CONSTRUCTION INDUSTRY COUNCIL
建造業議會

CIC Beginner's Guide on Construction Digitalisation – **Smart Site Digital Platform**

2022

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Executive Summary

This is one of the Beginner's Guides on Construction Digitalisation issued by the Construction Industry Council (CIC). Construction Digitalisation is the transformation of traditional operations in the construction industry to digitalised operations which includes the adoption of Building Information Modelling (BIM) as well as other digital solutions for various construction management functions including site work (e.g progress, quality, environmental performance etc.), safety and site monitoring.

This Beginner's Guide was prepared jointly by the Construction Digitalisation Department and the Construction Innovation and Technology Fund (CITF) Department of the Construction Industry Council (CIC) based on an the in-house study on the available digital solutions in the market that are designed to perform specific site work management functions under specific application areas for use in the construction stage to help users manage their construction projects and site work operations.

Use of an interoperable digital platform is the future trend. The Beginner's Guide will provide information to the industry stakeholders on the commonly required functionalities of a digital platform for managing a typical construction project to allow them to select a digital platform for use in the construction stage. This will also help them to make negotiation with the solution provider for the functions required to suit individual project needs. It is written from the perspective of the users. Hence, technical details are not discussed in detail in this guide. Relevant product vendors and professionals shall be consulted on the technical aspect.

This Beginner's Guide shall be read in conjunction with the CIC Beginner's Guide on Construction Digitalisation – Adoption of Common Data Environment (CDE) for Information Management using BIM and CIC Beginner's Guide on Construction Digitalisation – Adoption of BIM in Small and Medium Enterprises (SMEs) which cover different areas of application of constriction digital solutions in construction projects.

The Needs of Digital Platform in Construction Industry

- BIM adoption was mandated for capital works projects with a project estimate more than $30 Million since 2018.
- Associated with the BIM adoption, construction digitalisation has become increasingly popular and important in construction operations.
- Construction expenditure is expected to continue to rise in the coming 10 years. The construction industry is faced with aging workforce, increasingly tight project programme and budget and higher project requirements which will generate a stronger demand for more efficient and effective management tools.
- Digitalisation of construction operations signified by the adoption of digital platforms is a key solution to meet the upcoming challenges.
- Adoption of digital platforms meeting the CITF requirements in construction process was supported by the Construction Innovation and Technology Fund (CITF) since 2018.

Digital Platform

- A digital platform is a digital solution designed as a carrier and visualisation and/ or processing tool for a project, and site environment or workers'/ site activities' data to help users perform specific site work management functions under one or more application areas in one or more construction projects.

Common Application Areas and Functions of a Digital Platform

- Digital platforms can be applied to design, planning, construction or asset/ facilities management. ***For the purpose of this guide, only digital platforms providing specific site work management functions and the application areas in the construction stage will be discussed***. Common Data Environment (CDE) which usually serves as a central database and provides general management functions is not included in this guide. Details of CDE can be found in another CIC publication named **CIC Beginner's Guide on Construction Digitalisation – Adoption of Common Data Environment for Information Management using BIM**.
- Digital platform application areas for construction stage can be generally categorised into three types namely site work monitoring and administration, safety monitoring and site monitoring.
- Under each application area, there are functional areas and functions. ***(# below denotes priority functions which are considered common and universally applicable to most construction projects)***

Application Area	**Site Work Monitoring and Administration**		
Functional Area	**Site Record**	**Inspection Checklist**	**Defect/ Outstanding Work Monitoring**
Functions	• Request for Inspection/ Survey Check (RISC) Form # • Site Diary/Site Record Book # • Labour Return Record #	• Site Safety Inspection Records # • Cleansing Inspection Checklists # • Quality Inspection Checklist • Environmental Inspection Checklist	• Site Defect / Outstanding Work Inspection • Automatic comparison of site image and design • Drone for external inspection

Application Area	**Safety Monitoring**			
Functional Area	**Personal Protective Equipment (PPE) Checking**	**Well-being Monitoring**	**Workers' Behaviour Monitoring**	**Hazardous Area Zoning/ Access Control**
Functions	• Safety Helmet # • Reflective Vest # • Life jacket • Safety shoes • Wrist band / smart watch	• Workers' location tracking # • Body temperature # • Heartbeat # • Sudden fall # • Motionless # • Blood pressure	• People count based on different vests and helmets # • Smoking # • Driver sleeping • Driver using mobile phone • Driver motionless	• Anti-collision / Machinery safety distance - Sensor-based # • Anti-collision / Machinery safety distance - AI-based # • Restricted zone / Danger zone - Sensor- based # • Restricted zone / Danger zone - AI- based # • Fall from height prevention # • Truck license plate detection • Truck delivery and analytics • Face recognition for access control • Fire hazard detection and alarming • Crane for working platform and crane operation CCTV

Application Area	Site Monitoring		
Functional Area	**Site Environment Condition Monitoring**	**Building Element Monitoring**	**Equipment Status Monitoring**
Functions	• Noise # • Vibration # • Dust/ Air quality # • Electricity leakage # • Titling / Inclination • Displacement • Settlement • Harmful gas • Fire • Water level and/or leakage • Gas leakage • Security • External sensor compatibility	• Loading # • Concrete maturity # • Drainage piping assessment	• Equipment location tracking # • Power system fault # • Equipment data • Equipment operating data • Fuel consumption

- A digital platform can be adopted in an enterprise with different levels of adoption as shown below:

Corporate Level	A digital platform that is able to provide the project and site activities information of all the construction projects of the enterprise **(i.e. Company-wide Smart Control Centre)**.
Project Level	A digital platform that is able to provide the project and site activities information of one single construction project **(i.e. project-based Smart Control Centre)**.
Functional Level	A digital platform that is able to provide the project and site activities information of one or more application area(s) with one or more function(s) in a construction project, such as site work (e.g progress, quality, environmental performance etc.), safety or site monitoring. The functions vary depending on the operational needs and the application areas required, for example, function of personal protective equipment detection under safety monitoring application area **(i.e. function-based digital platform)**.

- There are different owners and users of digital platforms including clients (Appointing Parties), consultants, sub-consultants, main contractors and sub-contractors. There are also different digital platform providers for one project. The users shall make the most favorable arrangement to suit their needs.
- Each user may be involved in one or more digital platforms or projects depending on the user's needs.
- Deployment of digital platforms for the whole construction and asset life cycle is recommended.

Benefits of Adopting Digital Platforms

- Digital platforms bring multi-faceted benefits to users in the following six areas, among others:
    - Enabling saving in manpower and time
    - Providing visualisation if site operations at a glance

- Providing highly reliable and traceable data for all parties
- Improving project management efficiency
- Enabling instant and timely response
- Enabling efficient and meaningful analysis

Funding Support for Digital Platform Adoption

- The adoption of digital platforms meeting the requirements of the Construction Innovation and Technology Fund (CITF) by eligible consultants, contractors and sub-contractors in the construction process is supported by the CITF under the Advanced Construction Technologies (ACT) category.

Advice on Selection of Digital Platforms

- The 6 simple steps to get started for digital platform adoption are:

  - Step 1 – Identifying the need for digital platforms
  - Step 2 – Assessing capabilities of available digital platforms
  - Step 3 – Ascertaining the product details and negotiating with digital platform providers
  - Step 4 – Engaging the digital platform providers
  - Step 5 – Enabling successful delivery of digital platforms
  - Step 6 – Enabling successful adoption of digital platforms and continuous monitoring and feedback for fine-tuning and improvement

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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 given 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 provide standards or methodologies generally adopted and regarded by the industry as good practices. The CIC recommends the adoption of the standards or methodologies given in 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.

To allow us to further enhance this publication, we encourage you to share your feedback with us, after you have read this publication. Please take a moment to fill out the Feedback Form attached to this publication and send it back to us. With our joint efforts, we believe our construction industry will develop further and will continue to prosper in the years to come.

Definition of Abbreviations

Abbreviations	Definition
AI	Artificial Intelligence
BIM	Building Information Modelling
CAD	Computer Aided Drafting
CDE	Common Data Environment
CIC	Construction Industry Council, Hong Kong
DWSS	Digital Works Supervision System
GIS	Geographic Information System
IoT	Internet of Things
IT	Information Technology
SME	Small and Medium Enterprise[1]

The above abbreviations are not exhaustive. Reference should be made to the relevant sections in the document.

[1] Small and Medium Enterprise mean an enterprise which employs fewer than 50 persons.

1. The needs for digital platforms in the construction industry

1.1. Overview

In 2018, the HKSAR Government published the "Construction 2.0 – Time to Change" with initiatives to reform and upgrade the construction industry, to enhance its capacity and sustainability, increase productivity, promote regulation and quality assurance, improve site safety and reduce environmental impact, through "innovation", "professionalisation" and "revitalisation" [2]. Building Information Modelling (BIM) has been identified as one of the Innovations and use of BIM[3] should be further encouraged.

With the release of the Technical Circular (Works) Nos. 7/2017, 18/2018, 9/2019, 12/2020 & 12/2021 by the Development Bureau (DEVB) of The Government of the Hong Kong Special Administrative Region (HKSAR), capital works projects with a project estimate more than $30 Million are mandated to use BIM from 1st January 2018 onwards.

Since then, BIM has been adopted widely in the industry with proven benefits. Associated with the BIM adoption, various construction digitalisation solutions have been developed and becoming increasingly popular including site work monitoring and administration systems, digital twins and various digital platforms associated with different construction applications such as sensors and Internet of Things (IoT) devices which are regarded as the key pillars of the construction digitalisation.

The construction expenditure in Hong Kong is expected to increase by 21% from HK$280 billion in 2021-22 to some HK$340 billion in 2030-31[4]. Projects are also becoming increasingly complex with tighter project schedule and budget, higher and more stringent quality standard and statutory or contractual requirements as well as higher market competition. Meanwhile, the local construction industry is having an aging construction workforce of more than 46 years old on average[5]. Faced with some deep-rooted safety issues and the carbon neutrality target, the induced demand for more efficient construction operations, accurate and secure data, effective and effective control on the supply chain and project delivery as well as efficient decision-making and implementation is higher than ever.

Digitalisation of construction operations signified by the adoption of various digital management platforms is considered a key solution to meeting the aforesaid challenges and enabling the industry to manage construction projects much more efficiently and effectively than traditional methods.

[2] Project Strategy and Governance Office (2022) https://www.psgo.gov.hk/en/c20.html
[3] Construction 2.0 – Time to Change, 2018, DEVB
[4] CIC Construction Expenditure Forecast https://www.cic.hk/common/Fore/Fore.aspx?lang=en-US&year=2021_22v2
[5] CIC Statistics of Registered Construction Workers https://app.powerbi.com/view?r=eyJrIjoiZjY5Zjg2NzgtNzFiYS00OGQ3LTlmNDYtMDA5MjY1NzAxODcwIiwidCI6ImUzMWMzOWNlLTAxYzMtNGRiNS04ODI3LTdiNjdkMDczMjVmZiIsImMiOjEwfQ%3D%3D

1.2. What is a Digital Platform?

In a nutshell, digital platform is a digital solution that is designed as a carrier and a visualisation and/ or processing tool of project, site environment or workers'/ site activities' data to help users perform specific site work management functions under one or more application areas in one or more construction projects.

A digital platform has many functions to allow users to handle and manage a huge amount of data to to meet the project requirements and needs. The purpose(s) is/ are characterised by the defined application areas of the platform.

According to the digital platforms included in the Construction Innovation and Technology Fund (CITF) Pre-approved Technologies List (i.e. available in the market), a digital platform usually provides one or more specific site work management functions in one of the three common application areas, namely site work monitoring and administration, safety monitoring and site monitoring. Their primary purposes are quite clear and distinguishable as categorised below: (Fig. 1)

Type	Types of Digital Platforms	Primary Purpose
1	**Site Work Monitoring and Administration System**	Site work supervision and administrative workflow
2	**Safety Monitoring System**	Monitoring site safety
3	**Site Monitoring System**	Monitoring site conditions and progress

Fig.1 – Typical types of digital platforms and primary purposes

The typical application framework of a digital platform is depicted in Fig. 2.

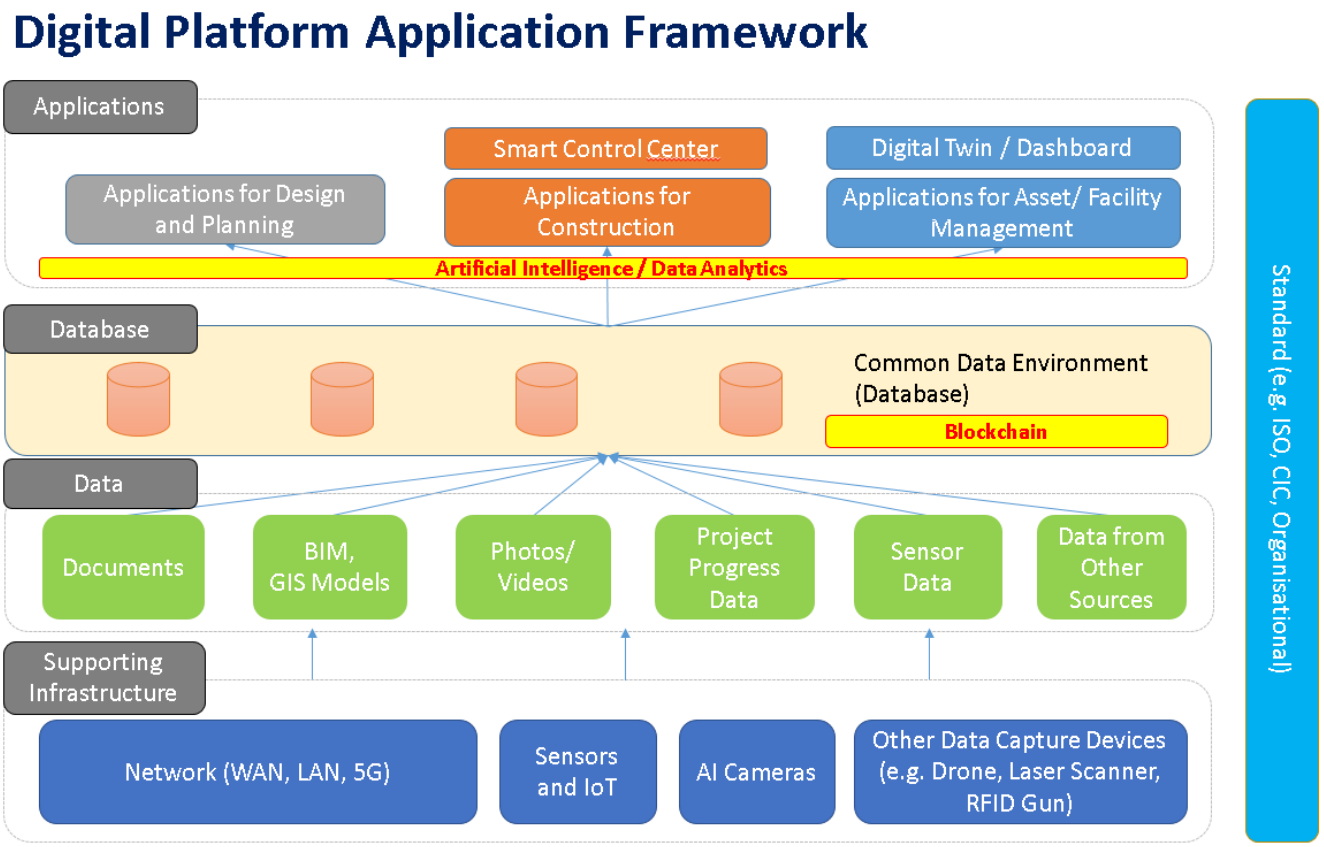


Fig.2 – Typical Digital Platform Application Framework

A digital platform runs on an infrastructure and one or some hardware which support the collection, storage and processing of data from various sources to form a database. The database can be a single integrated database or individual databases offered by different service providers for different products, either they are hardware (e.g. sensors) or software (e.g. electronic forms for manual data input and uploading).

Riding on the database and the infrastructure of the system at the backend, different functions are performed to serve different application areas in a project. The common database nowadays used in construction is called a CDE which is able to provide a single source of truth of the project information. For details of CDE and the guides for its selection, please refer to the **Construction Industry Council (CIC) Beginner's Guide on Construction Digitalisation – Adoption of Common Data Environment (CDE) for Information Management using BIM.**

There is a dashboard associated with a digital platform. A dashboard is an user interface at the front end that displays, summarises or even analyses the information of one particular application area received from various sources which could be images, videos, drawings, BIM models, different types of documents in different formats, data received from sensors or IoT equipment as well as manually-input data, in which the users can select the data to be viewed and operate certain workflows depending on the design. For complex digital platforms dealing with multiple application areas, a more sophisticated dashboard may be needed. Where there are digital platforms integrated to form an integrated digital platform, a comprehensive integrated dashboard to show the data processed by the individual digital platforms will be needed. The centralised digital platform integrating all the digital platforms for the individual application areas is often regarded as a **Smart Control Centre or Command Centre** (i.e. a central dashboard). A Smart Control Centre can be project-based and company-wide depending on the design.

Digital platforms can be applied to design, planning, construction and asset/ facilities management.

For construction, the typical digital platform application areas are site work monitoring and administration (e.g site records, progress, quality, environmental performance monitoring etc.), safety monitoring and site monitoring. ***For the purpose of this guide, only the application areas in the construction stage will be discussed.***

Each application area may have its own digital platform(s) depending on the user requirements, the nature of the product(s) selected and the solution package offered by the service providers. There can be a single digital platform serving a few application areas or a few platforms for one application area.

Under each application area, there are functional areas and functions.

To provide practical guidance on the selection of a digital platform, the functions under each application and functional areas of a digital platform are illustrated below:

Application Area	**Site Work Monitoring and Administration**		
Functional Area	**Site Record**	**Inspection Checklist**	**Defect/ Outstanding Work Monitoring**
Functions	• Request for Inspection/ Survey Check (RISC) Form • Site Diary/Site Record Book • Labour Return Record	• Site Safety Inspection Records • Cleansing Inspection Checklists • Quality Inspection Checklist • Environmental Inspection Checklist	• Site Defect / Outstanding Work Inspection • Automatic comparison of site image and design • Drone for external inspection

Application Area	**Safety Monitoring**			
Functional Area	**Personal Protective Equipment (PPE) Checking**	**Well-being Monitoring**	**Workers' Behaviour Monitoring**	**Hazardous Area Zoning/ Access Control**
Functions	• Safety Helmet • Reflective Vest • Life jacket • Safety shoes • Wrist band / smart watch	• Workers' location tracking • Body temperature • Heartbeat • Sudden fall • Motionless • Blood pressure	• People count based on different vests and helmets • Smoking • Driver sleeping • Driver using mobile phone • Driver motionless	• Anti-collision / Machinery safety distance - Sensor-based • Anti-collision / Machinery safety distance - AI-based • Restricted zone / Danger zone - Sensor- based • Restricted zone / Danger zone - AI- based • Fall from height prevention • Truck license plate detection • Truck delivery and analytics • Face recognition for access control • Fire hazard detection and alarming • Crane for working platform and crane operation CCTV

Application Area	Site Monitoring		
Functional Area	**Site Environment Condition Monitoring**	**Building Element Monitoring**	**Equipment Status Monitoring**
Functions	• Noise • Vibration • Dust/ Air quality • Electricity leakage • Titling / Inclination • Displacement • Settlement • External sensor compatibility • Harmful gas • Fire • Water level and/or leakage • Gas leakage • Security	• Loading • Concrete maturity • Drainage piping assessment	• Equipment location tracking • Power system fault • Equipment data • Equipment operating data • Fuel consumption

Fig.3 – Typical digital platform application and functional areas and functions for construction stage

1.3. Level of Digital Platforms for an enterprise

The level of digital platform adopted for an enterprise depends on the overall organisational strategy and specific project needs.

A digital platform can be used as an organisational-wide infrastructure for management of the whole project portfolio of an enterprise, or a relative trade- or function-specific digital platform for a specific purpose, such as for monitoring of workers' personal protective equipment in a particular project.

Different digital platforms may be deployed for the same project by different parties including the main contractor and the trade-specific sub-contractors for specific application areas and functions to suit the different project needs.

In general, there are three levels of digital platforms for an enterprise:

Corporate Level	A digital platform for providing project and site activity information of all the construction projects of the enterprise **(i.e. Company-wide Smart Control Centre)**.
Project Level	A digital platform for is able to provide the project and site activities information of one single construction project **(i.e. project-based Smart Control Centre)**.
Functional Level	A digital platform that is able to provide the project and site activity information of one or more application area(s) with one or more function(s) in a construction project, such as progress, safety or site monitoring. The type of functions used would depend on the operational needs and the application areas required, for example, function of personal protective equipment detection under safety monitoring application area **(i.e. function-based digital platform)**.

Fig. 4 – Different levels of adoption of digital platforms in an enterprise

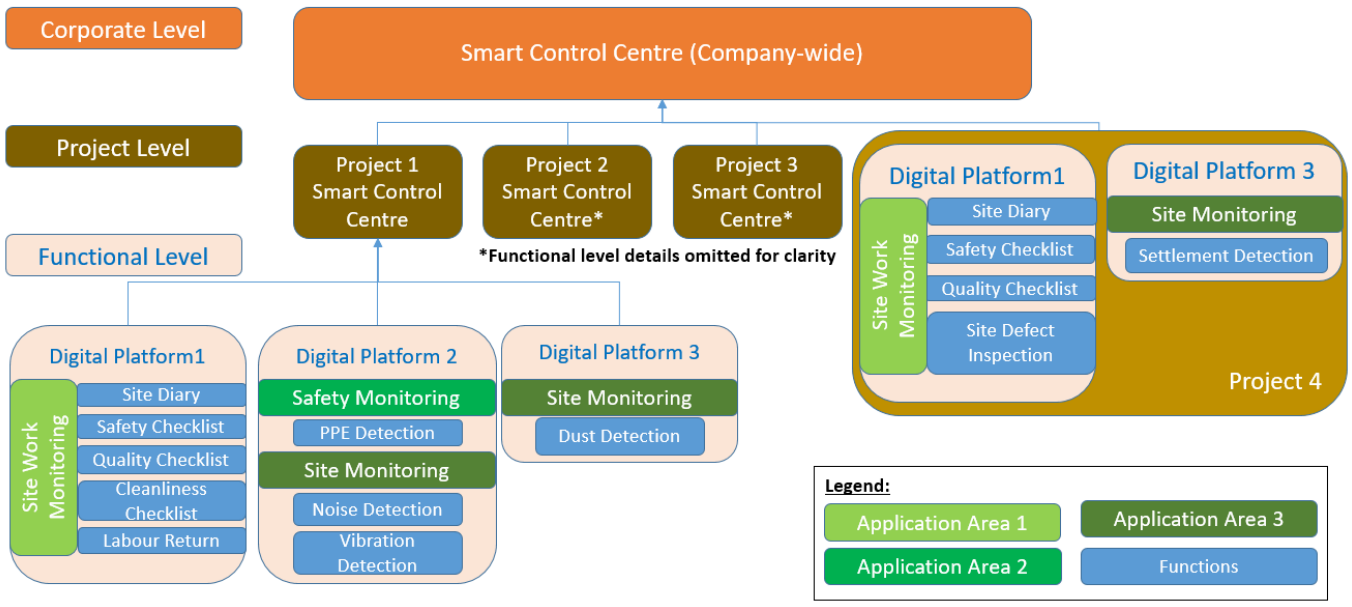


Fig. 5 – Different combinations of adoption levels and arrangements of digital platforms in an enterprise

Users should identify the project needs, enterprise' objectives and the expected performance output of deploying the digital platform(s) and check whether the application areas and functions of the digital platform(s) can match the user requirements. Details of the common functions of digital platforms for different application areas are given in **Chapter 2**.

1.4. When to use a Digital Platform? Who owns or operates it?

For the construction stage of a project, digital platforms should be adopted when there is a need and it is expected that their deployment would be beneficial to the project outcomes in terms of improvement in productivity, quality, safety, environmental performance or other project areas.

There are three main application areas of a digital platform for the construction stage, namely site work monitoring and administration (e.g progress, quality, environmental performance etc.), safety monitoring and site monitoring.

Users of a digital platform can be the client, the project consultant, the main contractor or the sub-contractors, either independent or collaborative depending on the functions they require the digital platform(s) to perform in their specific scope of work. Some users may need one or more platforms to perform one or more application areas and functions. Some users may also have to work on or use the same digital platform together to serve certain objectives, for example, site work monitoring and administration with approval workflow among sub-contractors and the main contractor or even the project consultant. To achieve the best expected outcomes, relevant users should co-ordinate and agree on the required type(s) and capability(ies) of the digital platform(s) at the early stage of the project. Some digital platforms may have to be integrated while some can be run individually subject to the actual project needs and various considerations. The need for integration and the responsible party(ies) for the integration work should be identified at the outset of the project.

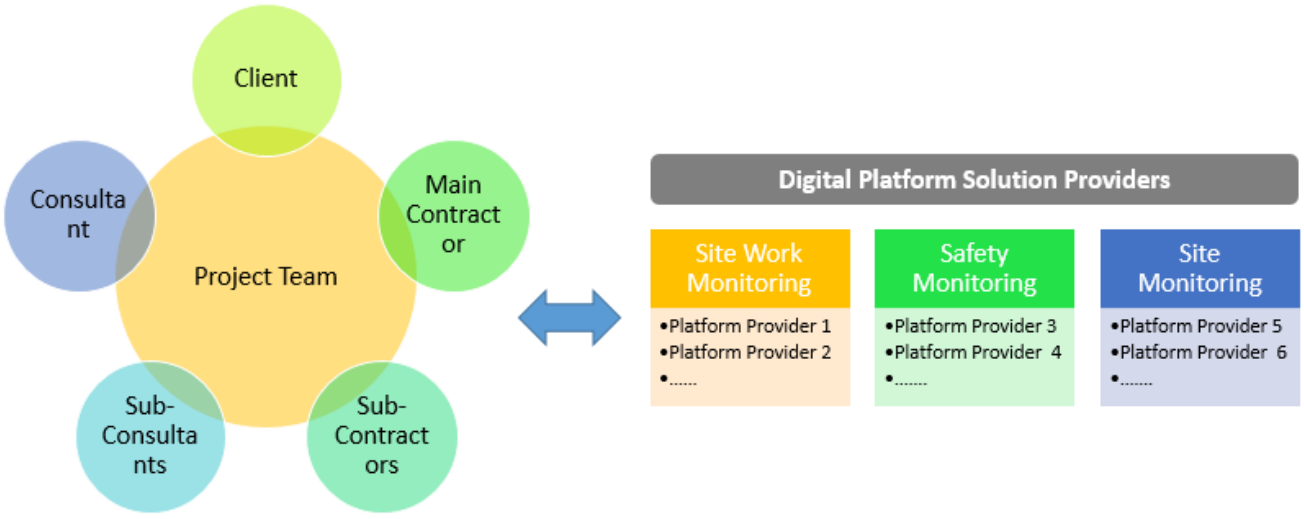


Fig. 6 – Users and providers of digital platforms in a construction project

Fig. 7 – An example of different users and digital platforms deployed in different construction projects for the same main contractor

The digital platforms should be financed by the owner of the system. The parties responsible for providing, owning and maintaining such platform(s) during the project period should be specified in the contract documents. Other parties may be need to have access to or use the digital platforms to perform the required functions according to their individual project requirements and needs (e.g. sub-contractors' submissions of inspection checklist). The platform owner shall manage the deployment and define clearly the roles, rights and responsibilities of each user. Some of the requirements may have to be laid down in the relevant contractual documents to avoid confusion or future dispute.

The use of the digital platform in the early project stage would enable the completeness, continuity and consistency of the project data and information that can be referred to, used and analysed

throughout the project period. Certain digital platforms can be integrated with BIM such that users can make use of the design BIM models to carry out overall site planning including the BIM-enabled site operation details, the associated progress, safety and site monitoring arrangement and implementation details, supply chain management etc. at the very beginning of the project so as to fully realise the benefits from the use of these platforms.

At the end of the project period or where the project has reached certain stages as specified in the contract, the platform owner may be obliged to hand over the data or the platform(s) to the clients or other project parties as specified. The detailed arrangement should be specified in the contract or agreed upon at the early stage to prevent any ambiguity. There is continuity and consistency of data, which will facilitate future maintenance and operation throughout the asset life cycle, when data are collected by digital platforms and/ or transferred to the asset/ facilities management party from other digital platforms.

Clients and consultants are strongly encouraged to include the adoption of various digital platforms in the project specifications so that their adoption could be realised in the whole project and asset life cycle and the benefits can be captured from the outset of the project.

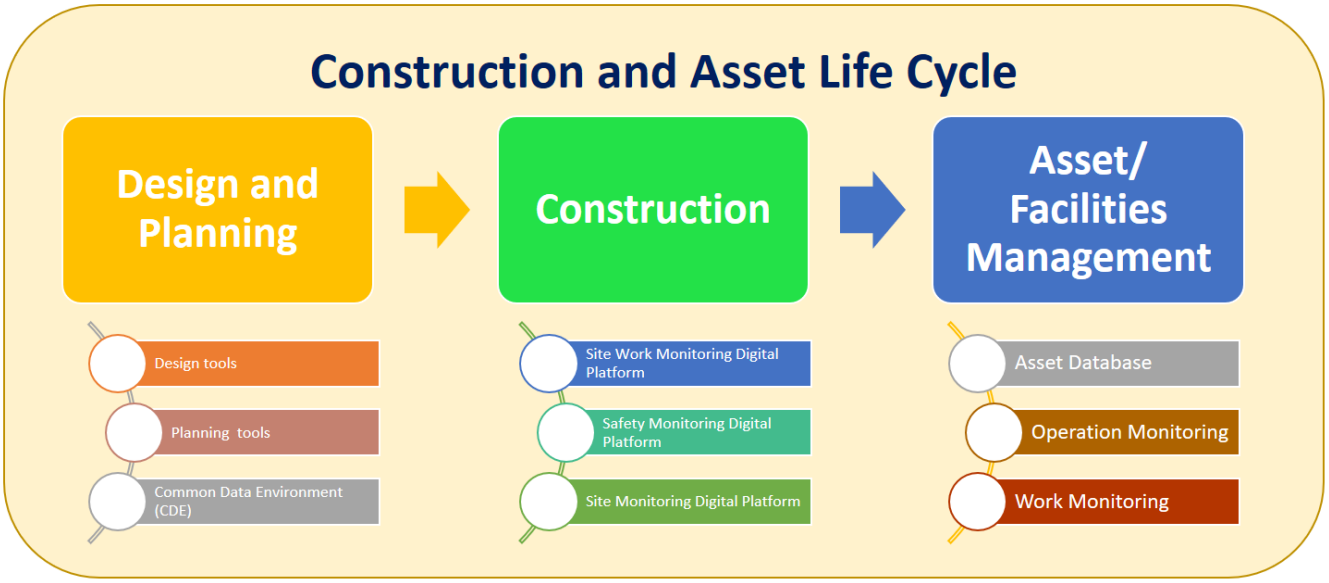


Fig. 8 – Early deployment of various Digital Platforms in all stages of a construction project and the whole asset lifecycle is encouraged

1.5. Application areas of a digital platform

A digital platform for the construction stage is normally designed to perform different functions under one or more of the following three typical application areas which are generally essential for every construction project:

1. Site work monitoring and administration;
2. Safety monitoring; and
3. Site monitoring.

Under each application area, there are a number of functional areas consisting of various functions which are specific to the different aspects of the construction project. Some digital platforms may only perform one function while others may perform more than one function for more than one application area depending on the platform design and capability.

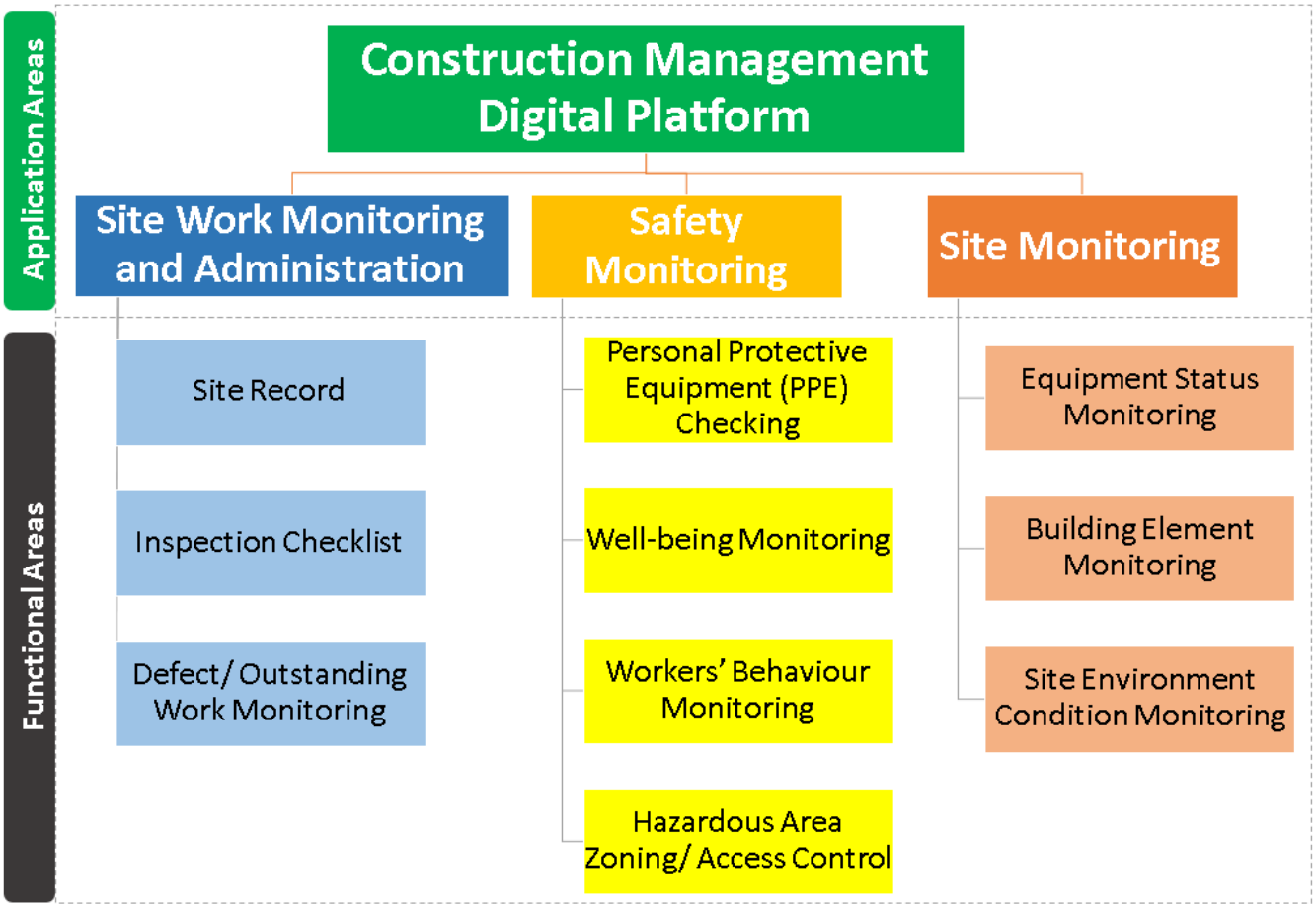


Fig. 9 – Typical application and functional areas of digital platforms for construction stage

Site Work Monitoring and Administration

Site work monitoring and administration is one of the critical applications of a digital platform which can assist the project team to keep track of the site operation, work progress and various work aspects such as quality and environmental performance against the project programme, design and specification in an efficient and systematic manner. Usually a digital platform helps users monitor site works to perform the specific functions under the following three functional areas:

a. Site record

b. Inspection checklist
c. Defect/ outstanding work monitoring

Fig. 10 – Typical functional areas of site work monitoring and administration digital platforms

According to the Technical Circular (Works) No. 3/2020 issued by the Development Bureau (DEVB), Digital Works Supervision System (DWSS) shall be adopted in capital works contracts with a pre-tender estimate exceeding HK$300 million which are to be tendered on or after 1 April 2020.

A typical DWSS shall include the following functions for recording and keeping track of site activities, including but not limited to:

a. Summary of Request for Inspection/ Survey Check (RISC) form status;
b. Site activities statistics;
c. Site safety performance;
d. Site cleanliness performance
e. Labour return statistic; and
f. Alert and reminder statistics, etc.

The key features and specific functions of the three typical functional areas are summarized as follows:

Site Work Monitoring and Administration Functions				
Functional Area	**Main Purpose**	**Key Features**	**Specific Functions**	**Description of Functions**
Site Record	Log site activities for record and future retrieval	• Provide electronic form for data input • Provide time stamp to ensure traceability • Allow efficient data retrieval and analysis	Request for Inspection/ Survey Check (RISC) Form	A form provided in electronic format for users, usually the contractors to raise RISC to the project consultants/ clients for acceptance of work done for approval to proceed the subsequent work

Site Work Monitoring and Administration Functions				
Functional Area	**Main Purpose**	**Key Features**	**Specific Functions**	**Description of Functions**
		• Generate report • Submission and approval workflow	Site Diary/Site Record Book	A form provided in electronic format for users, usually the contractors to report the daily site activities
			Labour Return Record	A form provided in electronic format for users, usually the contractors to report the labour deployment record
Inspection checklist	Allow efficient inspections and traceable records	• Electronic drawings (e.g. CAD/ design model)/ documents (e.g. specification/ programme) library • Allow users to upload drawings/ photos/ videos • Allow mark-up comments on drawings/ photos • Default or tailor-made checklists to record inspection results • Instant report and message conveyance to target parties for action • Submission and approval workflow • Provide time stamp to ensure traceability	Site Safety Inspection Records	A checklist provided in electronic format for users to check against the safety measures required in the approved safety plan and method statements and under the laws
			Cleansing Inspection Checklists	A checklist provided in electronic format for users to check against the site cleaning operations and general housekeeping required under the contract
			Quality Inspection Checklist	A checklist provided in electronic format for users to check against the quality requirements stated in the specification, quality plan/ manual and inspection and test plan
			Environmental Inspection Checklist	A checklist provided in electronic format for users to check against the environmental requirements stated in the specification, environmental management plan/ manual and under the laws
Defect/ outstanding work monitoring	Check work done against design and work plan	• Allow users to upload drawings/ BIM models/ photos/ videos/ working programme with location (GIS) reference • Side-by-side visualisation of work done against design drawings and models	Site Defect / Outstanding Work Inspection	A tool capturing and processing site images usually with geo- or location-reference to provide off-site virtual walkthrough for manual or automatic analysis of the work done against the design and work plan to identify defects and outstanding works (with or without electronic workflow for defect notification and follow-up)

Site Work Monitoring and Administration Functions				
Functional Area	**Main Purpose**	**Key Features**	**Specific Functions**	**Description of Functions**
		for the same location for users' visual (manual) comparison on screen • Automatic capturing of images of the site environment usually by drone or 360 degree camera with or without photogrammetry technology* • Automatic generation of virtual 3D environment for site walkthrough in computers for off-site virtual inspection* • Automatic detection (usually through AI technology) and comparison of work done captured in images against design drawings/ models/ programmes* • Allow annotation of defects/ outstanding works and comments on work done • Instant message conveyance to target parties for action • Submission and approval workflow • Provide time stamp to ensure traceability • Summary and dashboard of work progress against working programme **for some advanced platforms only*	Automatic comparison of site image and design	A tool automatically analysing the captured site images usually with geo- or location-reference of the work done against the design drawings/ models to identify defects and outstanding works
			Drone for external inspection	A tool specifically designed for capturing images of inaccessible areas (e.g. external walls, overhead cables, scaffoldings), detecting and analysing the conditions of the items under inspection (usually automatically by AI technology) against the design to identify defects and outstanding works

Fig. 11 – Typical functions of site work monitoring and administration digital platforms

Safety monitoring

Safety monitoring is another popular application of a digital platform which can assist the project team to keep track of the safety performance of workers and the safety conditions of equipment, site operations and site safety condition. Usually a digital platform helps users monitor safety to perform specific functions under the following four functional areas:

a. Personal Protective Equipment (PPE) checking
b. Well-being monitoring
c. Workers' behaviour monitoring
d. Hazardous area zoning/ access control

Fig. 12 – Typical Functional Areas of Safety Monitoring Digital Platforms

While the safety inspection checklists are usually provided in a site work monitoring and administration platform according to its application area, a considerable numbers of safety monitoring functions can be performed automatically by one or more digital platforms (systems).

The key features and specific functions of the four typical functional areas of safety monitoring digital platforms are summarized as follows:

Safety Monitoring Functions				
Functional Area	**Main Purpose**	**Key Features**	**Specific Functions**	**Description of Functions**
Personal Protective Equipment (PPE) Checking	Detect the presence and proper wearing of PPE to ensure compliance and enable timely	• Identify the presence and conditions of specified types of PPEs from captured image through CCTV by AI technology or physical sensors	Safety Helmet	Detection of presence and wearing conditions of safety helmet
			Reflective Vest	Detection of presence and wearing conditions of reflective vest

Safety Monitoring Functions				
Functional Area	**Main Purpose**	**Key Features**	**Specific Functions**	**Description of Functions**
	rectification	(e.g. tags, beacons, RFID/ GPS device) with/ without location reference • Instant automatic analysis of signals received from sensors or images captured from CCTV by the use of AI video analytic technology • Provide alerts to users and project management team for non-compliance identified • Provide electronic workflow for follow-up action request, record and reporting • Provide and visualise data and statistics on the dashboard	Life jacket	Detection of presence and wearing conditions of life jacket
			Safety shoes	Detection of presence and wearing conditions of safety shoes
			Wrist band / smart watch	Detection of presence and conditions of wrist band/ smart watch
Well-being Monitoring	Detect the physical condition of workers to ensure they are in order and enable timely response to undesirable situations	• Track workers' locations by AI video analytic technology or physical sensors (e.g. tags, beacons, RFID/ GPS device, etc.) • Measure workers' health parameters on real-time basis by sensors (e.g. thermometer, pulse readers etc.) • Detect sudden fall or motionless conditions • Instant automatic	Workers' location tracking	Tracking of workers' location to ensure workers' attendance in the workplace and movement for further analysis
			Body temperature	Measurement of workers' body temperature to ensure their conditions are fit for work and early identification of potential safety and health issues
			Heartbeat	Measurement of workers' heartbeat rates to ensure their conditions are fit for work and early identification of potential safety and health issues
			Sudden fall	Detection of workers' sudden fall conditions to enable early identification of fall location for timely response

Safety Monitoring Functions				
Functional Area	**Main Purpose**	**Key Features**	**Specific Functions**	**Description of Functions**
		analysis of signals received from sensors or images captured from CCTV by the use of AI video analytic technology • Provide alerts to users and project management team for unsafe or undesirable conditions • Provide electronic workflow for follow-up action request, record and reporting • Provide and visualise data and statistics on the dashboard	Motionless	Detection of workers' motion conditions to enable early identification of incident location for timely response
			Blood pressure	Measurement of workers' blood pressure to ensure their conditions are fit for work and early identification of potential safety and health issues
Workers' Behaviour Monitoring	Detect the behaviour of workers to identify misbehaviour and enable timely rectification	• Detect workers' behaviour by AI video analytic technology on real-time basis • Detect unsafe act or misbehaviour • Provide alerts to users and project management team for unsafe or undesirable conditions • Provide electronic workflow for follow-up action request, record and reporting • Provide and visualise data and statistics on the dashboard	People count based on different vests and helmets	Identification of types of workers by recognising the helmet and vest colours and counting of different types of workers at different work locations for providing useful data for manpower deployment and utilisation analysis
			Smoking	Detection of workers' smoking behaviour to enable early warning and timely rectification
			Driver sleeping	Detection of workers' fatigue condition to enable early warning and timely response/ rectification
			Driver using mobile phone	Detection of workers' attention of work to enable early warning and timely rectification
			Driver motionless	Detection of workers' motion conditions to enable early identification of incident location for timely response
Hazardous Area Zoning/ Access	Detect the location of the workers or equipment	• Detect locations of workers or equipment and entry	Anti-collision / Machinery safety distance –	Detection of proximity of different equipment or equipment and workers to ensure a safe distance is

Safety Monitoring Functions				
Functional Area	**Main Purpose**	**Key Features**	**Specific Functions**	**Description of Functions**
Control	against virtual restricted zoning to identify unauthorised access or intrusion of unsafe zones and enable timely rectification	to restricted zones by AI video analytic technology or physical sensors (e.g. tags, beacons, RFID/ GPS device, proximity sensors etc.) on real-time basis • Detect unauthorised access to restricted or dangerous zones • Dynamic restricted or dangerous zoning* • Provide alerts to users and project management team for unsafe or undesirable conditions • Provide electronic workflow for follow-up action request, record and reporting • Provide and visualise data and statistics on the dashboard **for some advanced platforms only*	Sensor-based	maintained by the use of sensors to prevent collision
			Anti-collision / Machinery safety distance – AI-based	Detection of proximity of different equipment or equipment and workers to ensure a safe distance is maintained by the use of AI video analytics to prevent collision
			Restricted zone / Danger zone – Sensor- based	Detection of intrusion of equipment and/ or workers in restricted or danger zones by the use of sensors to prevent potential accidents
			Restricted zone / Danger zone – AI-based	Detection of intrusion of equipment and/ or workers in restricted or danger zones by the use of AI video analytics to prevent potential accidents
			Fall from height prevention	Detection of presence and proper attachment of fall arresting devices for high level work and protective barriers to floor edges or openings/ vertical shafts by the use of sensors or AI video analytics to prevent potential fall
			Truck license plate detection	Detection of truck license plate to enable access control to the site or different zones of the site
			Truck delivery and analytics	Detection of truck loading condition and identification/ measurement of loaded materials to ensure compliance and acceptable utilisation
			Face recognition for access control	Identification of workers' identify by facial recognition to give access to authorized workers only
			Fire hazard detection and alarming	Detection of heat and smoke by the use of sensors or AI video analytics to prevent potential fire

Safety Monitoring Functions				
Functional Area	**Main Purpose**	**Key Features**	**Specific Functions**	**Description of Functions**
			Crane for working platform and crane operation CCTV	Provision of close-up real-time images of loads being lifted to enable close monitoring to ensure proper conditions of the loads and lifting gears as well as safe lifting operation

Fig. 13 – Typical functions of safety monitoring digital platforms

Site monitoring

Site monitoring is the remaining one out of the three typical application areas of a digital platform which can assist the project team to keep in view of the site or built element conditions. Usually, a digital platform performs the specific functions under the following three functional areas:

a. Site Environment Condition Monitoring
b. Building Element Monitoring
c. Equipment Status Monitoring

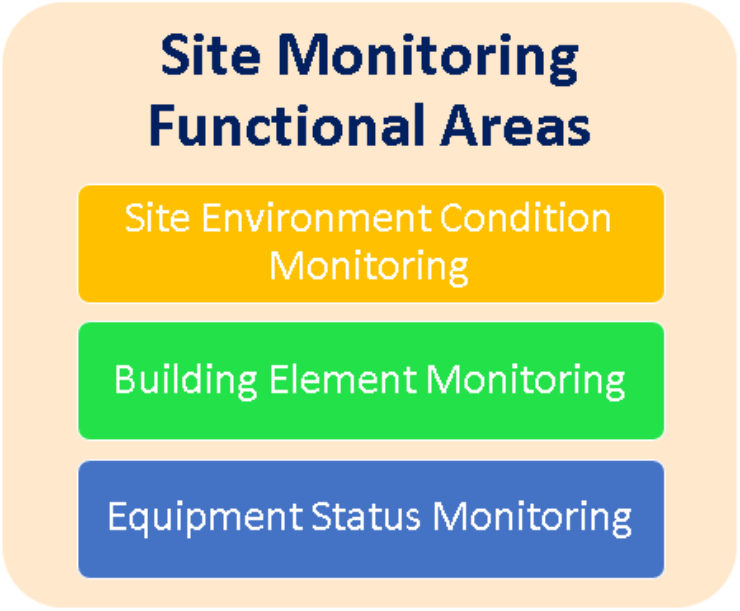


Fig. 14 – Typical functional areas of site monitoring digital platforms

The key features and specific functions of the three typical functional areas of site monitoring digital platforms are summarized as follows:

Site Monitoring Functions				
Functional Area	**Main Purpose**	**Key Features**	**Specific Functions**	**Description of Functions**
Site Environment Condition Monitoring	Detect and monitor site environment parameters	• Allow users to set threshold limits of the relevant	Noise	Detection of noise level of site environment/ equipment/ construction operation

Site Monitoring Functions				
Functional Area	**Main Purpose**	**Key Features**	**Specific Functions**	**Description of Functions**
		environmental parameters • Automatically detect the site environment parameters through sensors and positioning technology (e.g. GNSS, RTK etc.) • Instant automatic analysis of signals received from sensors against the pre-set threshold • Provide alerts to users and project management team for non-compliance identified • Provide electronic workflow for follow-up action request, record and reporting • Provide and visualise data and statistics on the dashboard	Vibration	Detection of vibration level of site environment/ building elements or equipment (e.g. hammering in demolition work)
			Dust/ Air quality	Detection of dust or other air pollutants' level of the work site (e.g. PM2.5 particulates)
			Electricity leakage	Detection of leakage of electrical supply system of the work site/ equipment
			Titling / Inclination	Detection of level of tilting/ inclination of site environment/ building elements (e.g. existing adjoining building structure)
			Displacement	Detection of displacement level of site environment/ building element
			Settlement	Detection of settlement level of site environment (e.g. ground settlement)
			Harmful gas	Detection of harmful gas of the site environment
			Fire	Detection of fire potential of the site environment
			Water level and/or leakage	Detection of water level / leakage of site environment
			Gas leakage	Detection of gas leakage of site environment/ equipment
			Security	Detection of break-in and access to restricted zones
			External sensor compatibility	Capability of integrating with or capturing data from other external sensors to the platform
Building Element Monitoring	Detect and monitor building element conditions	• Allow users to set threshold limits of the relevant monitoring parameters (e.g. stress of temporary	Loading	Detection of loading or stress of the temporary structural works

Site Monitoring Functions				
Functional Area	**Main Purpose**	**Key Features**	**Specific Functions**	**Description of Functions**
		work members) • Automatically detect the building element parameters by sensors • Instant automatic analysis of signals received from sensors against the pre-set threshold • Provide pre-defined template and data input options for efficient building element assessment • Provide alerts to users and project management team for undesirable conditions identified • Provide electronic workflow for follow-up action request, record and reporting • Provide and visualise data and statistics on the dashboard	Concrete maturity	Detection of fresh concrete temperature for assessment of concrete strength to determine the time for early striking of formwork and proceeding to subsequent works so as to improve construction efficiency.
			Drainage piping assessment	Provide pre-defined template and data input options for efficient drainage piping condition assessment, recording and reporting work
Equipment Status Monitoring	Detect and monitor equipment status	• Allow equipment position tracking • Automatically detect equipment operating data by built-in or add-on sensors • Instant automatic analysis of signals received from sensors against the pre-set reference values • Provide alerts to	Equipment data	Provision of pre-determined equipment data according to the product brand and models (e.g. specification)
			Equipment location tracking	Tracking equipment location to ensure restricted/ dangerous zones and assessment of plant utilisation (e.g. equipment movement)
			Equipment operating data	Detection of equipment operating data for visualisation of and assessment of plant operating conditions, efficiency and utilisation etc.

Site Monitoring Functions				
Functional Area	**Main Purpose**	**Key Features**	**Specific Functions**	**Description of Functions**
		users and project management team for abnormal conditions identified • Provide generation of standard report • Provide and visualise data and statistics on the dashboard	Fuel consumption	Detection of fuel consumption of the equipment
			Power system fault	Detection of abnormality of electrical supply system of the work site/ equipment

Fig. 15 – Typical Functions of Site Monitoring Digital Platforms

1.6. Benefit of adopting digital platforms

The benefits of adopting digital platforms in the construction stage are multi-faceted which can be grouped into six areas from manpower and time saving to allowing quick analysis.

Fig. 16 – Benefits of adoption of digital platforms

Benefits of Digital Platform Adoption	
Benefit	**How**
Saving in manpower and time required for collecting, processing, analysing and reporting data in useful format	Traditional Practice: Project data are collected, processed and retrieved mainly manually by different project participants involved in the different project aspects, work trades and project stages. Data are usually fragmented and piecemeal requiring considerable manual input and time in their collection, processing, analysing and reporting. There is usually a lack of integration of data handling to provide co-ordinated and well-organised data. Digital Platform: With the use of sensors and other technologies, digitalised project data can be captured automatically in the digital platform for processing, analysing and reporting which greatly reduce the manpower demand.

Benefits of Digital Platform Adoption	
Benefit	**How**
Visualise various site operations at a glance	Traditional Practice: Without a digital platform, it is very difficult to grasp all the relevant current or historical project data and site activities status efficiently in a very short time especially when the project is large in scale and complex. Information is usually collected manually by various parties from various sources (e.g. photos, videos, drawings, etc.) and then saved in fragmented folders/ locations. Piecemeal information could also hardly be integrated to give a complete picture such that visualisation of the project status in an easy manner is not quite feasible. Evidenced-based performance assessment of sub-contractors and cross-sub-contractors comparison are also rare due to the lack of systematic and centralised database. Users also seldom have analysis across projects within the same enterprise despite availability of data due to difficulties in retrieval and integration for meaningful analysis. Digital Platform: Complete data can be retrieved and the essential project status can be visualised in pre-defined format in the dashboards of the digital platforms on a real-time basis with just a few clicks. Cross-sub-contractors and cross-projects analysis become possible for certain functions.
Provide data with high reliability and traceability for all parties	Traditional Practice: Data are collected, processed and retrieved mainly manually by different project participants which are usually loosely controlled without sufficient trail with respect to changes and file movement which render the data prone to loss, incompleteness and inaccuracy. Digital Platform: Data are stored in the well-structured digital platform according to the pre-defined structure and logic with access right control and audit trail such that data would be properly filed, accurate and protected with full traceability.
Improve project management efficiency	Traditional Practice: Management staff have to wait for reports from site staff to understand the current project situations. It is difficult to manage multiple project functions efficiently and effectively at the same time. Digital Platform: With the availability of real-time visualisation of reliable data in a pre-defined dashboard, management staff can quickly understand the key performance of the different project aspects and perform multiple project functions at the same time efficiently over a single platform anywhere, anytime.
Enable instant and timely response	Traditional Practice: Management staff can only made informed decision upon receiving the reports from site staff and verification of information received which involves delay. Decisions and management responses are thus prone to delay and inaccuracy.

Benefits of Digital Platform Adoption	
Benefit	**How**
	Digital Platform: Management staff can make timely decisions and management responses according to accurate and real-time data available in the digital platform. This would improve the speed and quality of decisions made and the relevant follow-up actions.
Enable efficient and meaningful analysis	Traditional Practice: Huge amount of resources are required to retrieve up-to-date data and produce useful and insightful analysis from data gathered from fragmented sources which are prone to outdating. Digital Platform: Dashboards of digital platforms can automatically generate reports, summaries, charts and statistics etc. in desired format to enable meaningful analysis in an efficiently manner.

Fig. 17 – Summary of benefits of digital platform adoption

1.7. Funding support on adoption of digital platforms

The Construction Innovation and Technology Fund (CITF), with an approved allocation of HK$1 billion, was established by the Development Bureau (DEVB) of the Government of the Hong Kong Special Administrative Region (HKSAR) in October 2018. The Construction Industry Council (CIC) is commissioned by DEVB to be the implementation partner. In 2022, another $1.2 billion has been injected for its ongoing operation and implementation of enhancement measures launched recently, including expanding the funding scope and increasing the funding ceiling[6].

The CITF is established to encourage wider adoption of innovative constructive methods and new technologies in the construction industry with a view to promoting productivity, uplifting built quality, improving site safety and enhancing environmental performance. The CITF is dedicated to:

A. Encourage wider adoption of innovative construction methods and technology in the construction industry (in short, **technology adoption**), and
B. Build up the capacity of industry practitioners (ranging from skilled workers to professionals) and tertiary students of construction-related disciplines to build an innovative culture and foster the mind-set to espouse new technology for the continuous improvement of the industry (in short, **manpower development**).

Eligible Applicants

The following types of companies are eligible to applying for technology adoption under the CITF.

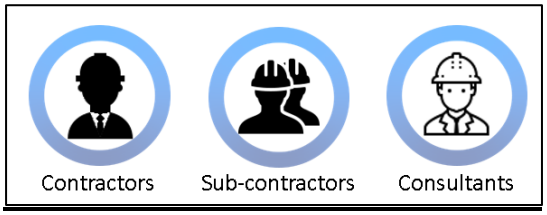


Fig. 18 – Key CITF Technology Adoption category eligible applicants

a. Levy-paying Contractors

Levy-paying contractors which have paid levy for construction works under the Construction Industry Council Ordinance (Cap. 587) to the CIC in the 24 months preceding the time of application.

b. Registered Specialist Trade Contractors Scheme and Registered Subcontractors

Specialist Trade Contractors and Subcontractors who are registered under the Registered Specialist Trade Contractors Scheme (RSTCS) and the Subcontractor Registration Scheme (SRS) operated by the CIC.

c. Consultants

Consultants on the lists maintained by Government and professional bodies, including

[6] The 2022-23 Budget Speech, https://www.budget.gov.hk/2022/eng/budget65.html

i. the Engineering and Associated Consultants Selection Board;
ii. the Architectural and Associated Consultants Selection Board;
iii. the Band 3 Architectural Consultants and the list of Registered Practices maintained by the Hong Kong Institute of Architects;
iv. the Band 3 Architectural Consultants maintained by the Association of Architectural Practices Ltd;
v. member companies of the Association of Consultant Quantity Surveyors;
vi. member companies of the Hong Kong Institute of Surveyors;
vii. member companies of the Association of Consulting Engineers of Hong Kong; or
viii. member companies of the Association of Registered Engineering Consultants

d. Other players in the construction process may be considered on a case-by-case basis.

Digital Platforms on the CITF Pre-approved Technologies List

Digital Platforms fall into the category of the Advanced Construction Technologies (ACT) of the CITF. These platforms come in the forms of different products which could be a pure digital platform without hardware or a digital platform associated with a hardware or equipment such as sensors depending on the product functions. Most of the pure digital platforms are under the Technology Type named Digitalisation in the Pre-approved List while the platforms associated with hardware are usually under the Technology Type named Sensors and IOT of the Pre-approved List. To facilitate the selection of relevant platforms, reference prices (if applicable) are included provided in the product description.

The CITF Pre-Approved Technologies List can be found at https://www.citf.cic.hk/?route=search.

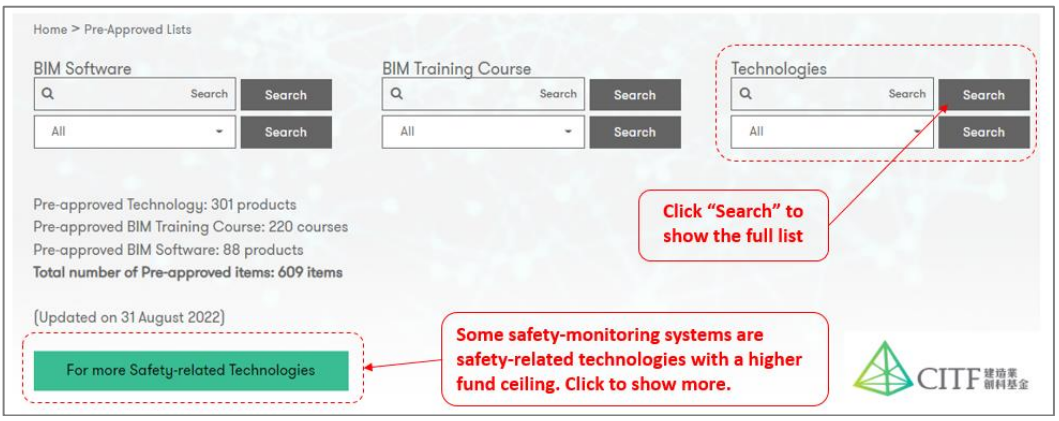


Fig. 19 – The CITF Pre-approved Technologies List

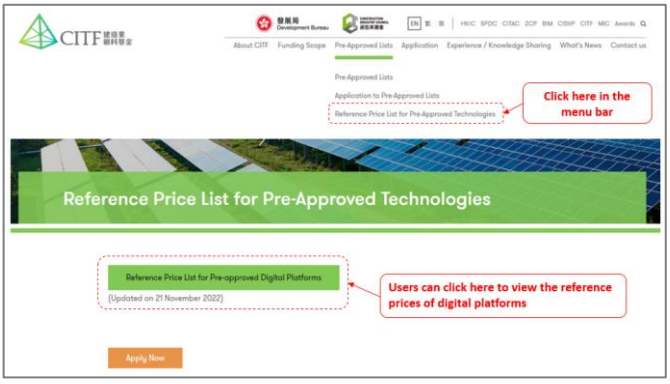


Fig. 20 – Reference prices of CITF pre-approved digital platforms

Apart from the CITF Pre-approved List, there are also many other digital platforms available in the market. It is suggested that interested parties shall contact the relevant vendors or seek for relevant professional advice.

2. Advice in selection of suitable Digital Platforms

2.1. How to get started?

Users are advised to take the following steps to get started when exploring the adoption of digital platforms for smart site management.

a. Step 1 – Identifying the need for digital platforms
b. Step 2 – Assessing capabilities of available digital platforms
c. Step 3 – Ascertaining the product details and negotiation with digital platform providers
d. Step 4 – Engaging the digital platform providers
e. Step 5 – Participating in the customisation and/ or development of the digital platform and User Acceptance Test (UAT)
f. Step 6 – Adoption of digital platform and continuous monitoring and feedback for fine-tuning and improvement

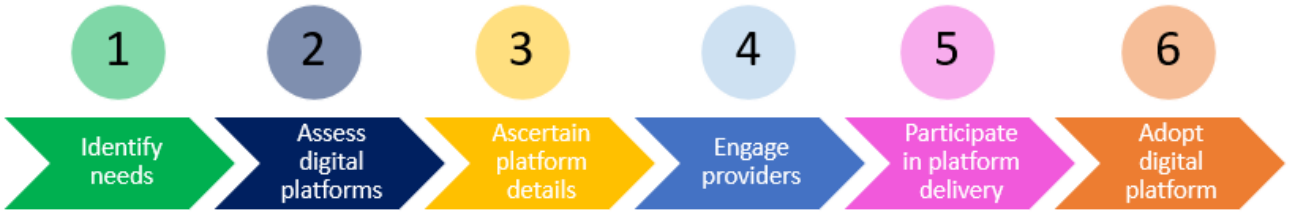


Fig. 21 – 6 simple steps to get started of adopting a digital platform

2.2. Step 1 – Identify the need for digital platforms

Users are advised to look into the following factors to identify the needs for different functions required for the project and the user requirements.

- Contact requirements and specification
  - Specification
  - Contract terms (payment and timeframe)
- Enterprise's own policy and goals
  - Plan to have enterprise-wide integrated management platform for all projects
  - Standard project digital platform requirements
  - Integration with existing systems or workflow
- Project-specific practical needs
- Project scale and nature
- Scope of work
  - Work trades and site operations involved
  - Project needs for different application areas and functions

Users should first look at the contract documents to check if the use of certain digitalised solutions or

operations are specified. They should then refer to the specification on digitalised site operations such as collision detection or ground settlement monitoring which require the adoption of sensors and IoT systems for the purposes. Under these circumstances, the digital platforms will be associated with the different products deployed for the different site operations. Users may also refer to other digital management platforms or an integrated control centre for additional requirements.

Users shall also check the payment (i.e. cashflow) schedule and timeframe allowed for the delivery of the specified digital platforms which may restrict the degree of customisation allowed and the options for solution packages.

Users shall also determine the enterprise's own policy and goals in adopting the site management digital platforms. Some organisations may have a policy to operate an enterprise-wide integrated management platform for all projects or a standard digital management platform for each individual project. Some organisations may also require the individual digital platforms to integrate with their existing systems and workflow. All these factors will affect the scope of work, time of delivery and the cost of a digital platform which have to be studied in details.

Apart from the contract and in-house requirements, users shall carefully study the project's practical needs including the project scale and nature, the scope of work, the work trades and site operations involved, the different application areas and functions of digitalised management and operation that may arise and finally the cost-effectiveness of introducing those digitalised tools in meeting the needs.

Normally, the larger and more complex the project is, the more the data and variety of site operations would be, such that the need for a digital platform would be more justifiable. There are more benefits for projects with more repetitive site operations or projects with a higher degree of monitoring needs.

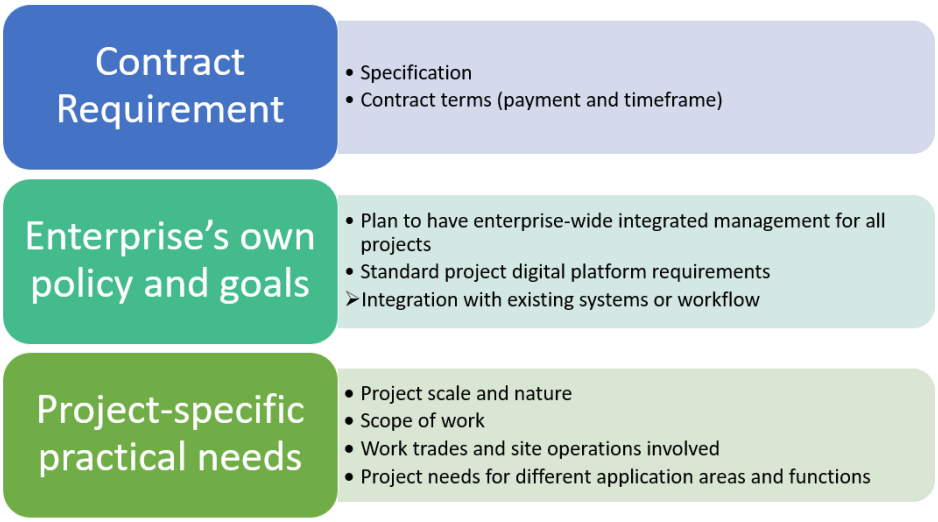


Fig. 22 – Considerations for identifying the needs for a digital platform

2.3. Step 2 - Assessing digital platform capabilities

Users are advised to conduct product research to check carefully the full functions of the targeted digital platforms and see if they match the user requirements. The assessment shall cover the following key areas:

- Functions and expected performance output of the adoption of digital platforms
- User interface
- No. of users supported
- Flexibility in customisation for specific user requirements
- Delivery timeframe
- Additional services and other considerations
- Pricing model and cost

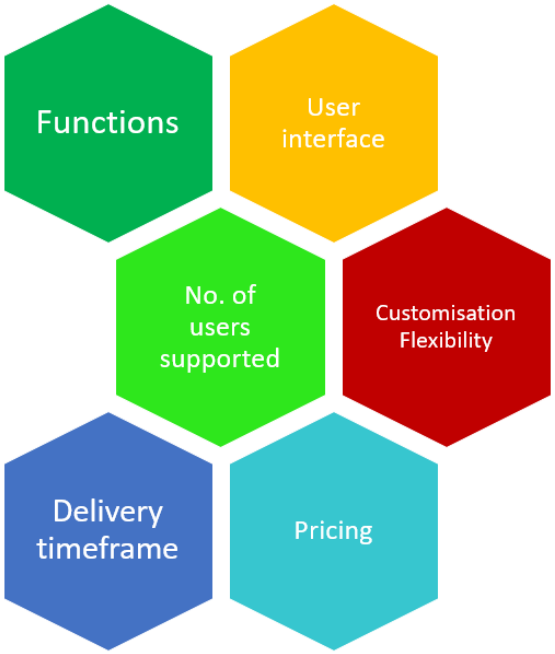


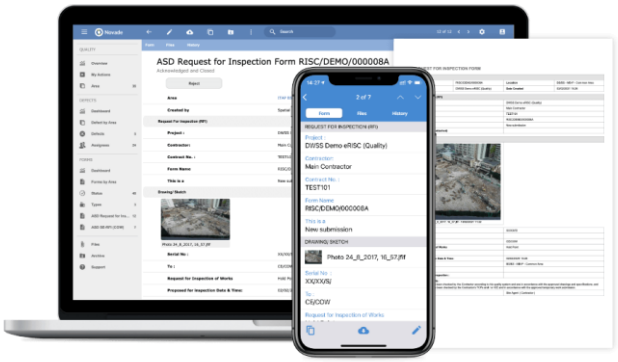
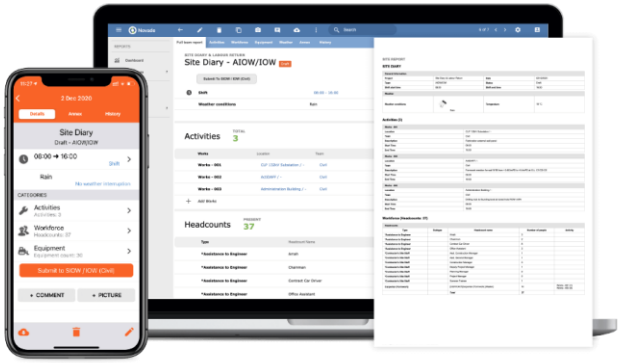
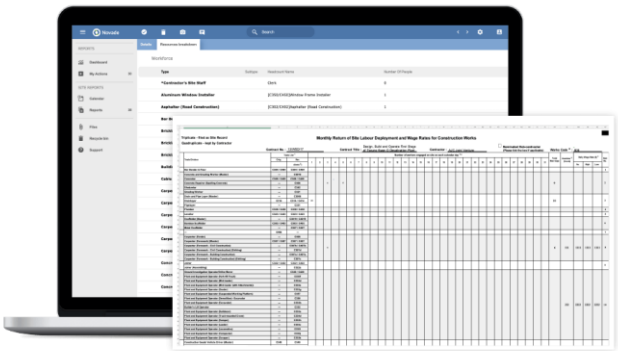
Fig. 23 – Key assessment areas for a digital platform

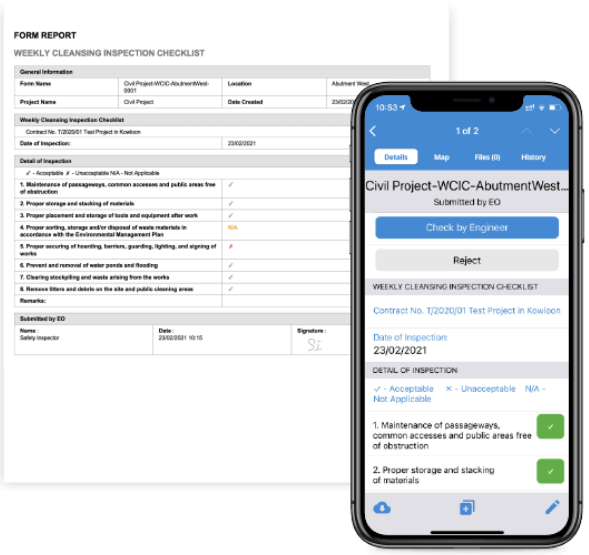
2.3.1 Functions and expected performance output of the adoption of digital platforms

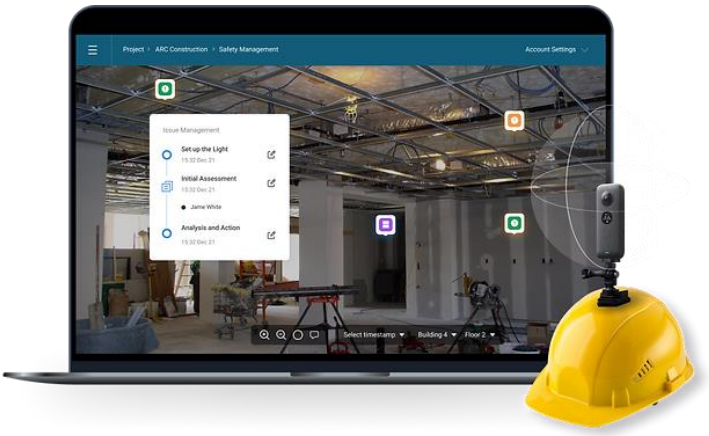
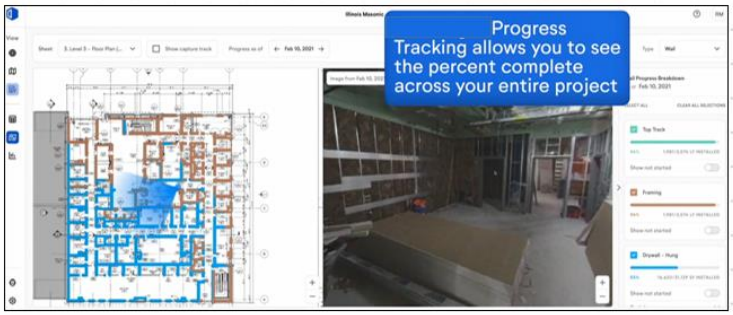
In Section 1, the key features and specific functions of digital platforms for different applications and functional areas are discussed. To facilitate the selection of the required functions for a digital platform for subsequent sourcing in the market and negotiation with the solution providers, users can refer to the following list of functions with some reference images and priority functions specified with respect to the three application areas, namely progress, safety and site monitoring[7].

[7] Unless otherwise specified, all reference images are extracted from the CITF Pre-approved List or the websites of the solution providers of the Pre-approved technologies. All images are for reference only. Users shall verify the actual product functions with the solution providers.

The priority functions are those commonly used functions which are considered to be essential and generally applicable to most of the construction projects. Users shall also take into account of other relevant factors, such as cost etc., as discussed in later sections and adjust their requirements to suit their own needs.

Site Work Monitoring and Administration Functions (# Priority/ commonly used functions)		
Functional Area	**Specific Functions**	**Description and Reference Image**
Site Record	**Request for Inspection/ Survey Check (RISC) Form #**	A form provided in electronic format for users, usually the contractors to raise RISC to the project consultants/ clients for acceptance of work done for approval to proceed the subsequent work  Source: Novade Website https://www.novade.net/hk-construction-management-platform/
	Site Diary/Site Record Book #	A form provided in electronic format for users, usually the contractors to report the daily site activities  Source: Novade Website https://www.novade.net/hk-construction-management-platform/
	Labour Return Record #	A form provided in electronic format for users, usually the contractors to report the labour deployment record  Source: Novade Website https://www.novade.net/hk-construction-management-platform/

Site Work Monitoring and Administration Functions (# Priority/ commonly used functions)		
Functional Area	**Specific Functions**	**Description and Reference Image**
Inspection checklist	**Site Safety Inspection Records #**	A checklist provided in electronic format for users to check against the safety measures required in the approved safety plan and method statements and under the laws  Source: Novade Website https://www.novade.net/hk-construction-management-platform/
	Cleansing Inspection Checklists #	A checklist provided in electronic format for users to check against the site cleaning operations and general housekeeping required under the contract  Source: Novade Website https://www.novade.net/hk-construction-management-platform/
	Quality Inspection Checklist	A checklist provided in electronic format for users to check against the quality requirements stated in the specification, quality plan/ manual and inspection and test plan
	Environmental Inspection Checklist	A checklist provided in electronic format for users to check against the environmental requirements stated in the specification, environmental management plan/ manual and under the laws

Site Work Monitoring and Administration Functions (# Priority/ commonly used functions)		
Functional Area	**Specific Functions**	**Description and Reference Image**
Defect/ outstanding work monitoring	Site Defect / Outstanding Work Inspection	A tool capturing and processing site images usually with geo- or location-reference to provide off-site virtual walkthrough for manual or automatic analysis of the work done against the design and work plan to identify defects and outstanding works (with or without electronic workflow for defect notification and follow-up)  Source: ViACT Website https://www.viact.ai/  Source: OpenSpace Website https://www.openspace.ai/resources/videos/clearsight-progress-tracking-demo/
	Automatic comparison of site image and design	A tool automatically analysing the captured site images usually with geo- or location-reference of the work done against the design drawings/ models to identify defects and outstanding works  Source: CITF Website https://www.youtube.com/watch?v=4W9P_NMpBJE

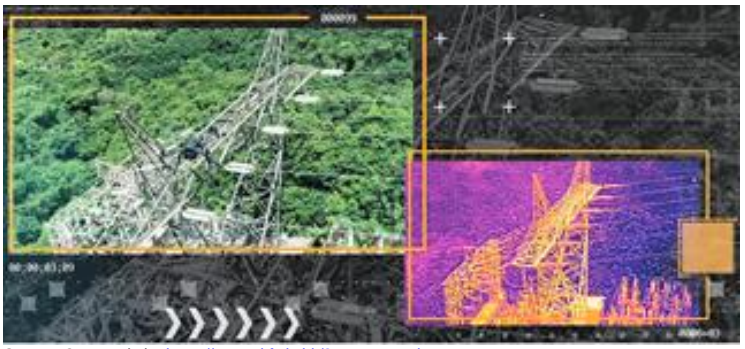
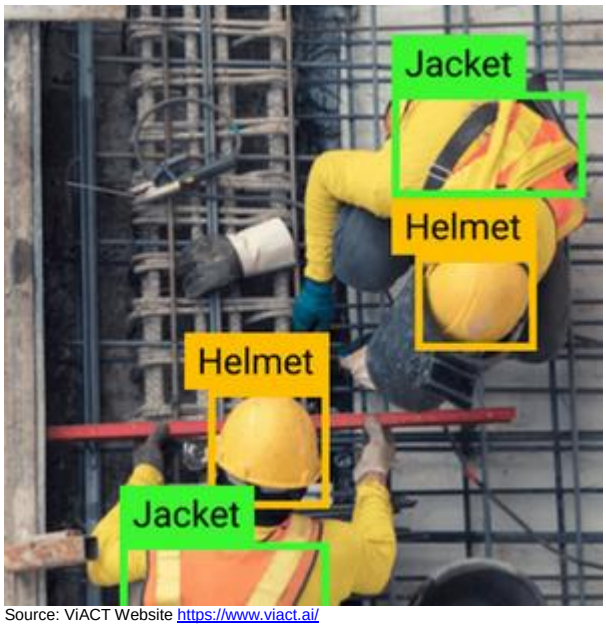
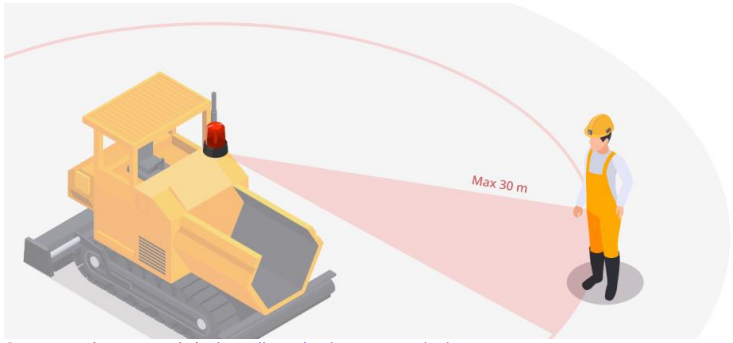
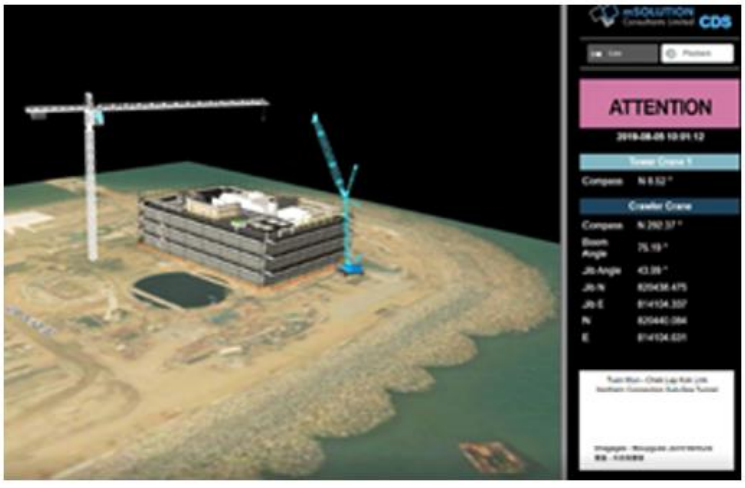
Site Work Monitoring and Administration Functions (# Priority/ commonly used functions)		
Functional Area	**Specific Functions**	**Description and Reference Image**
	Drone for external inspection	A tool specifically designed for capturing images of inaccessible areas (e.g. external walls, overhead cables, scaffoldings), detecting and analysing the conditions of the items under inspection (usually automatically by AI technology) against the design to identify defects and outstanding works  Source: CITF Website https://www.citf.cic.hk/?route=search

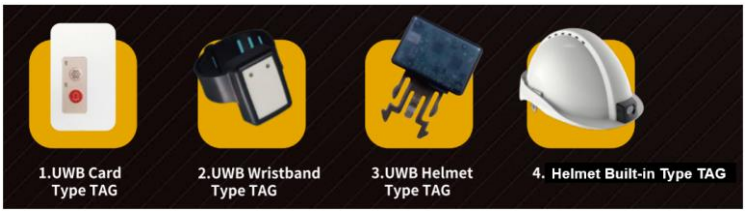
Fig. 24 – List of priority functions of site work monitoring and administration digital platform

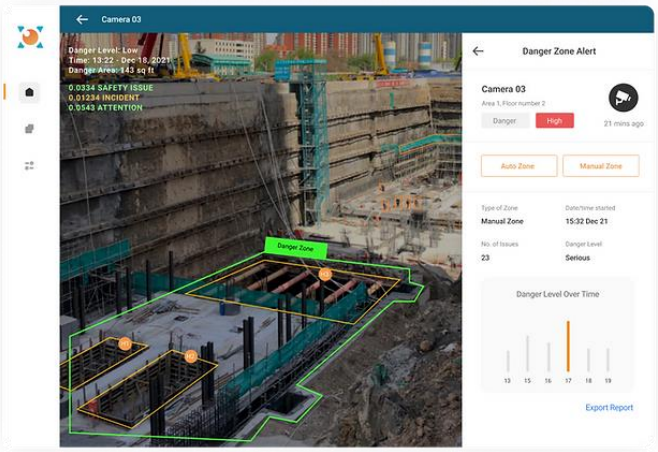
Safety Monitoring Functions (# Priority/ commonly used functions)		
Functional Area	**Specific Functions**	**Description and Reference Image**
Personal Protective Equipment (PPE) Checking	**Safety Helmet #**	Detection of presence and wearing conditions of safety helmet  Source: ViACT Website https://www.viact.ai/

Safety Monitoring Functions (# Priority/ commonly used functions)		
Functional Area	**Specific Functions**	**Description and Reference Image**
	Reflective Vest #	Detection of presence and wearing conditions of reflective vest  Source: McMarvin Website https://www.mcmarvin.com/Manufacturing-Facility.html
	Life jacket	Detection of presence and wearing conditions of life jacket
	Safety shoes	Detection of presence and wearing conditions of safety shoes
	Wrist band / smart watch	Detection of presence and conditions of wrist band/ smart watch
Well-being Monitoring	**Workers' location tracking #**	Tracking of workers' location to ensure workers' attendance in the workplace and movement for further analysis  Source: ViACT Website https://www.viact.ai/
	Body temperature #	Measurement of workers' body temperature to ensure their conditions are fit for work and early identification of potential safety and health issues  Source: Beeinventor Website https://www.beeinventor.com/en/

Safety Monitoring Functions (# Priority/ commonly used functions)		
Functional Area	**Specific Functions**	**Description and Reference Image**
	Heartbeat #	Measurement of workers' heartbeat rates to ensure their conditions are fit for work and early identification of potential safety and health issues
	Sudden fall #	Detection of workers' sudden fall conditions to enable early identification of fall location for timely response  Source: McMarvin Website https://www.mcmarvin.com/Manufacturing-Facility.html
	Motionless #	Detection of workers' motion conditions to enable early identification of incident location for timely response
	Blood pressure	Measurement of workers' blood pressure to ensure their conditions are fit for work and early identification of potential safety and health issues
Workers' Behaviour Monitoring	**People count based on different vests and helmets #**	Identification of types of workers by recognising the helmet and vest colours and counting of different types of workers at different work locations for providing useful data for manpower deployment and utilisation analysis  Source: ViACT Website https://www.viact.ai/

Safety Monitoring Functions (# Priority/ commonly used functions)		
Functional Area	**Specific Functions**	**Description and Reference Image**
	Smoking #	Detection of workers' smoking behaviour to enable early warning and timely rectification  Source: ViACT Website https://www.viact.ai/
	Driver sleeping	Detection of workers' fatigue condition to enable early warning and timely response/ rectification
	Driver using mobile phone	Detection of workers' attention to work to enable early warning and timely rectification
	Driver motionless	Detection of workers' motion conditions to enable early identification of incident location for timely response
Hazardous Area Zoning/ Access Control	**Anti-collision / Machinery safety distance - Sensor-based #**	Detection of proximity of different equipment or equipment and workers to ensure a safe distance is maintained by the use of sensors to prevent collision  Source: Beeinventor Website https://www.beeinventor.com/en/  Source: CITF Website https://www.citf.cic.hk/?route=search

Safety Monitoring Functions (# Priority/ commonly used functions)		
Functional Area	**Specific Functions**	**Description and Reference Image**
	Anti-collision / Machinery safety distance - AI-based #	Detection of the proximity of different equipment or equipment and workers to ensure a safe distance is maintained by the use of AI video analytics to prevent collision  Source: CITF Website https://www.citf.cic.hk/?route=search
	Restricted zone / Danger zone - Sensor- based #	Detection of intrusion of equipment and/ or workers in restricted or danger zones by the use of sensors to prevent potential accidents  Source: Beeinventor Website https://www.beeinventor.com/en/
	Restricted zone / Danger zone - AI-based #	Detection of intrusion of equipment and/ or workers in restricted or danger zones by the use of AI video analytics to prevent potential accidents  Source: ViACT Website https://www.viact.ai/

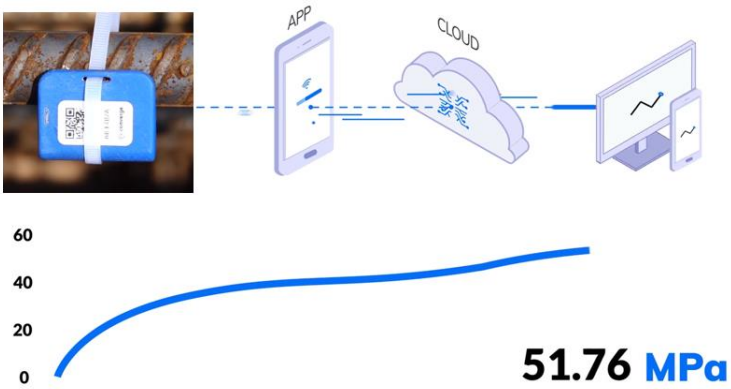
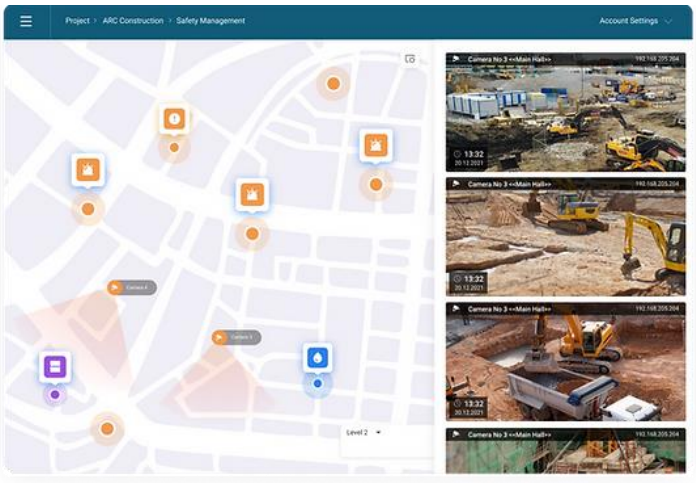
Safety Monitoring Functions (# Priority/ commonly used functions)		
Functional Area	**Specific Functions**	**Description and Reference Image**
	Fall from height prevention #	Detection of the presence and proper attachment of fall arresting devices for high level work and protective barriers to floor edges or openings/ vertical shafts by the use of sensors or AI video analytics to prevent potential fall  Source: ViACT Website https://www.viact.ai/
	Truck license plate detection	Detection of truck license plate to enable access control to the site or different zones of the site  Source: SmarTone Website https://www.smartonesolutions.com.hk/en/business_digitalization/efficiency_enhancement_tools/smartworks/?gclid=EAIaIQobChMIoLqtiJOf-gIVHpJmAh0zyQqsEAAYASAAEgKyJvD_BwE
	Truck delivery and analytics	Detection of truck loading condition and identification/ measurement of loaded materials to ensure compliance and acceptable utilisation  Source: ViACT Website https://www.viact.ai/

Safety Monitoring Functions (# Priority/ commonly used functions)		
Functional Area	**Specific Functions**	**Description and Reference Image**
	Face recognition for access control	Identification of workers' identify by facial recognition to give access to authorised workers only
	Fire hazard detection and alarming	Detection of heat and smoke by the use of sensors or AI video analytics to prevent potential fire
	Crane for working platform and crane operation CCTV	Provision of close-up real-time images of loads being lifted to enable close monitoring to ensure proper conditions of the loads and lifting gears as well as safe lifting operation

Fig. 25 – List of priority functions of safety monitoring digital platform

Site Monitoring Functions (# Priority/ commonly used functions)		
Functional Area	**Specific Functions**	**Description of Functions**
Site Environment Condition Monitoring	**Noise #**	Detection of noise level of site environment/ equipment/ construction operation  Source: ViACT Website https://www.viact.ai/
	Vibration #	Detection of vibration level of site environment/ building elements or equipment (e.g. hammering in demolition work)
	Dust/ Air quality #	Detection of dust or other air pollutants' level of the work site (e.g. PM2.5 particulates)  Source: SmarTone Website https://www.smartonesolutions.com.hk/en/business_digitalization/efficiency_enhancement_tools/smartworks/?gclid=EAIaIQobChMIoLqtiJOf-gIVHpJmAh0zyQqsEAAYASAAEgKyJvD_BwE

Site Monitoring Functions (# Priority/ commonly used functions)		
Functional Area	**Specific Functions**	**Description of Functions**
	Electricity leakage #	Detection of leakage of the electrical supply system of the work site/ equipment  Source: CITF Website https://www.citf.cic.hk/?route=search  Source: CITF Website https://youtu.be/k4hBGjdFB2Y
	Titling / Inclination	Detection of level of tilting/ inclination of site environment/ building elements (e.g. existing adjoining building structure)
	Displacement	Detection of displacement level of site environment/ building element
	Settlement	Detection of settlement level of site environment (e.g. ground settlement)
	Harmful gas	Detection of harmful gas of the site environment
	Fire	Detection of fire potential of the site environment
	Water level and/or leakage	Detection of water level / leakage of site environment
	Gas leakage	Detection of gas leakage of site environment/ equipment
	Security	Detection of break-in and access to restricted zones
	External sensor compatibility	Capability of integrating with or capturing data from other external sensors to the platform

Site Monitoring Functions (# Priority/ commonly used functions)		
Functional Area	**Specific Functions**	**Description of Functions**
Building Element Monitoring	**Loading #**	Detection of loading or stress of the temporary structural works  Source: LR Construction Technologies Ltd. Website https://www.lrctl.com/
	Concrete maturity #	Detection of fresh concrete temperature for assessment of concrete strength to determine the time for early striking of formwork and proceeding to subsequent works so as to improve construction efficiency.  Source: Converge Website https://www.converge.io/
	Drainage piping assessment	Provide pre-defined template and data input options for efficient drainage piping condition assessment, recording and reporting work
Equipment Status Monitoring	**Equipment location tracking #**	Tracking equipment location to ensure restricted/ dangerous zones and assessment of plant utilisation (e.g. equipment movement)  Source: ViACT Website https://www.viact.ai/

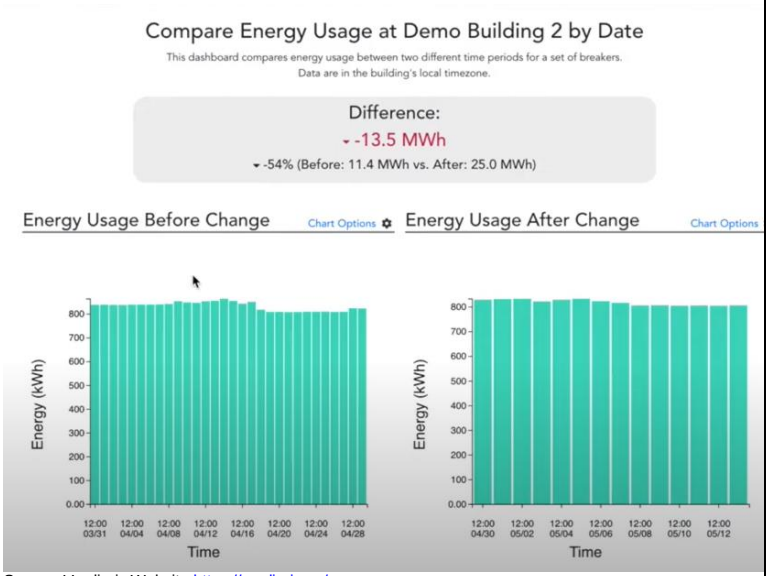
Site Monitoring Functions (# Priority/ commonly used functions)		
Functional Area	**Specific Functions**	**Description of Functions**
	Power system fault #	Detection of abnormality of electrical supply system of the work site/ equipment  Source: Verdigris Website https://verdigris.co/
	Equipment data	Provision of pre-determined equipment data according to the product brand and models (e.g. specification)
	Equipment operating data	Detection of equipment operating data for visualisation and assessment of plant operating conditions, efficiency and utilisation etc.
	Fuel consumption	Detection of the fuel consumption of the equipment

Fig. 26 – List of priority functions of site monitoring digital platform

2.3.2 User interface

The user experience or satisfaction and operation efficiency are heavily dependent on the user interface and its ease of use. The followings are some of the key factors to be considered when selecting the digital platform:

a. Language support
b. Structure and layout
c. Flexibility in customisation of the user interface
d. Availability of a map-based interface

Support for different languages is always preferred when choosing a digital platform. Some digital platforms may not support Chinese. Even if Chinese is supported, users shall check whether the terms used in the digital platform are commonly understood or whether the terms are direct translation that could not be easily understood by general users. Language support for different imported files or sources of data is also essential. As files and data generated by other software or sensors in other languages may be sent to the digital platform, it is important that the digital platform would support the proper display of the relevant data.

Simple and clear structure and layout is preferred for every digital platform. Users should be able to operate the frequently used functions at the landing page or the main page of the digital platform with menus for expanded options to enable the selection of the content to display and operate.

Digital platforms with flexibility for users to customise certain user interface are preferred, e.g. customised and personalised user interfaces for different users which provide and display preferred key functions and information once logged in.

There are a number of suggested specific functions of different functional areas aiming to identify, locate and/ or track the locations of workers and equipment with the use of geo- or location-reference information. A map-based interface that can make showing and understanding geo- or location-reference information easier should be used.

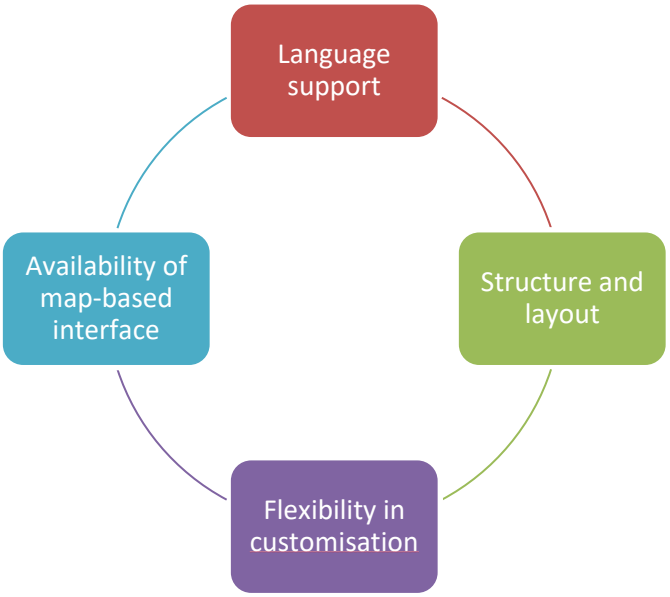


Fig. 27 – Key considerations for the user interface of digital platforms

2.3.3 No. of users supported

A digital platform should support the required no. of expected users for the purpose required at the acceptable price. While some digital platforms support unlimited no. of users, some platforms are charged according to the no. of users such that the users have to estimate the no. of users before choosing the products. Platforms supporting unlimited users may be charged according to the project sum such that the price may be higher than that of a platform for a limited no. of users. Therefore, users should holistically assess the actual no. of users required and take into account the cost-effectiveness and other relevant factors where platforms with the same functions are available.

2.3.4 Flexibility in customisation for specific user requirements

Digital platforms offering built-in flexibility for users to customise the content are preferred. Apart from the flexibility for customisation of the user interface, some digital platforms may allow the users to change the content of the digital platform such that the users can make necessary customisation when

the needs arise.

One of the most common examples is the checklists of Digital Works Supervision System (DWSS). Some platforms allow users to add checklists or change the items in the checklists without additional charge or engaging the solution provider. Some may allow certain degree of expandability in functions to suit users' needs as the project progressed.

This is particularly useful when the project involves a number of uncertainties and complexity. Such flexibility and expandability may involve an additional cost. Users are advised to check with the solution providers.

2.3.5 Delivery timeframe

Users shall choose a digital platform that could deliver the required functions within acceptable timeframe to suit the project programmes.

Off-the-shelf digital platforms with readily available functions without the need for customisation have the shortest delivery period whereas platforms requiring a lot of customisation take longer time to develop and deliver. Some digital platforms offer different functions as individual modules that the users can subscribe at different points of time. The price of off-the-shelf platforms (basic package) is usually more competitive and reasonable. Users should look for those readily available platforms as the top priority unless their functions could not fully meet the user requirements.

Depending on the project progress, some functions or modules of digital platforms may not be required at the beginning of the project. Even if some users requirements could not be met by the off-the-shelf digital platforms, users can liaise with the solution providers and check the delivery period required for the additional functions. When the delivery time can be met, users can procure and adopt the basic package first while waiting for the development and provision of the additional modules to be delivered at a later stage.

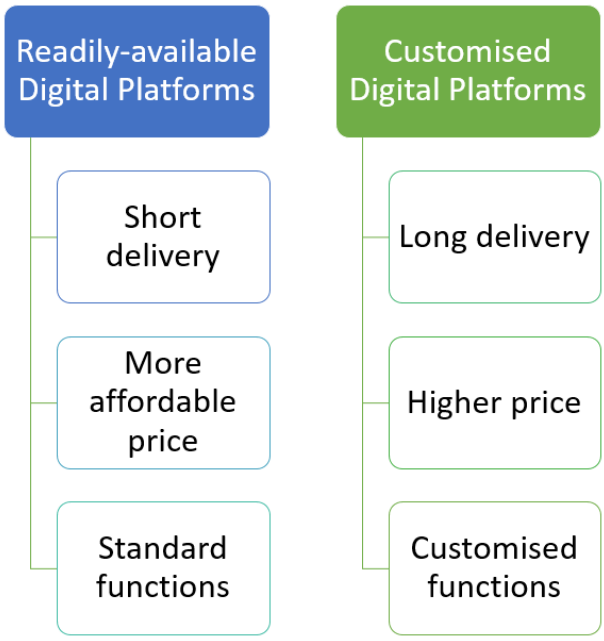


Fig. 28 – Comparison between readily-available and customised digital platforms

2.3.6 Additional services and other considerations

Solution providers providing suitable additional services for their digital platforms can be considered favorably when choosing a platform.

Some common additional services include:

a. System set-up
b. Training
c. Warranty
d. Technical support
e. Data migration and system handover
f. Data security checks

Basic system set-up including creation of user accounts, is essential. Advanced set-up is usually required when the system set-up is complicated or a special skillset is required to enable the normal and proper function of the system. For examples, some sensors and IoT equipment are very sensitive to the orientation, positioning and calibration of the hardware. If the set-up is not done properly, the results may be adversely affected which could not serve the original purpose, e.g. inaccurate data or failure in covering the required sensing area. Some integration among systems and necessary modification to users' own systems or infrastructure may also be required to enable the proper functions of the digital platform. Users shall clarify with the solution provider on the set-up required and the corresponding prices.

As each digital platform and associated hardware systems are different and come with different user interfaces, training is usually required to get the users familiar with all the functions of the digital platforms to enable proper and efficient operation. Some platforms offer free bundled training and some just offer it at a separate charge. Bundled training usually includes a basic no. of training period and no. of users. Users shall check carefully with the solution provider about the price and the sufficiency of the training package. The content of training shall be appropriate for the background and level of staff in terms of language and digital operation proficiency.

A reasonable warranty period (e.g. minimum 1 year) shall be requested for digital platforms especially when they are buy-out products (i.e. not on subscription basis) or when hardware (e.g. sensors) is involved to ensure the system would perform properly during the initial use period. The warranty shall cover bug fixing and hardware maintenance where applicable. If warranty is not included in the product package or price, users shall request for a clear price model for the product maintenance and agree upon when entering the service agreement to prevent disputes in the future.

Availability of local physical technical support is always preferred. Remote technical support (e.g. telephone technical support) may not be able to address the users' needs adequately under some circumstances. Users shall always clarify the technical support arrangement with the solution provider.

Depending on the user's requirements, data migration or integration of the digital platform to existing systems being used by the user may be required at different project stages such as before commencement of project and after project completion. The detailed requirements and arrangement shall be laid down and agreed upon in the service agreement.

In view that project data are confidential and sensitive, the arrangement of the data security and its protection shall be clarified and agreed at the outset of the project. Solution providers with reputable track records should be preferred. Regular security drills such as simulated attacks on the firewall are

recommended. Users are advised to check the price of these security measures with the solution providers. Details of the Data security should make reference to the CIC Beginner's Guide on Cybersecurity Awareness for the Construction Industry (to be published).

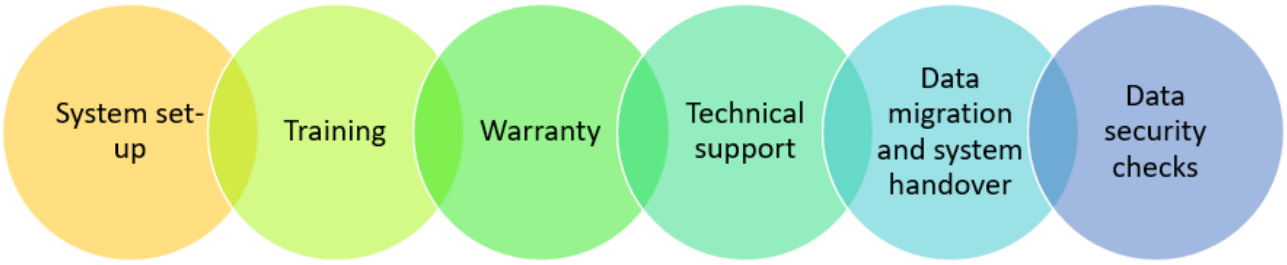


Fig. 29 – Typical additional services for digital platforms

2.3.7 Pricing model and cost

Digital platforms are usually priced according to the following factors

a. Fixed price for a given package – a lump price for a package of defined content:
   i. Subscription period
   ii. Maximum no. of users/ user accounts
   iii. Fixed no. of pre-defined modules and functions
b. Project cost – digital platform cost is a fraction (a certain percentage) of the project cost for a defined project period
c. User requirements – no fixed price and subject to negotiation

A fixed price for a given package is the usual pricing model of a standard packaged platform with well-defined functions and scope of services. These platforms are usually suitable for projects that are smaller in scale and less complex.

Digital platforms that are priced based on the project cost are usually suitable for more sizable and complex projects.

Non-standard (i.e. custom-made) digital platforms do not have standard price and the price is subject to negotiation with the solution providers according to the specific user requirements. This arrangement is usually required for complex projects or projects with unique required management functions. This arrangement also applies to the case when the users would like to develop a specific system for their own enterprise-wide use. The negotiation time shall also be considered when making the choice of the platform.

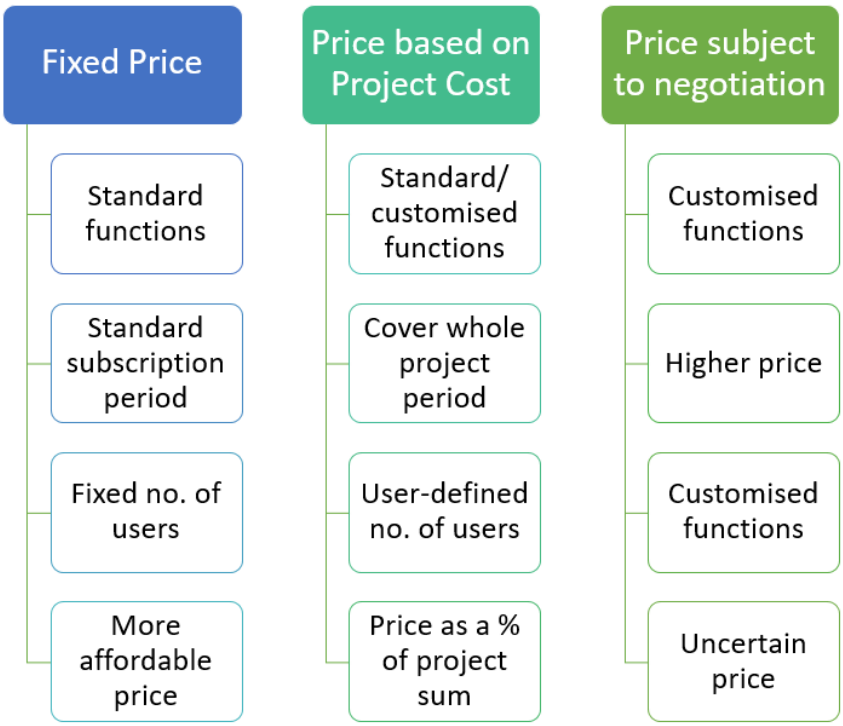


Fig. 30 – Typical pricing models for digital platforms

2.4. Step 3 – Ascertaining the product details and negotiation with digital platform providers

Having finished the product research, users are advised to contact the relevant targeted digital platform providers to make enquiry on the full capabilities of and service and price offered for their products to ascertain the product that can best fulfil the user requirements.

Before the enquiry and negotiation with the solution providers, users are advised to gather the users requirements and prepare a full list of functions and expected performance output to facilitate the liaison work. The user requirements are not necessarily written in technical terms but just a comprehensive workflow and description of functions involved with the expected output (i.e. the deliverables of the digital platform) step-by-step. Some functions when considered together at the same time would normally be priced altogether. Requests e.g. additional functions, that are raised at a later stage would on one hand delay the liaison process and on the other hand involve an additional cost despite the agreement is not yet reached.

During the enquiry and negotiation process, the users shall request for demonstration of the products to experience the user interface and the product functions to understand their performance. The key project team members who are the main users of the digital platforms shall also be engaged to provide feedback and participate in the selection process to ensure the selected product best suits the user requirements.

Users shall also consider the job reference of the targeted digital platforms, in terms of the types of clients and projects, the product functions and location of the projects etc. For example, DWSS products successfully adopted in government projects may demonstrate compliance with the government requirements for DWSS. Local job references of sizeable and complex projects may illustrate the higher capability and capacity of a digital platform.

Apart from the functions, users shall also confirm with the solution providers the payment terms, delivery timeframe and the detailed terms and conditions according to their needs. For products delivered in phase, request for staged payment shall be made. A huge portion of upfront payment (i.e. deposit) should only be accepted if the bulk of the products is delivered and used in one go and the solution provider is reputable.

A comparison of the different solution providers based on the same set of requirements shall be made unless there is no time or resources to do so. For users looking for funding support from the CITF, the required procurement procedures laid down in the CITF Terms and Conditions shall be observed (i.e. the required no. of quotations from different solution providers shall be obtained).

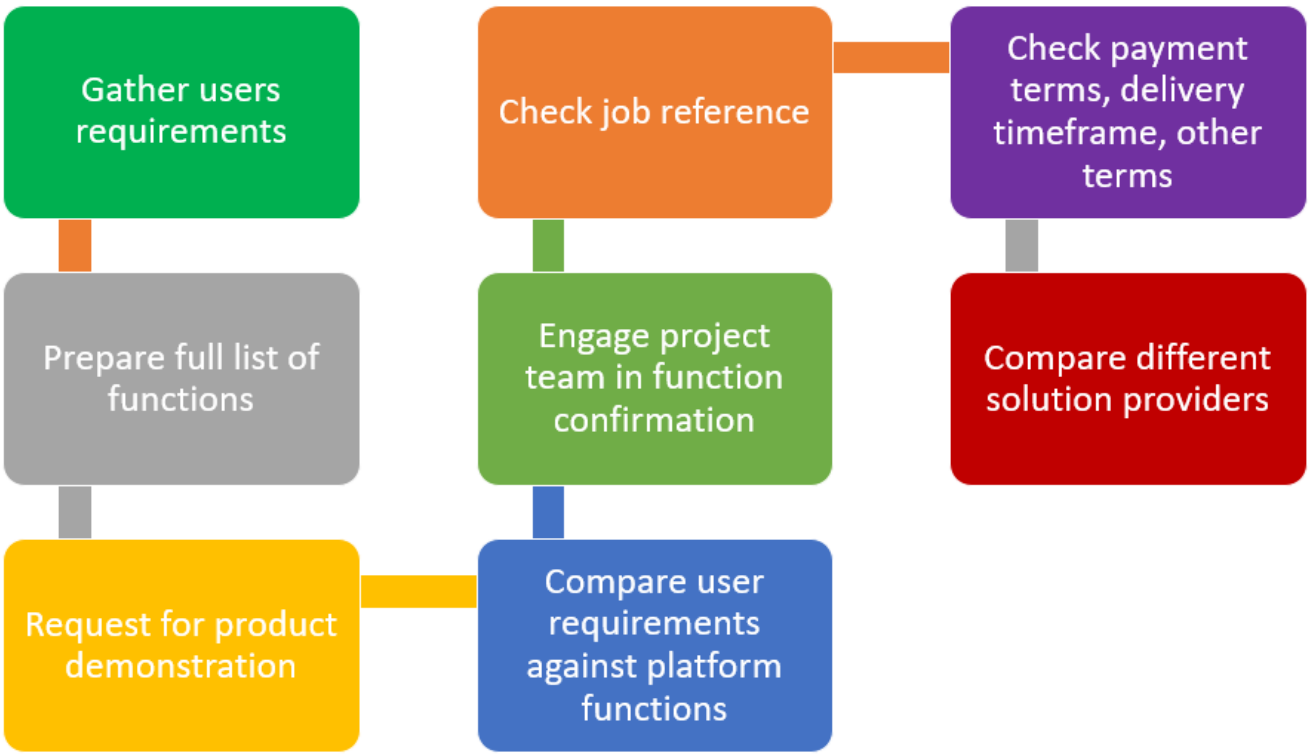


Fig. 31 – Typical steps of ascertaining suitability of a digital platform

2.5. Step 4 – Engaging the digital platform providers

Users shall engage the digital platform providers as soon as all the user requirements and the terms and conditions are agreed upon such that the digital platforms can be delivered on time to meet the project schedule.

For users looking for funding support from the CITF, necessary funding applications shall be made before committing any expenses (i.e. making agreement with the solution providers).

Usually the solution provider would provide a quotation with a validity period for the users to confirm within that period. However, very often, the product content in the quotation is brief and does not mention all the required details. Users are advised to jointly prepare a full list of users requirements and product content with all the terms and conditions stated as part of the agreement.

Users shall also be aware that some agreements would only take effect upon clearance of the deposit

payment. If the deposit payment is not settled, the agreement may become invalid upon the expiry of the validity of the quotation. The solution provider would then have the right to ask for a different price which may be less favorable to the users. Therefore, the users shall prepare the necessary financial resources for the digital platform procurement.

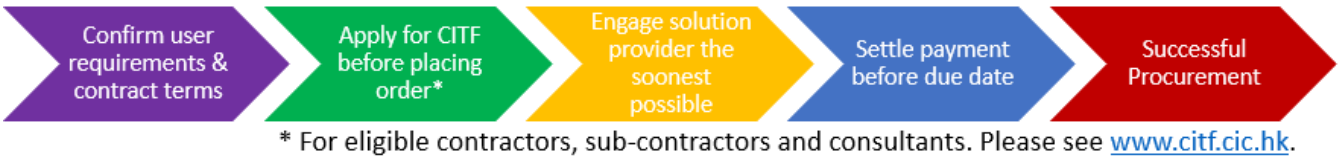


Fig. 32 – Typical steps of engaging the digital platform provider

2.6. Step 5 – Enabling successful delivery of the digital platforms

Users are advised to actively participate in the customisation/ development (where applicable) and the User Acceptance Test (UAT) of the digital platform to ensure timely and satisfactory delivery.

Users' participation in the customisation/ development process is crucial because the solution provider may not be able to correctly and accurately interpret the user requirements and turn them into the desired digital platform. Users' participation throughout the process can keep track of progress and ensure the digital platform is being developed in the right direction and with the required functions. Regular liaison meetings and target deliverables at various milestones throughout the process should be specified.

Upon receiving the mock-up or final test version of the digital platform, the key actual users of the digital platforms shall be engaged to conduct the UATs and provide feedback to the solution providers to follow-up.

Depending on the agreement, training shall also be provided by the solution providers. Users shall send appropriate staff to attend the training.

Upon acceptance of the delivery of the digital platforms and all associated deliverables including training and other deliverables, the users shall request for a delivery note and on which the users and the solution provider shall jointly sign off to confirm the satisfactory acceptance of all the deliverables. In case there are something outstanding or that needs to be followed-up, the users shall state clearly in the delivery note.

For users seeking funding support from the CITF, the original delivery note is a mandatory document for reimbursement purposes.

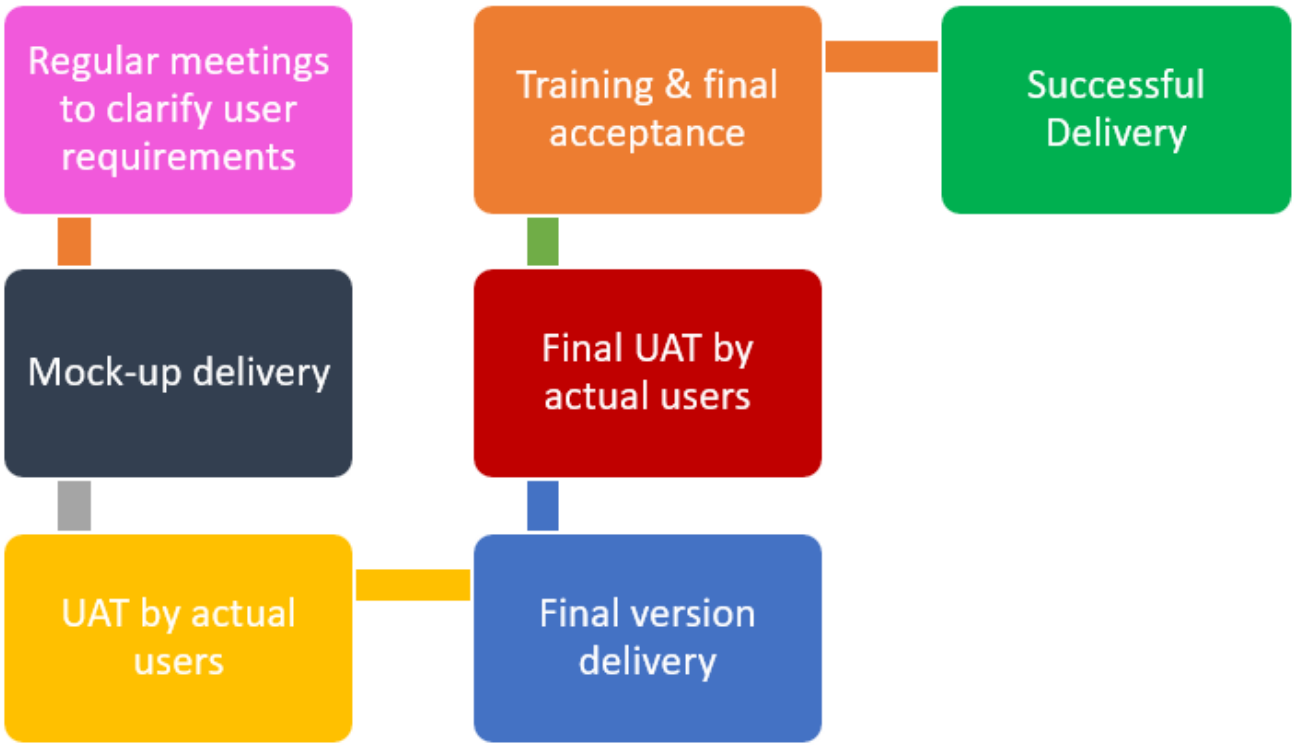


Fig. 33 – Typical steps of ensuring successful delivery of a digital platform

2.7. Step 6 – Enabling successful adoption of digital platforms

Users shall continuously monitor the performance of the digital platform and collect feedback from the operating staff to allow timely reports on unsatisfactory functions and necessary improvements to ensure the desired functions would be performed to meet the purpose.

Users are advised to designate a system administrator for each of the digital platforms to be the single point of contact for both the user and the solution provider, who shall be responsible for the overall management of the operation of the digital platform and liaison with the solution provider, such as repair and maintenance. This system administrator shall preferably be someone engaged in the digital platform scouting and procurement process who is familiar with the system at the very beginning to ensure efficient and effective management.

The system administrator shall be responsible for managing access control and granting the relevant access rights to designated users as appropriate.

Where maintenance services or data security checks are carried out, proper record shall be kept.

For relatively comprehensive and complex digital platforms, regular liaison meetings with the solution providers are recommended to enhance mutual communication for continuous improvement on the product's performance.

For subscription-based digital platforms, users shall make necessary early financial arrangement to meet the periodic financial commitment to ensure continuity of the digital platforms.

Where data migration or system handover are required, users shall make early agreement on the

details of the arrangement to ensure smooth process. Disruption to site operations shall also be taken into account with necessary precautionary measures and their implementation plan devised before the actual migration or handover. Upon completion, the results shall be checked to ensure the work done is satisfactory. Proper record shall be signed off and confirmed by the user and the solution providers. The details of the handling of digital data should make reference to CIC BIM for Asset Management and Facility Management Case Sharing 2021 and other CIC BIM Standards-related Publications.

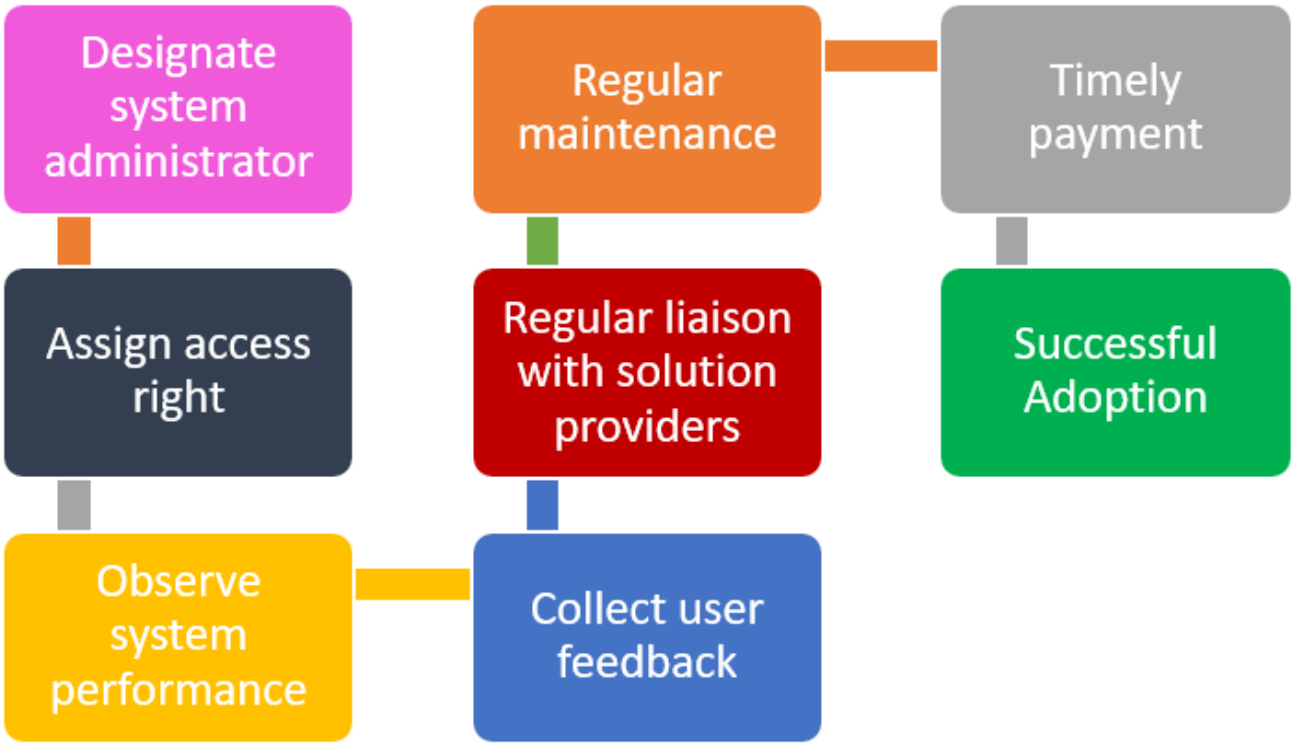


Fig. 34 – Typical steps of ensuring successful adoption of a digital platform

3. Annex A – Checklist on Digital Platforms for Site Management

Users can use the following checklist of common smart applications enabled by digital platforms in the construction stage to select the required functions for sourcing and negotiation with digital platform solution vendors. Please refer to the reference product and price information of digital platforms in the CITF website here. ***(# below denotes priority functions which are considered common and universally applicable to most construction projects)***

Area	Application	Code	Function	Yes/ No
Site Work Monitoring and Administration (**SWM**)	**SWM-A** – Site Record	**SWM-A1**	**Request for Inspection/ Survey Check (RISC) Form #**	☐
		SWM-A2	**Site Diary/Site Record Book #**	☐
		SWM-A3	**Labour Return Record #**	☐
	SWM-B – Inspection Checklist	**SWM-B1**	**Site Safety Inspection Records #**	☐
		SWM-B2	**Cleansing Inspection Checklists #**	☐
		SWM-B3	Quality Inspection Checklist	☐
		SWM-B4	Environmental Inspection Checklist	☐
	SWM-C – Defect/Outstanding Work Monitoring	**SWM-C1**	Site Defect / Outstanding Work Inspection	☐
		SWM-C2	Automatic comparison of site image and design	☐
		SWM-C3	Drone for external inspection	☐
Safety Monitoring (**SaM**)	**SaM-A** – Personal Protective Equipment (PPE) Checking	**SaM-A1**	**Safety Helmet #**	☐
		SaM-A2	**Reflective Vest #**	☐
		SaM-A3	Life jacket	☐
		SaM-A4	Safety shoes	☐
		SaM-A5	Wrist band / smart watch	☐
	SaM-B – Well-being Monitoring	**SaM-B1**	**Workers' location tracking #**	☐
		SaM-B2	**Body temperature #**	☐
		SaM-B3	**Heartbeat #**	☐
		SaM-B4	**Sudden fall #**	☐
		SaM-B5	**Motionless #**	☐
		SaM-B6	Blood pressure	☐
	SaM-C – Workers' Behaviour Monitoring	**SaM-C1**	**People count based on different vests and helmets #**	☐
		SaM-C2	**Smoking #**	☐
		SaM-C3	Driver sleeping	☐
		SaM-C4	Driver using mobile phone	☐

Area	Application	Code	Function	Yes/ No
		SaM-C5	Driver motionless	☐
		SaM-C6	Truck license plate detection	☐
	SaM-D – Hazardous Area Zoning/ Access Control	**SaM-D1**	**Anti-collision / Machinery safety distance - Sensor-based #**	☐
		SaM-D2	**Anti-collision / Machinery safety distance - AI-based #**	☐
		SaM-D3	**Restricted zone / Danger zone - Sensor- based #**	☐
		SaM-D4	**Restricted zone / Danger zone - AI- based #**	☐
		SaM-D5	**Fall from height prevention #**	☐
		SaM-D6	Truck delivery and analytics	☐
		SaM-D7	Face recognition for access control	☐
		SaM-D8	Fire hazard detection and alarming	☐
		SaM-D9	Crane for working platform and crane operation CCTV	☐
Site Monitoring (**SiM**)	**SiM-A** – Site Environment Condition Monitoring	**SiM-A1**	**Noise #**	☐
		SiM-A2	**Vibration #**	☐
		SiM-A3	**Dust/ Air quality #**	☐
		SiM-A4	**Electricity leakage #**	☐
		SiM-A5	Titling / Inclination	☐
		SiM-A6	Displacement	☐
		SiM-A7	Settlement	☐
		SiM-A8	Harmful gas (e.g. ad hoc welding location, storage location)	☐
		SiM-A9	Fire	☐
		SiM-A10	Water level and/or leakage	☐
		SiM-A11	Gas leakage	☐
		SiM-A12	Security	☐
		SiM-A13	External sensor compatibility	☐
	SiM-B – Building Element Monitoring	**SiM-B1**	**Loading #**	☐
		SiM-B2	**Concrete maturity #**	☐
		SiM-B3	Drainage piping assessment	☐
	SiM-C – Equipment Status Monitoring	**SiM-C1**	**Equipment location tracking #**	☐
		SiM-C2	**Power system fault #**	☐
		SiM-C3	Equipment data	☐
		SiM-C4	Equipment operating data	☐
		SiM-C5	Fuel consumption	☐

CONSTRUCTION INDUSTRY COUNCIL 建造業議會

Feedback Form

CIC Beginner's Guide on Construction Digitalisation – Smart Site Platform

To improve future editions of this publication, we would be grateful to have your comments.

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

***1.* As a whole, I feel that the publication is:**	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Informative	❑	❑	❑	❑	❑
Comprehensive	❑	❑	❑	❑	❑
Useful	❑	❑	❑	❑	❑
Practical	❑	❑	❑	❑	❑
***2.* Does the publication enable you to understand more about the subject?**	Yes		No		No Comment
	❑		❑		❑
***3.* Have you made reference to the publication in your work?**	Quite Ofter		Sometimes		Never
	❑		❑		❑
***4.* To what extent the publication benefits you?**	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Improving the preparation and decision making for the selection of suitable digital platforms	❑	❑	❑	❑	❑
Improving the sourcing and procurement process	❑	❑	❑	❑	❑
Improving the digital platform adoption process	❑	❑	❑	❑	❑
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	❑	❑	❑	❑	❑
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