023
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C-SMART System Introduction 4S Function



- **Scope of DCMBI**

Item	Digital Initiatives
1	Smart Site Safety Centralized Management Platform (C-Smart)
2	Digitized Tracking System for site plants, powered tools and ladders (LALG System)
3	Electronic processing of permit to work for more high-risk activities
4	Hazardous areas access control by Electronic Lock and Key System (Smart Lock System)
5	Unsafe acts/ dangerous situation alert for Mobile Plant Operation Danger Zone (360 Anti-Collision)
6	Unsafe acts/ dangerous situation alert for Tower Crane Lifting Zone
7	Smart Monitoring Device for Workers and Contractor's Superintendent
8	Safety Monitoring System using Artificial Intelligence
9	Confined Spaces Monitoring System
10	Safety training with Virtual Reality technology
11	Authenticating authorized operation of plants and equipment
12	Revised Specification of resolution of camera and display unit for tower crane and contractor's site office
13	Sensor and alert system to detect the proper application of handbrake for site vehicles



Development and Construction Management Board Instruction P06/23

From : AD(P)3 To : All Project Teams and Contract Managers
 Date : 22 December 2023 Total Pages : 3 + 36 (Annex)
 + 5 (supplementary information for internal use only)

Wider Application of Smart Technology for Site Safety Management

PURPOSE

To promulgate the new / revised specification clauses for wider application of smart technology for site safety management in Capital Works New Works Contracts.

ACTION & STATUS

2. This Instruction is **MANDATORY**. DCMB approved the issue of this Instruction on 15 December 2023.

3. With immediate effect, Project Teams and Contract Managers for Capital Works New Works Contracts shall take actions for implementation as follows –

(a) **For Projects under Planning, Design, due for Tender or with Tenders Issued**
 Incorporate the new / revised specification clauses in **Annex** into the tender document or addendum as appropriate.

C-SMART System Introduction 4S Function



- **C-Smart 4S Function: CMP**

The screenshot displays the C-SMART system interface for the BLX Project, specifically the 1A stage main contract development project. The interface is divided into several sections:

- Top Bar:** Includes the C-SMART logo, traditional and interactive language options, a location pin, the project name "1A階段主合約發展項目 BLX 港", a weather icon (26°C), and various user and system icons.
- Project Overview (项目概况):** Shows the total construction period (630 days), total area (57,003 m²), and total contract amount (35.5 billion Hong Kong dollars). It also includes the developer information: Hong Kong-Shenzhen Innovation and Technology Park Ltd. and the contract amount: \$3.55B.
- Project Progress (工程进度):** Displays the current progress (42%), completion timeline (363 days), and remaining percentage (58%). It also shows the status of various milestones: B11蓬火牛完成 (Completed), B12得TSTP持放許可證 (Obtained TSTP permit), B13・5座完成 (Completed), B143座完成 (Completed), and B15&6 (In Progress).
- Project Milestones (工程節點):** Lists the next milestone: "走下一个節點 - , 还有 - 天" (Next milestone - , still - days). It also shows three specific milestones: 1 B11廢壓器室順利移交中 (B11 pressure relief chamber successfully transferred), 2 獲得TSTP持放許可證 (Obtained TSTP permit), and 3 B&9號樓鋼筋混凝土結構 (B&9 floor steel concrete structure).
- Central View:** A 360-degree spherical view of the construction site, showing a mix of greenery and developed land.

C-SMART System Introduction 4S Function



- **C-Smart 4S Function:**

Digitized Tracking System for site plants, powered tools and ladders(LALG)

By using Internet of Things technology and wireless network, real-time dynamic tracking of each mobile machinery in different working areas can be achieved.

An overview, including the **real-time location, usage status, machine safety data and inspection reminders** of any machine or equipment can be reviewed on the platform, strengthen and improve the efficiency of resources allocation.



C-SMART System Introduction 4S Function



- Digitalized Permit-To-Work system for high risk activities (E-PERMIT)

A digitized permit-to-work for the following high risk activities:

- Work in confined spaces
- Work with electrical hazard
- Work in lift shaft
- Mobile crane, heavy machinery and piling rig operating or moving on the Site
- Hot work
- Use of ladder for work above ground for work purpose
- Lifting operations by tower cranes, mobile cranes, crawler cranes, or cranes alike or lifting operation by mechanical means

Allow electronic application, issuance and tracking of permit to work/permit to move and operate in the Site

Alert message if the corresponding permit-to-work/permit to move and operate has expired



C-SMART System Introduction 4S Function



- Digitalized Permit-To-Work system for high risk activities (E-PERMIT)

The screenshot displays the C-SMART system's E-permit module. The top navigation bar includes the C-SMART logo, language switch (Traditional/Interactive), location (首期公屋發展計劃 BLN 宏照), weather (26°C), and various system icons. The left sidebar provides a summary of permit status: 2 valid permits, 603 applied, 24 pending, and 577 registered. Below this are sections for E-permit applications, including HWP, WILS, and ESW categories, and a section for pending and registered E-permits. The main area shows a 3D map of a construction site with building footprints. Overlays on the map indicate E-permit status for specific buildings: '第三座大樓 有效許可證:' (Building 3, Valid Permit), '第二座大樓 有效許可證:' (Building 2, Valid Permit), and '外圍+地牢 有效許可證:' (Perimeter+Basement, Valid Permit). A legend in the bottom left corner identifies the colors: blue for valid, green for applied, yellow for pending, and purple for registered. A large blue banner on the right side of the map area contains the text '電子化許可證' (Digital Permit).

電子化許可證

C-SMART System Introduction 4S Function



• Hazardous areas access control by Electronic Lock and Key System (Smart Lock System)

C-Smart Lock will be deployed for Access Control for such as temporary/restricted working area, electrical box opening management, etc.

Only authorized worker can unlock the padlock with his own worker registration card. When an unauthorized person forcibly unlocks the door, alarm will be triggered and displayed directly on the C-Smart platform. All the history of authorization details and padlock lock/unlock status can also be reviewed on the platform.



The screenshot displays the C-SMART platform's access control interface. At the top, there are navigation tabs for '安全管理' (Safety Management), '报警' (Alarm), '事件' (Event), and '地图' (Map). The main area shows a circular dashboard with '授权数量: 728' (Granted Number: 728) and '已解锁数量: 98' (Unlocked Number: 98). Below this is a '报警统计' (Alarm Statistics) section with a table of events and a bar chart showing '授权未解除' (Granted Not Released) at 85.72% and '授权已解除' (Granted Released) at 9.52% over a 7-day period. The bottom part of the interface shows a map of a building with a legend for '授权未解除' (Granted Not Released), '授权已解除' (Granted Released), and '授权被锁' (Granted Locked). A legend also indicates '授权未解除' (Granted Not Released) in blue, '授权已解除' (Granted Released) in orange, and '授权被锁' (Granted Locked) in green.



Electrical box opening management

C-SMART System Introduction 4S Function



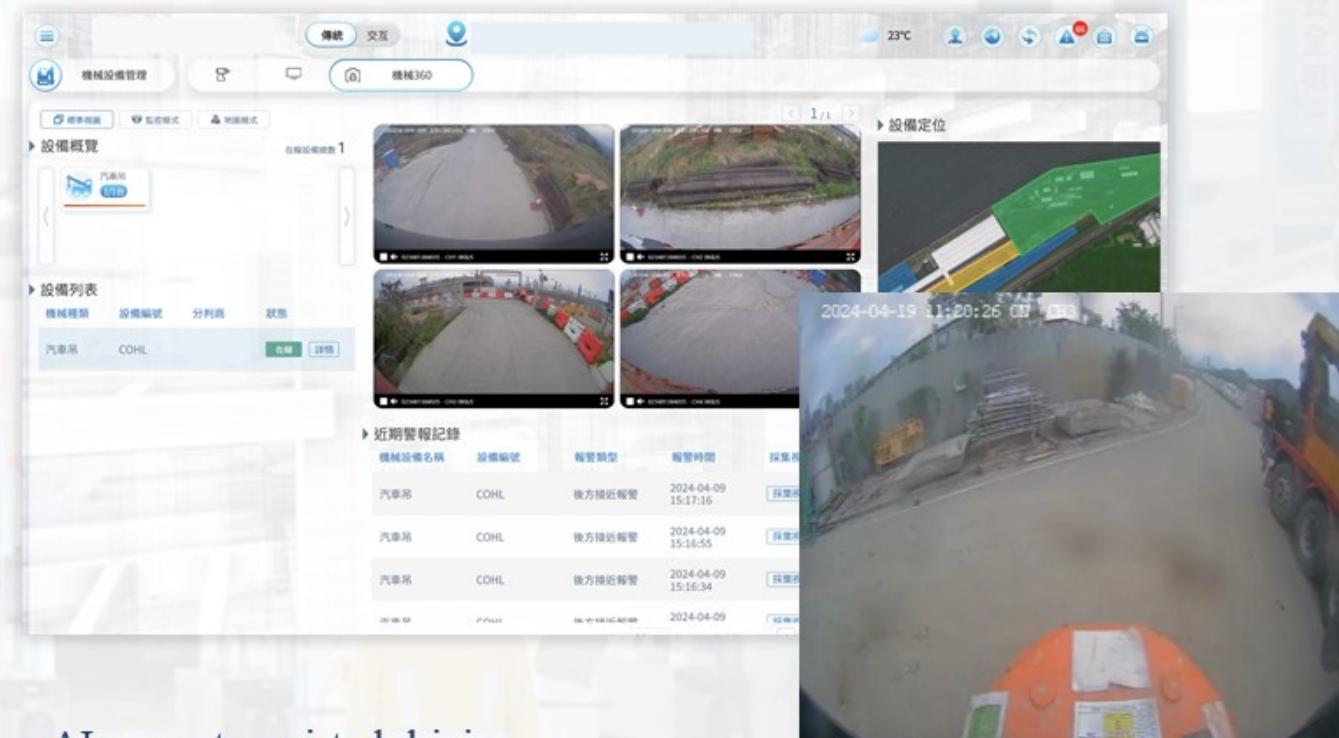
- **Unsafe acts/ dangerous situation alert for Mobile Plant Operation Danger Zone (360 Anti-Collision)**

- **360° car camera**

The 360° vehicle camera has four-azimuth imaging capabilities and can capture panoramic images. By utilizing advanced 360° panoramic stitching techniques, this camera empowers operators with a heightened understanding of their surroundings, thereby minimizing the presence of blind spots and dead angles.

- **Sound/Light alerts for instant reminder**

The camera is outfitted with a dual alert system, combining audible and visual alarms. In the event of detecting a potential collision risk, the camera promptly triggers an alarm to promptly notify the operator. This immediate alert serves as a crucial reminder to the operator, prompting them to undertake appropriate measures and thereby enhancing overall safety protection in a comprehensive manner.



- **AI prompts assisted driving**

The vehicle camera incorporates an AI function that offers valuable features such as reversing assistance, collision prevention, and early warning capabilities, thereby augmenting driving safety. This allows managers to remotely monitor the vehicle's driving conditions and camera status via the management background system, facilitating efficient oversight and management.

C-SMART System Introduction 4S Function



• Unsafe acts/ dangerous situation alert for Tower Crane Lifting Zone

The system plays a crucial role in mitigating on-site crane collisions, encompassing both crane-to-crane and crane-to-structure scenarios. Various sensors, including wind speed sensors, will be strategically installed on the tower crane to facilitate real-time monitoring. The collected data will be prominently displayed on the platform, accompanied by warning alerts promptly notifying operators of any potential collision risks. This comprehensive approach enhances safety measures and minimizes the likelihood of crane-related incidents on the construction site.

The screenshot displays the C-SMART system interface, which includes the following components:

- Top Bar:** Includes the C-SMART logo, language selection (Traditional Chinese), and a location pin.
- Left Sidebar:** Features a shield icon for "安全管理" (Safety Management) and a camera icon for "天秤資訊" (Scale Information). The "天秤資訊" section shows a diagram of a tower crane with a 50m jib length and a 45.5m radius, along with a photo of a person and detailed crane information: 型號: TCR-159, 身份證: Y518****, 進場日期: 2023-11-14.
- Central Monitoring Area:** Shows a 3D site map with three green circular collision detection zones labeled TC2, TC3, and TC4. Tower cranes are positioned within these zones.
- Right Panel:** Displays a table of "近期警報記錄" (Recent Alarm Records) for crane TC2, listing alarms from April 23, 2024, to April 22, 2024, such as "小車碰撞警報" (Small car collision alarm) and "過速警報" (Excessive speed alarm).
- Bottom Left:** A "天秤工作數量統計" (Scale Work Quantity Statistics) chart showing the number of operations (180), total load (288.5), and working time (393 minutes) over the past 7 days.
- Bottom Right:** A "警報數量 警報類型" (Alarm Quantity Alarm Type) chart showing the count of alarms (0, 1, 2, 3) for different alarm types over the past 7 days.

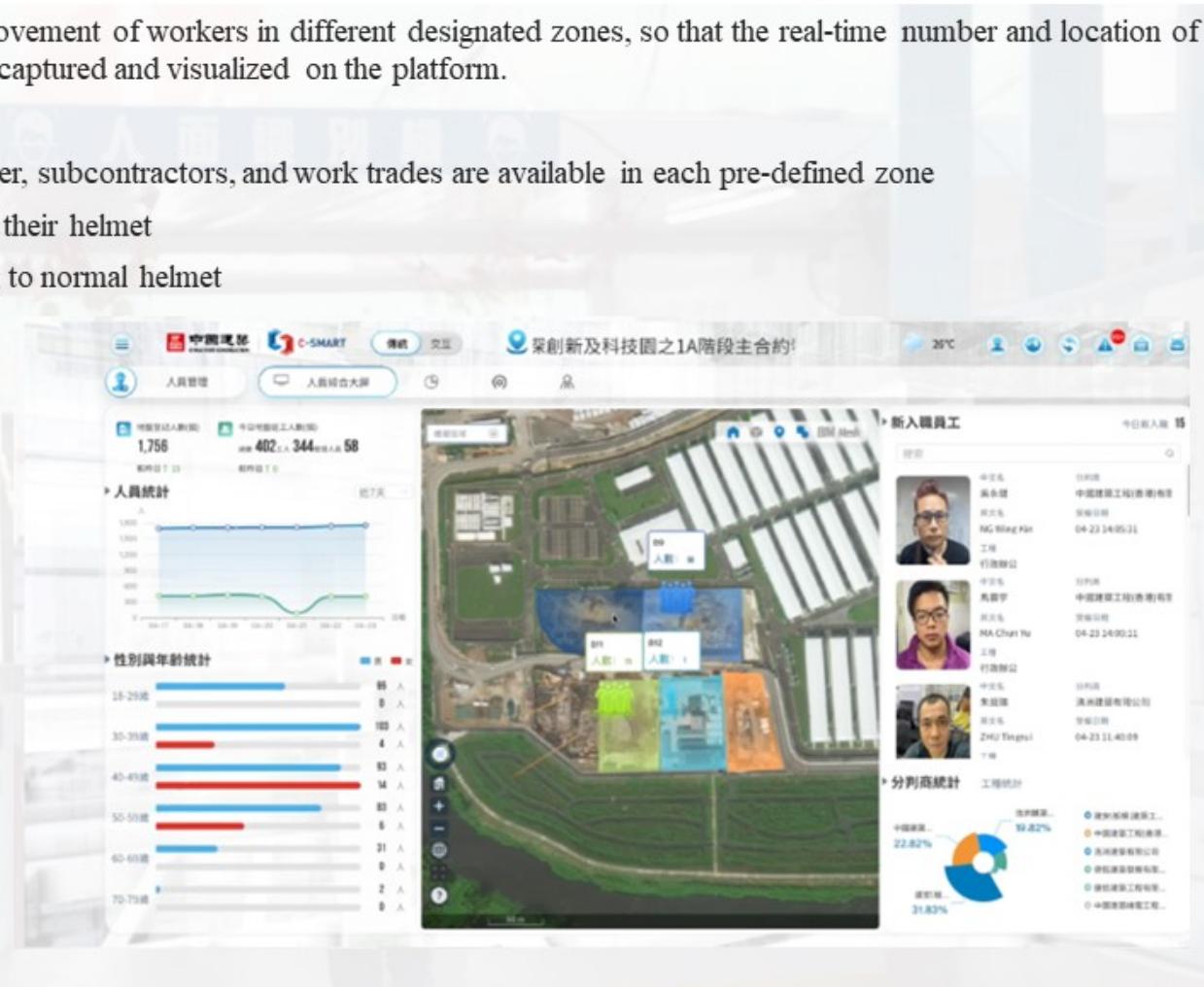
C-SMART System Introduction 4S Function



• Smart Monitoring Device for Workers and Frontline Site Personnel (Worker Management System)

With 3 kinds of simple devices, we can accurately monitor the movement of workers in different designated zones, so that the real-time number and location of workforce, distribution performance of subcontractors can all be captured and visualized on the platform.

- A total solution for worker management
- Details including number of workers distribution by age, gender, subcontractors, and work trades are available in each pre-defined zone
- Long range passive RFID tag is used to pair each worker with their helmet
- No additional procedure for using the smart helmet comparing to normal helmet

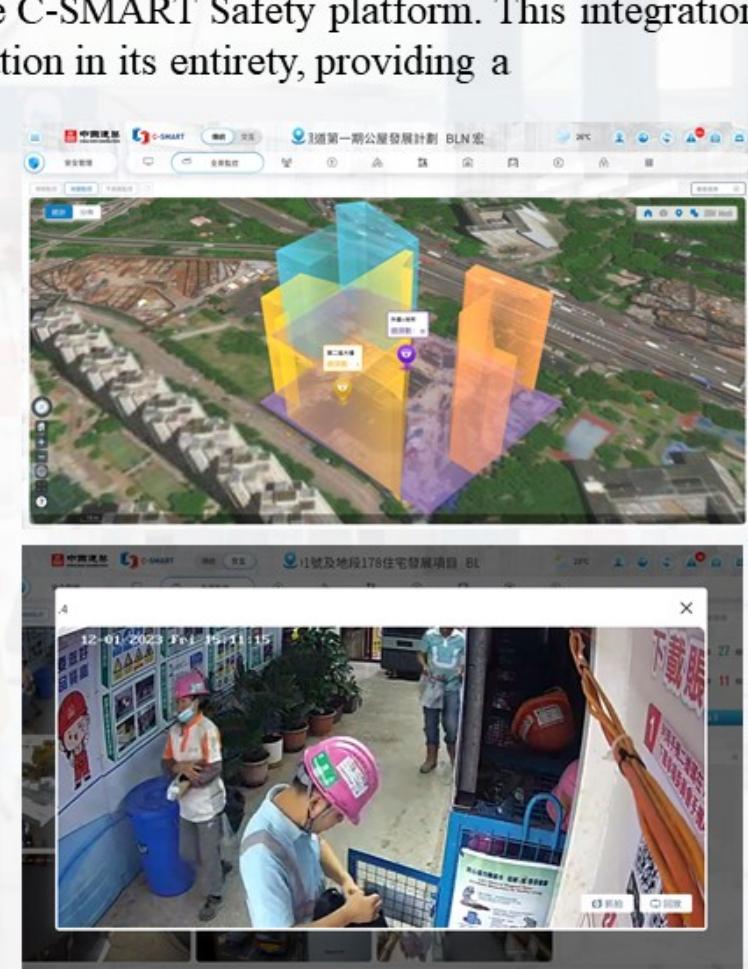
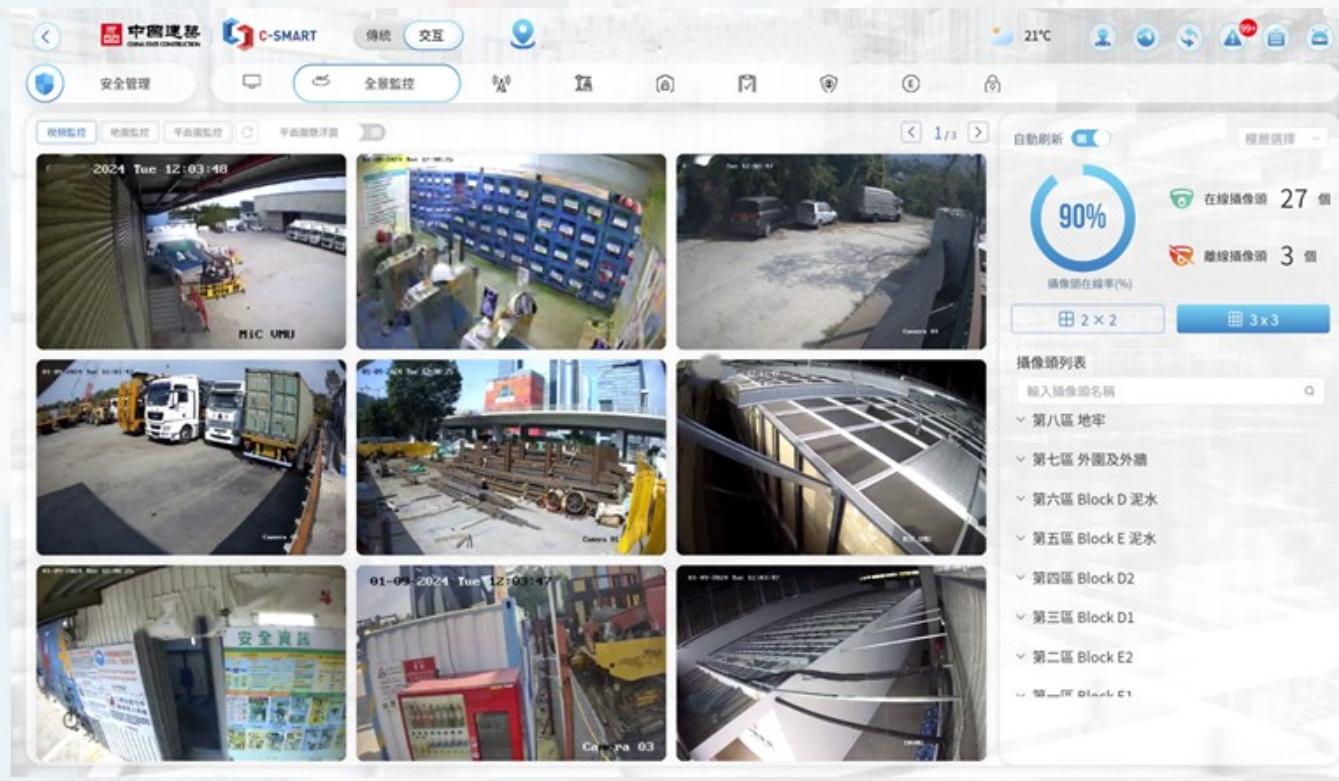


C-SMART System Introduction 4S Function



• CCTV Surveillance

All images captured by the CCTV cameras will be seamlessly integrated into the C-SMART Safety platform. This integration enables the safety manager to conveniently access and monitor the live site situation in its entirety, providing a comprehensive overview of security conditions.



C-SMART System Introduction 4S Function



• Safety Monitoring System using Artificial Intelligence

• Worker's Unsafe Behavior

With the aid of high-resolution CCTV camera and artificial intelligence (AI) model, our system is able to monitor the general safety practices in construction sites, such as whether worker wearing safety helmet, safety vest, etc. If any violation is detected, real-time alert will be generated automatically on the platform, while the data and images will be stored at the back-end system for further analysis.

• Current AI Algorithm

1. Unauthorized access to restricted zones
2. Workers near site vehicles or plant;
3. Under Lifting
4. PPE Detection
5. Monitoring of fatigue, distraction,
6. Open Edge
7. Over Speeding
8. People Counting

The screenshot displays the C-SMART platform interface. At the top, there are navigation tabs: 安全管理 (Safety Management), 交互 (Interaction), AI 通道监控 (AI Channel Monitoring), and 視頻監控 (Video Monitoring). The main area shows a 3D map of a construction site with various colored 3D blocks representing different zones. A camera icon indicates the location of the AI monitoring. Below the map are three circular charts: '警報數量' (Warning Quantity) showing a peak around April 19th; '警報類型' (Warning Type) showing 56% for '受限區域警報' (Restricted Area Warning) and 44% for '防護裝備警報' (Protection Equipment Warning); and '警報區域' (Warning Area) showing 100% for '外圍+地牢' (Periphery + Basement). To the right, there are two video feeds: 'AI 通道監控' (AI Channel Monitoring) showing a worker near a vehicle, and '視頻監控' (Video Monitoring) showing a worker in a basement area. A blue banner at the bottom reads 'Platform Warning Notification'.



C-SMART System Introduction 4S Function



• Confined Spaces Monitoring System (AMS)

The enclosed space gas system monitors air quality through a gas detection control box. This control box supports air quality tests with ten types of sensors, detecting oxygen (O2), PM2.5, PM10, carbon monoxide (CO), carbon dioxide (CO2), hydrogen sulfide (H2S), methane (CH4), combustible gases (EX), temperature, and humidity. When gas concentrations reach predefined warning levels, an audio and visual alarm is triggered in the control box.



• BI Dashboard

The detection data, warning, and alarm information are transmitted in real-time to the IoT platform and integrated into C-Smart. Users can add devices in C-Smart, set warning and alarm thresholds for various gases, and monitor detection, warning, and alarm data through a BI dashboard.



產品優勢 PRODUCT FEATURES

- 支持離線使用，超過設定閾值即時觸發聲光報警
- 吸式氣路設計，更適合密閉空間環境
- 採用過濾網機件、背扣等設計，方便安裝保養
- 監測、預警及報警資料集成 CSMART大屏展示
- CSMART監測大屏兩種頁面樣式可選
- 檢測的氣體類型可擴展

可檢測的氣體類型 DETECTABLE GAS TYPE

1 氧氣O2	2 PM2.5	3 PM10	4 硫化氫H2S	5 一氧化碳CO	6 二氧化碳CO2
7 甲烷CH4	8 可燃氣EX	9 濕度	10 濕度		

產品規格 PRODUCT SPECIFICATION

類型	量程	解析度	精 度	使用壽命	類型	量程	解析度	精 度	使用壽命
氧氣O2	0~30%Vol	0.1	0.5%	2年	一氧化碳CO	0~1000ppm	1ppm	±3%讀數	2年
溫度	-40°C~100°C	0.1	±0.5%	10年	二氧化碳CO2	400~5000ppm	1ppm	±3%ppm(±3%)	10年
濕度	0~100%RH	0.1	±0.3%RH	10年	硫化氫H2S	0~100ppm	0.1ppm	±5%讀數	2年
PM2.5	0~1000µg/m³	1µg/m³	±10%讀數	>40000小時	甲烷CH4	0~100%LEL	1%LEL	±5%讀數	3年
PM10	0~1000µg/m³	1µg/m³	±10%讀數	>40000小時	可燃氣體EX	0~100%LEL	1%LEL	±5%讀數	2年

平台界面 PLATFORM INTERFACE

密閉空間安全
C-SMART平台
一手掌握

All information is clearly visible on C-SMART

C-SMART System Introduction 4S Function



- **Safety training with Virtual Reality technology**

- Combining Virtual Reality, interactive technology, IoT and cloud based integrated platform to create scene models and animation
- Provide trainings to workers to adopt suitable measures in different situations
- Greatly optimize the safety level and efficiency of employee training

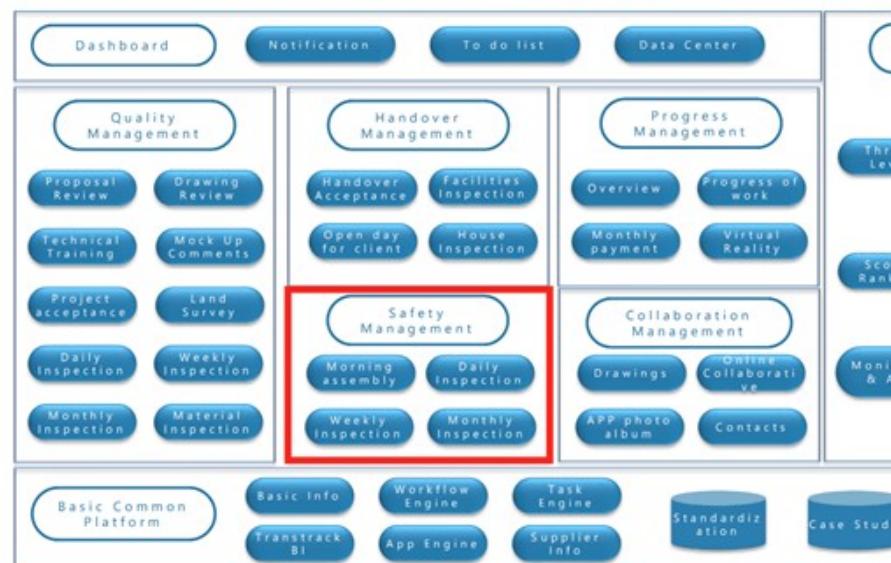


C-SMART Other Smart Safety Functions



- Digital Works Supervision System (DWSS)
- SAFETY INSPECTION

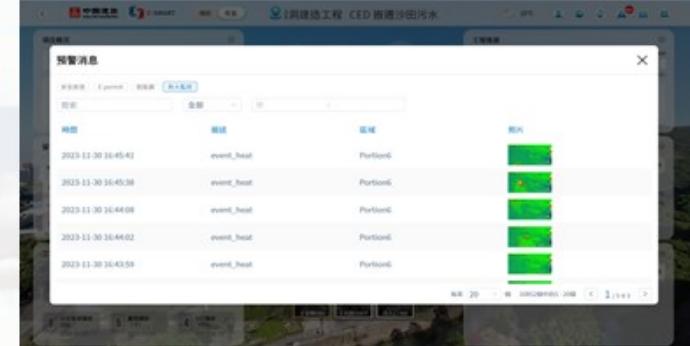
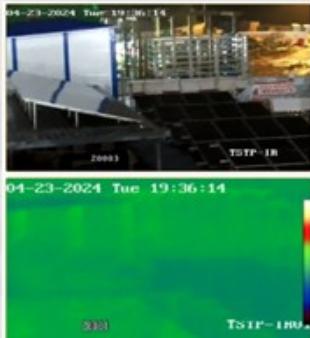
Function Framework



• AI FIRE PROTECTION

• AI Fire/Smoke Detection

Both visible light and infrared cameras are installed for CCTV surveillance. The CCTV system is integrated with AI algorithm and deep machine learning technology, fire and smoke can be detected through both computer vision and infrared cameras, which greatly enhances the accuracy and capability of early fire detection 24/7. Upon detection, alerts with location are immediately sent to responders through the system and mobile application.



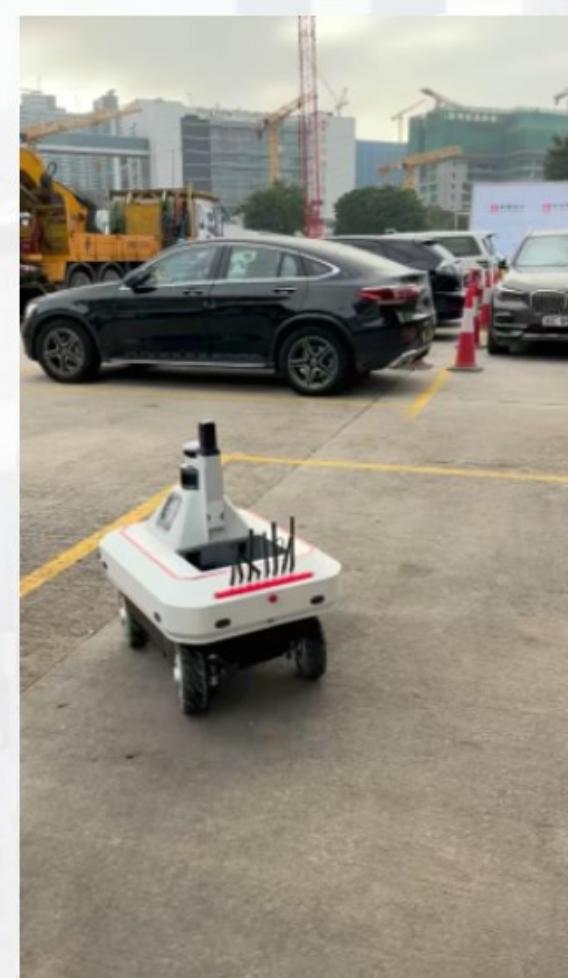
- Application of Building Robot in construction industry



Inspection Robot



- New AMR hardware integrated industrial design and assembly
- Self developed Robot control system
- Self developed Interactive system
- 360 panoramic camera, PTZ binocular camera, sterilization device control and data collection
- Return and charging system



C-SMART Other Smart Safety Application

- Application of Building Robot in construction industry



Transport Robot

- Automatic following navigation system, more flexible and safe
- One click start, route memory function
- Automatic obstacle avoidance function
- Man-machine collaboration to improve work efficiency, max safety work load 250kg



3. Q&A

THANKS!

This is a clip from the 26 April 2024 recording of the

Hong Kong Housing Authority

"Site Safety Seminar for Capital Works New Works Contracts"

The speaker on stage is Mr Chris GUAN

Assistant Director of Transcendence Company Limited

His topic is

Building a Safer Future:

A Spotlight on 4S Implementation in Construction Sites

(00:23)

Hello everyone, my name is Chris GUAN

I am honoured to have this opportunity today

to share with you the application of the Smart Safety Site System on construction sites

As this is an invitation from the Housing Department

today I will mainly focus on applications on Housing Department sites

If you have questions about other sites

I will be happy to share as well

Today's theme is about

how we can build a safer construction site

My presentation will be divided into three parts

In the first part, I will talk about the development path of C-SMART

The second part will cover

the key technologies in the Smart Safety Site System and their applications

The third part will include

other voluntary smart site safety applications

to share with you all

This is our C-SMART platform

which focuses on smart safety development

C-SMART was launched in August 2020

During the pandemic at the Lantau Hospital site

we already started paying attention to workers' health

In the early stages, our main technology application

focused on worker and

collecting health data feedback

We hoped that workers on the construction site

could maintain good physical condition

to avoid health problems

not only to perform their work well

but also because physical health is very important

In October 2020

we established a standard

based on BIM, called 7+2+1

What is the "7"?

It refers to the usual construction site management approaches

workers, machinery, materials, quality, safety, progress, and environment

"2" refers to two areas of concern in Hong Kong

progress and robotics

I understand the Housing Department

pays special attention to robotics

The "1" is the concept of the centralised management platform

where everything is displayed through one platform

to help management better understand their site

This is what we call technology empowerment

There were a few setbacks in between

which I will not go into now

One point to highlight

is that in July 2022

we extracted three core modules

workers, machinery, and safety

and consolidated them into one

smart digital safety solution

This solution came before

the technical circular on Smart Site Safety Systems issued by the Development Bureau in

2023

After half a year of development

by the time the circular was published

we had basically fully implemented the system

In August last year, we released C-SMART 4.0

And this August

the advanced version of the Smart Safety Site System will be launched

This is a preview

As I mentioned earlier

we are working within the 7+2+1 framework

As you all know

what determines a successful smart site safety system

or a good practice of smart safety

is mostly related to IoT, AI, and BIM

Whether it is collision prevention, smart wearables

or tower crane lifting safety

they are all related to IoT

Confined space monitoring

is associated with AI

And BIM acts as a bridge between systems

This is our analysis

As everyone knows

the Development Bureau document outlines ten categories

I will not go into each one

but I will briefly mention a few

For example, centralised management platform

monitoring of site machinery, power tools and ladders

permit-to-work systems, e-locks

tower crane lifting and mobile plant collision prevention

AI analytics, smart wearables

confined space monitoring and VR safety training

We also know that

the Housing Department has taken this a bit further

They issued the DCMBI at the end of last year

When we compared the content, we found that three items were newly added

If you have worked on Housing Department projects

you will likely be aware of these three

First is the certification process for operating machinery

Workers must be certified as competent persons

before they can operate the equipment

Second for CCTV

alarm systems and image resolution in tower crane operations

requirements are enhanced

as tower crane lifting is a key concern for the Housing Department

and for us as well

Third is for machinery like forklifts

and bobcats

we aim to monitor their manual brake system

These three items are newly added

I will share more of our thoughts later

Next, I will talk about

in Housing Department projects

how the Smart Safety Site System is being applied

We can now see that

This is the main interface of our C-SMART 4.0

Here I am showing a public housing project

the Wang Chiu Road project

The interface is simple

You can see many different modules

The final module selection

is up to the site team

After entering the system

this interface is linked with renderings, 720-degree views

BIM, and GAS

to display the site in different ways

We hope that all colleagues working in different trades

can better understand the site

through this central platform interface

They can track progress

and stay informed about safety conditions

All IoT statuses

can also be displayed on this homepage

What are the items on the left?

These are some of the functions within our C-SMART system

As of now

we have over fifty different functions

More than twenty of them are safety-related

which already exceeds the current requirements of the Smart Site Safety System or DCMBI

Let's look deeper into the system

The first item is about

tracking of site machinery, power tools, and ladders

How could these information be used on site?

We install GPS or motion sensors

on different types of machinery

For power tools and ladders

we attach metal plates with QR codes

All machinery, power tools, and ladders entering the site

must be inspected and registered by relevant personnel

For example, machinery on site

may be registered by the safety officer

Power tools

may be registered by the foreman

During the registration process

we enter all certification details

subcontractor information

and previous inspection checklists

All detailed data and photos are consolidated

and displayed on the central management platform

So what are the different coloured boxes on the right?

They represent added value

We have enhanced the GPS with motion sensors

Through motion monitoring

we can calculate

how efficiently each machine is being used
whether it is reaching its maximum performance
to manage the site more effectively
Besides knowing its location
we can also tell whether it is in use
I believe this function is useful for most construction sites

On the other hand
the permit-to-work system
is crucial for all construction projects
The Smart Site Safety System and DCMBI
require seven types of electronic permits
During actual implementation
we found that although there are seven types
different sites and clients
may have slight variations
on the permits details
Some may want to optimise the process
or have different formatting preferences
or request permits beyond the original seven
So we turned our permit-to-work system
into a process engine
which allows us to quickly configure a new e-permit
tailored to each site and client

What is the benefit?
Take a confined space work as an example
We may select "confined space" from the list
But confined space is a broad category

Some sites require separate permits

for specific work inside manholes

With our system

this can easily be set up

All permits are filled out through our mobile app

eliminating the old paper-based process

We provide every worker and foreman on site

with access to this app

Before any work begins

they can use the app to submit the application

Filling out the form

typically takes just two minutes

Once submitted it is sent to the foreman or relevant personnel

After approval

the e-permit becomes active

All permits can also be displayed

within the central management platform

on the GAS map

We can see details of the e-permit

such as the work location and nature of work

and view analytical reports

to track active and cancelled permits

Through these management tools

senior staff who are not stationed onsite

can understand the site conditions

just by viewing the centralised management platform

Another feature

is for restricted zones on site

such as electrical rooms, material stores, or lift shafts

We provide access control system

Previously, we relied on physical locks

But padlocks will often be damaged

or keys went missing

If a worker needed help

we had to bring the key over

Now we have switched to all electronic locks

Our company currently uses

three types of electronic locks

designed for different site needs

The simplest is the 4G lock

shown here on the left which uses a SIM card

What is its advantages?

We can use tap card, QR code

or a third-party access card to open this lock

All authorisation is managed by the site team

But what is the issue with 4G?

Everyone knows that lift shafts require this electronic lock

But lift shafts usually do not have signal

So the 4G lock may not function properly

It may fail to unlock

or the signal cannot transmit

So we offer a second solution

unlocking via a mobile app

by scanning a QR code

Why use this method?

Because the app works offline

Even inside confined spaces or lift shafts

you can still scan the QR code to unlock

When your phone reconnects

the record is immediately sent to the backend

Currently on Housing Authority projects

all lift shafts are using this system

As you can see in this screenshot

a typical project

may involve hundreds of locks

In this project we have equipped all of them with electronic locks

I believe this is one of the most widely adopted systems

currently in use on sites across Hong Kong

Next is our system for key machinery

which I know the Housing Authority and Buildings Department are both highly concerned

about

In general, the industry uses 360° camera technology

and we use the same approach

As shown in this video

If a person appears

near a moving vehicle

a frame will appear on screen to highlight them

and all alerts will be displayed on the centralised platform

A 25-second video clip will be generated

Also our integrated alert system will trigger alarms

both on site

and on the centralised management platform

We also have an alert centre

for safety officers or site supervisors

to follow up as needed

Now for tower crane operations

Many technical circulars state clearly

that the area beneath a lift must be clear

With artificial intelligence

as seen in this video

If a person enters the area under lifting operation

a frame will appear to highlight them

An alert will be sent to the platform

and an audio warning will be played on site

to remind workers to stay alert

What else have we added?

On Housing Authority projects

We have installed various IoT sensors on the tower cranes

These sensors could detect

the crane's tilt angle, radius, load, and wind speed

capturing critical safety IoT data

All the IoT sensor data

is sent back to our centralised platform

The platform can also monitor the crane's load weight

the number of lifts, and the lifting history

This helps everyone understand the ongoing site operations

or which crane is the busiest

Through this system we can closely monitor the usage status of the cranes

This covers crane applications

Next, we focus on monitoring frontline workers' health and location

There are many solutions on the market

some use safety helmets, some use RFID technology

others use smartwatches

We combine different solutions

so different sites can use what suits them best

On the left, we have smart tags attached to safety helmets

workers just scan their card at the gate to pair it

We can know their real-time location using information gateways

What are the pros and cons of the system?

The advantage is saving power and cost

the downside is it is harder to detect workers' health conditions

Therefore, we also use a smartwatch system

This is the smartwatch

When workers wear it

we can see their real-time status

To protect their privacy

all data on body temperature and heartbeat is confidential

only normal or abnormal status is shown

Also, if we tap on a worker's location

we can see their basic profile and certificate information

and their previous locations

As shown in this video

we can track the worker's movement

This enables better monitoring of workers' conditions

For example, if a worker falls

or sends an SOS alert

but their location is unknown

By replaying their movement trail

we can see their last known position

and immediately rescue them

There are also other functions

like when a worker is still showing on screen after clocking out

All safety personnel will receive an alert

with a phone number included

As you see here

they can call the worker anytime

to check on the situation

Regarding CCTV use

I won't go into detail

The main difference is

we aim to use

CCTV that requires wiring for power or internet

to gradually replace traditional CCTV

because wires can be damaged by workers

We now use solar-powered cameras to replace the traditional setup

which helps with site modifications or moving the cameras

With these CCTVs combined with AI algorithms

we can implement various functions

In our applications for the Housing Department

we mainly focus on eight algorithms

You can see on the list on the left

including restricted zones, workers too close to machinery

lifting, personal protective equipment detection

monitoring driver fatigue and distraction

excavation edges, vehicle speeding, headcount, and etc.

In fact, according to DCMBI there is one algorithm missing from the above

which is AI monitoring if workers wear safety harnesses

We have tried many times

but so far we think AI may not be fully feasible

First, because it can be blocked by scaffolding nets

Second, it may require installing many CCTV cameras site-wide

to observe this level of detail

This is unrealistic for site application

So this remains a hurdle in implementation

Also, confined spaces are a major concern on sites

We developed our own device

which has been certified under the Hong Kong Laboratory Accreditation Scheme

What can this confined space device do?

Besides reading gas data

we have connected it to the centralised management platform

This video below shows

the location of each confined space monitoring system

and the status of each device

Its historical data

for each gas reading

whether there were issues before, when limits were exceeded, and reasons

Through these analyses site safety officers and management can be more confident

For example, if there are many manholes under construction

or confined spaces being worked on

I can see gas conditions in advance

then I can be less worried to

approve work permits for workers

We aim to connect different smart site systems

such as the permit-to-work system, electronic locks, and confined space monitors

The system behind this has one logic to enable real management

not isolated systems

allowing different sites to use the system continuously

Lastly, some virtual reality safety training

I will not elaborate much here

because it is similar to videos on the market

The only difference is

different sites based on their needs

can produce VR safety promotion videos

The equipment is mostly similar

The final part I will talk about

are some other safety-related functions

Some of these have been used in 50 to 60 sites

I believe they can help Housing Department or Buildings Department sites

First, we know Hong Kong requires a digitalised site supervision system

The Housing Department has its own e-Housing system

but it probably does not use a digitalized supervision system

Therefore, for safety

we developed some new methods for our digital site supervision system

As you see on this screen

through our simple digital supervision system

all site inspection records are linked to the central management platform

All problems, solutions, and plans

statistical data and site performance

can be viewed at a glance through the central platform

Unresolved issues will trigger the alarm system

This enables better management of site safety

Another area we focus on is fire prevention

Fire prevention is not explained in the technical circulars or DCMBI

However, we use artificial intelligence and augmented reality imagery to perform some analysis

This imagery is applied on different sites

installed at various locations

It automatically patrols at 360 degrees

When it detects unusual temperatures

such as in this image

when the temperature is abnormal

AI will zoom in to confirm

If there is indeed a danger

an alarm will be triggered

All alarms are sent to the central management platform

and mobile app alerts

and connected to the police control centre

What was the image just now?

It showed a machine engine during construction

exceeding 150 degrees Celsius

Currently on all our sites

first, there is full 360-degree coverage

Second, the minimum threshold is set at 150 degrees Celsius

because most materials have a minimum ignition point around 200 degrees Celsius

We added some safety margins

to better protect the site and prevent fires

What is this?

As Mr Tse mentioned earlier about scaffold safety measures

it is mainly for scaffolds

On some sites

we also apply IoT technology to scaffolds

installing sensors

These sensors monitor

the tilt angles of critical scaffold positions

When it exceeds site critical threshold values

an immediate alert is issued

so our workers can pay attention to safety

We connect these to the site alarm system

through these measures, site management is better controlled

Of course, these ideas come from the sites themselves

So I always want to emphasise one point

whether smart site safety systems or intelligent safety

If the site truly puts in effort

we can achieve much better results together

Finally, related to safety

we also have some applications involving robotics

This is also used in a Housing Department project

What is this?

It is an autonomous inspection robot

equipped with LiDAR and cameras

What is our intention in using it?

We hope it can patrol during less busy times such as at night or early morning

or on Sundays to conduct inspections and take photographs

All LiDAR point cloud data

360-degree photos

or other activities detected

are all linked to the central management platform

This makes it more flexible

When there is no power it can automatically return to its charging station

It is an autonomous inspection robot

What is this?

It is also applied in a Housing Department project

In fact, material handling by workers on site

is an activity that risks injuries

So we use these material-handling robots

to assist in some of these tasks

Its main function is to follow workers

At the same time, when distributing materials on floors

it can remember five routes

and deliver materials from the material crane to the unit door

Through these measures

we hope to further enrich the applications of smart site safety systems

This concludes my introduction today

Thank you for watching

(24:14)