WSH Technology for Construction

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Provide evidence-based, insightful and practical solutions

Ensuring Workplace Safety and Health @ Work

Occupational Safety And Health Division (MOM)

Workplace Safety and Health Council

REGULATOR
Legislation, Policies & Enforcement

SOLUTIONING
Data Insights
WSH Assessment Tools
WSH Technology Solutions

INDUSTRY PARTNER
Educate & Engage Stakeholders, Set Standards, Promote WSH

WSHI's Role

- Uncover red flags, root causes and emerging WSH issues through data
- Develop industry assessment tools, such as iWorkHealth[1] and iOwnWSH[2]
- Improve WSH through technology

[1] https://www.wshc.sg/iWorkHealth

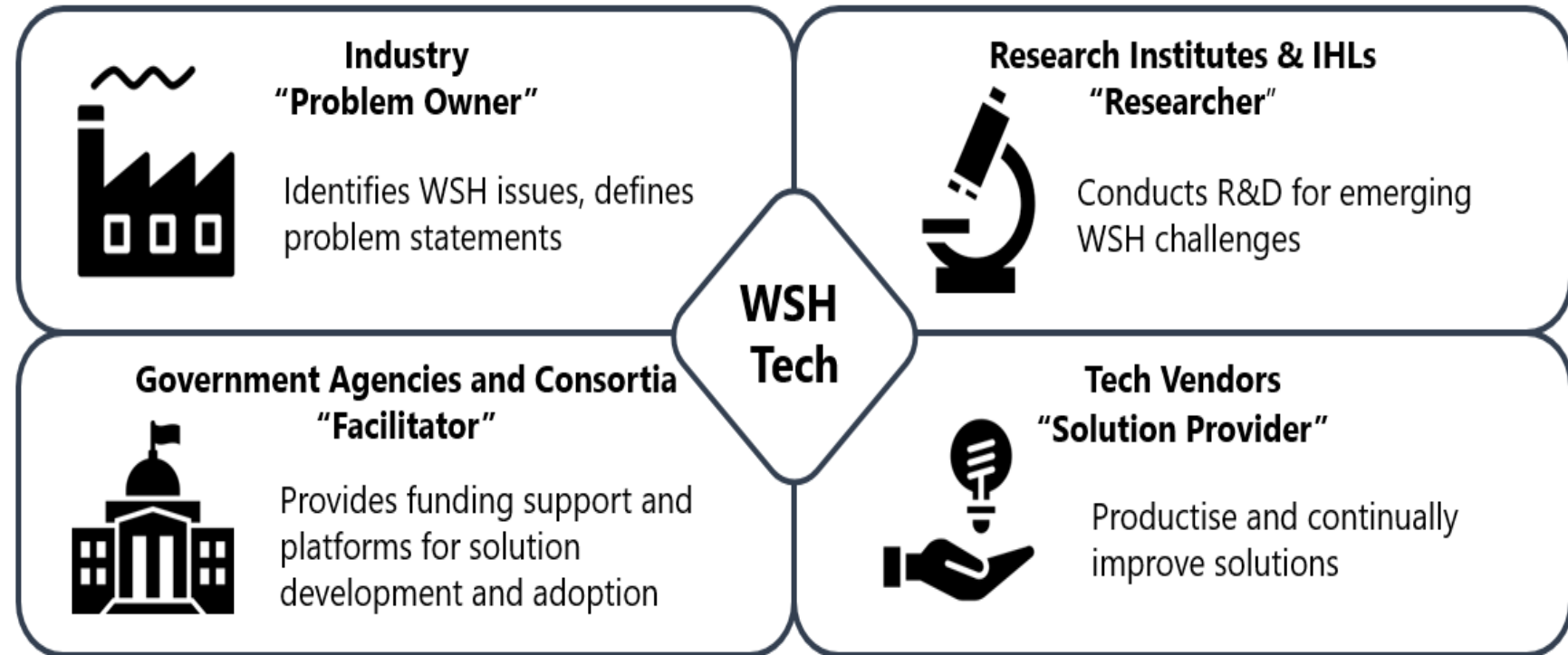[2] https://www.tal.sg/wshc/programmes/iownwsh/overview

Promote Technology-Enabled WSH is one of the key strategies to achieve WSH 2028 goals

Reduce and sustain Singapore' workforce **fatality rate at less than 1 per 100,000 workers by 2028,** in line with the safest countries in the world
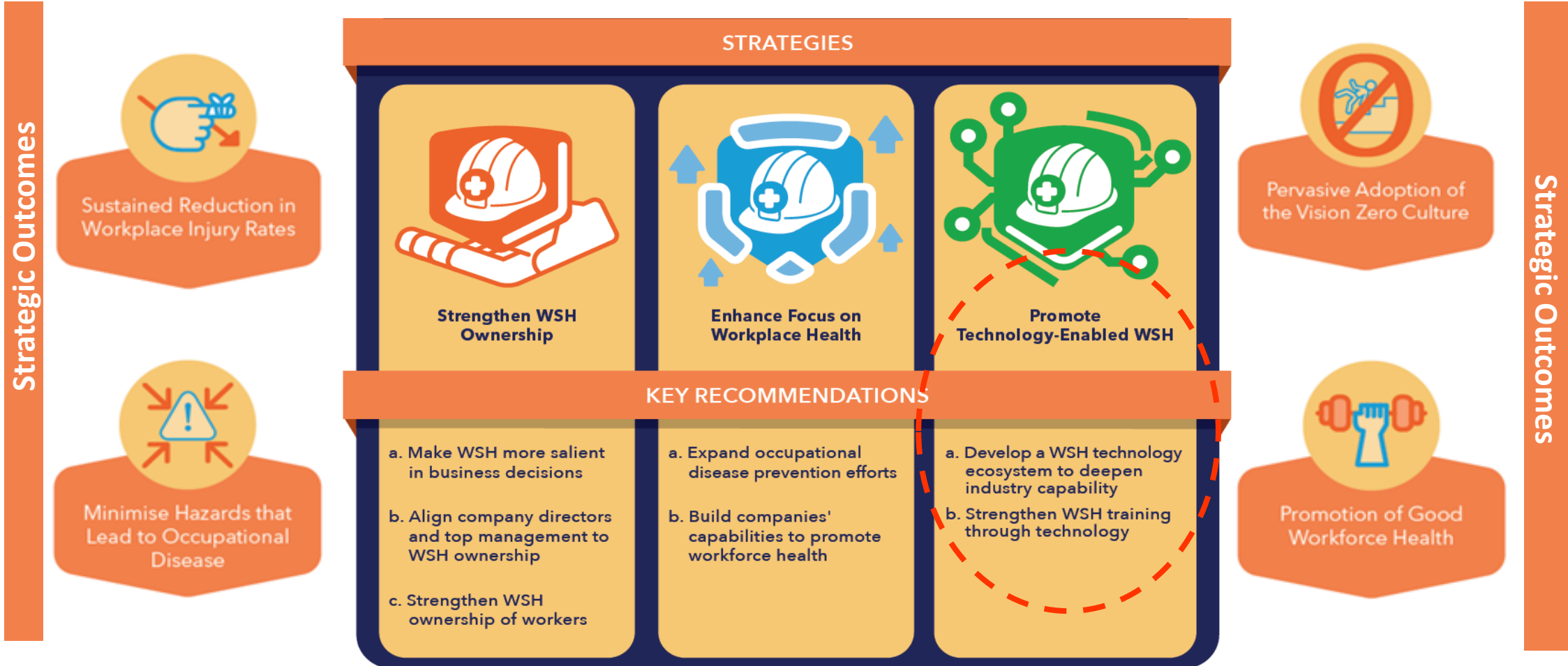
Partner key stakeholders to grow the WSH tech ecosystem in Singapore and scale adoption of mature WSH tech

WSHI works with different stakeholders in the technology ecosystem, based on technology readiness level of WSH solutions, and scale-worthiness of the tech

Industry
"Problem Owner"

Identifies WSH issues, defines problem statements

Research Institutes & IHLs
"Researcher"

Conducts R&D for emerging WSH challenges

WSH Tech

Government Agencies and Consortia
"Facilitator"

Provides funding support and platforms for solution development and adoption

Tech Vendors
"Solution Provider"

Productise and continually improve solutions

Launching WSH Tech innovation challenges, and working with trade associations to promote and scale tech adoption

BEAMP: Digital Tech Challenge

Slips trips and falls (STF) and STF near miss detection using wearable and CCTV with AI

Commercialized solution by Vulcan AI 'WorkSafe'

Open Innovation Platform Tech Challenge

Using sensors and video analytics to detect worker wearing harness and hook attached to lifeline when working at height

Lite solutions for SMEs

Identify solutions suitable for SMEs to adopt to improve WSH surveillance. The cost of SME lite solutions are lower, to make it assessable and attractive for adoption
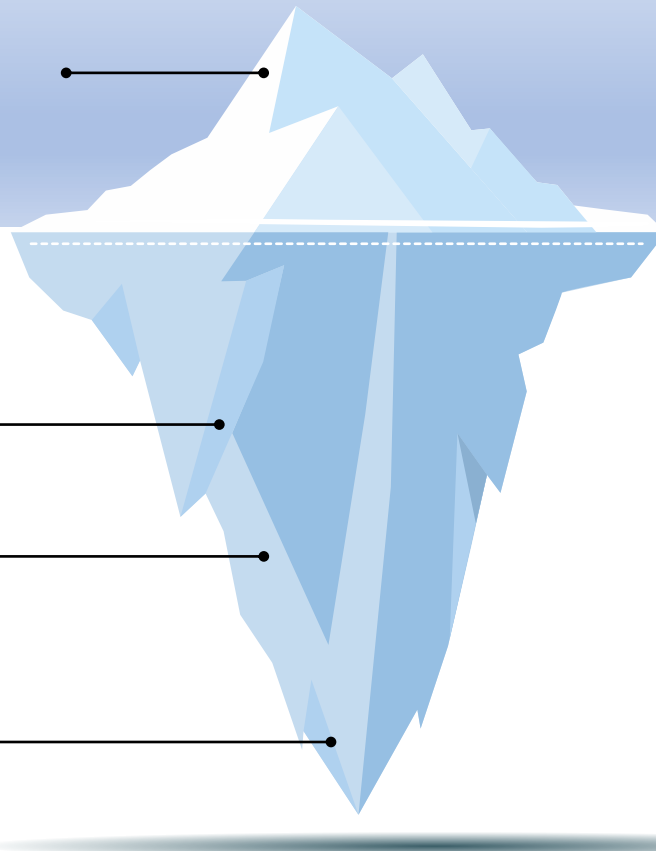
Workplace safety and health incidents are very costly. They can also affect business reputation and staff morale.

COST OF ACCIDENTS

DIRECT COSTS

Workers' compensation payout stood at $143.75 million in 2023, 18% higher than 2022.

OTHER DIRECT AND INDIRECT COSTS

WORKERS
- Net loss of future earnings
- Additional cost of medical treatment and rehabilitation

COMMUNITY
- Social payouts
- Investigation/ Inspection activities
- WSH promotion activities
- Loss of human capital
- Medical subsidies

EMPLOYERS
- Staff turnover costs
- Training costs
- Loss of worker output
- Insurance premiums
- Legal costs

Incident Cost Calculator

https://www.mom.gov.sg/-/media/mom/documents/safety-health/incident-cost-calculator.xlsx

Immediate Costs
- First-aid Treatment
- Making area safe
- Staff downtime

Accident Investigation
- Internal investigation
- Time spent with authority
- Consultant's fee

Recovery
- Site cleanup and repair
- Rescheduling work activities
- Machinery replacement

Intangible Costs
- Business reputation
- Staff morale

Penalties and Fines
- Contract penalties
- Fines
- Insurance premium increase

Business Costs
- Injury compensation
- Recruitment and training of new workers

Examples of how WSH Tech solutions can enhance WSH

Video Surveillance System (VSS)
- Required for construction worksites with contract value of $5 million and above
- Enables real-time monitoring and serves as deterrence against unsafe acts

✓ **Video analytics**
- Detect non-compliance to safety protocols
- Detect open sides, areas under crane load and other worksite hazards
- Geofencing

360 cameras smart inspection
- Track project progress, hazard identification and resolution, and facilitate communication

✓ **ePermit-to-work**
- Prevent falsification and backdating of permits
- Full visibility of ongoing work
- Identify conflicting work and overdue permits
- Improve productivity by reducing paperwork

✓ **Vehicular safety tech**
- Proximity sensors prevent collisions
- 360 degrees camera increase situational awareness
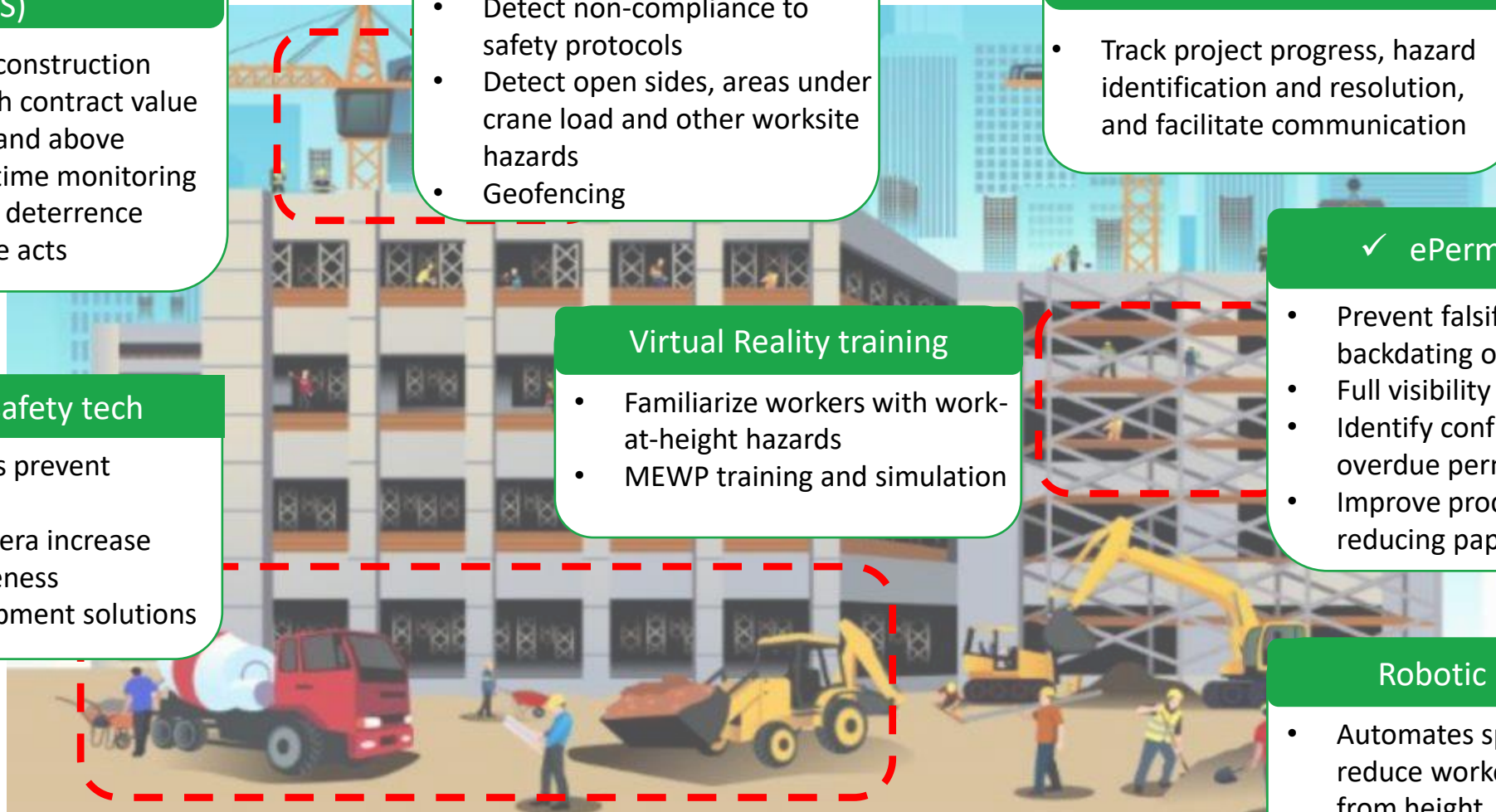- MEWP ani-entrapment solutions

Virtual Reality training
- Familiarize workers with work-at-height hazards
- MEWP training and simulation

Robotic solutions
- Automates specific tasks to reduce worker exposure to fall from height, fatigue and WRMSD risks

✓ **Pre-approved solutions on PSG with funding support for SMEs**

(Not exhaustive)

From 1 Jun 2024, all construction worksites with a contract value of $5 million and above are required to install Video Surveillance Systems (VSS)

A **Video Surveillance System** (VSS) comprises a network of cameras for monitoring and recording activities within specific work areas.

Work locations covered by VSS monitoring at construction worksites

- Every area, including every floor of a building under construction, where the following work activities are carried out or intended to be carried out:
    a) Work at height where a person fall off or through a distance of more than 2 metres;
    b) Erection, dismantling and maintenance of scaffolds and formwork structures
    c) Excavation and shoring
- At areas where lifting operations are carried out or intended to be carried or lifting machines are used (e.g. cranes, gondolas or mobile elevated working platforms).
- At areas where industrial trucks (e.g. forklifts, excavators or steam rollers) are used.
- At areas where vehicular traffic may cause danger to persons carrying out any work.
- At loading or unloading areas
- At confined spaces where any work is carried out or intended to be carried out, if a VSS can be safely installed.

VSS helps contractors to manage risks and improve WSH in several ways

Monitoring – Provide real-time monitoring of the workplace, for supervisors to identify unsafe conditions, and act in time to prevent accidents.

Deterrence – Under camera supervision, workers are likely to be more compliant with safety procedures

Training – Recordings can facilitate worker training, such as toolbox meetings, to reinforce the safe work procedures and what risks are associated with the work activity

Insight – Recordings can provide insights for investigation of WSH-related incidents such as near-miss or dangerous occurrence, to prevent similar incidents recurring.
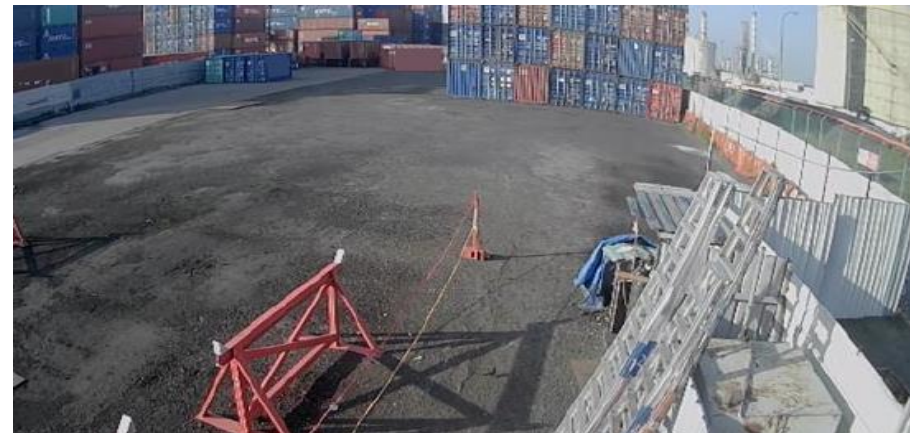
Examples of areas monitored

Work-at-height

At the floor of a building under construction

Construction of support structure


Loading/unloading area

10 useful tips for setting up an effective and reliable VSS

1. **Strategic Placement:** Position cameras at high vantage points with clear line of sight to the work activity, and supplement coverage with portable cameras in other areas as needed

2. **Recording:** Ensure the VSS is switched on and recording whenever there is work activity, and ensure that there is a date stamp, time stamp and camera identification code, that does not obstruct the recorded images.

3. **Power Supply:** Recommended to use power line or battery pack, with backup power supply as contingency

4. **Storage medium:** Local storage device (e.g. SD card), network-based drive or cloud-based solution, capable of exporting video footages in .avi, .mp4 or equivalent format. Recordings must be kept for 30 days (if no WSH incident) or 180 days from date of WSH incident.

5. **System Maintenance:** Perform regular checks to ensure VSS is in good working condition and operational at all times

6. **Robust Cameras:** Recommended to use weather-proof and dust-proof cameras for increased durability.

7. **Camera Specifications:** min. full HD 1920x1080, of at least 12 frames per second.

8. **Minimize Unnecessary Recording:** Minimize recording of neighbouring premises.

9. **Video Management System (VMS):** Recommended to use VMS software for easy management and retrieving recorded footage

10. **Security:** Take reasonable measures to ensure that recordings are not tampered with.

For more information, please refer to the WSH guide on Video Surveillance System published on WSHC website.

VSS establishes the infrastructure for video analytics to provide automated real-time alerts for unsafe conditions or behaviours

While video analytics (VA) is not within the scope of the VSS mandate, it complements VSS by automating detection of unsafe conditions or behaviours and enhancing safety and productivity.

Examples of use cases in Construction
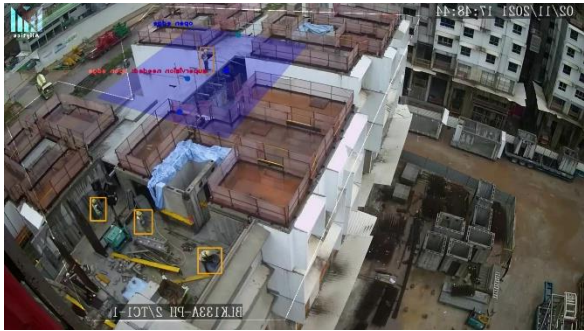
Open Edge detection

Worker under lifting load

PPE detection

Worker near machinery/vehicles

Smoke and fire

Geofencing

Housekeeping

Slips, Trips and Falls

Images from Ailytics, Invigilo
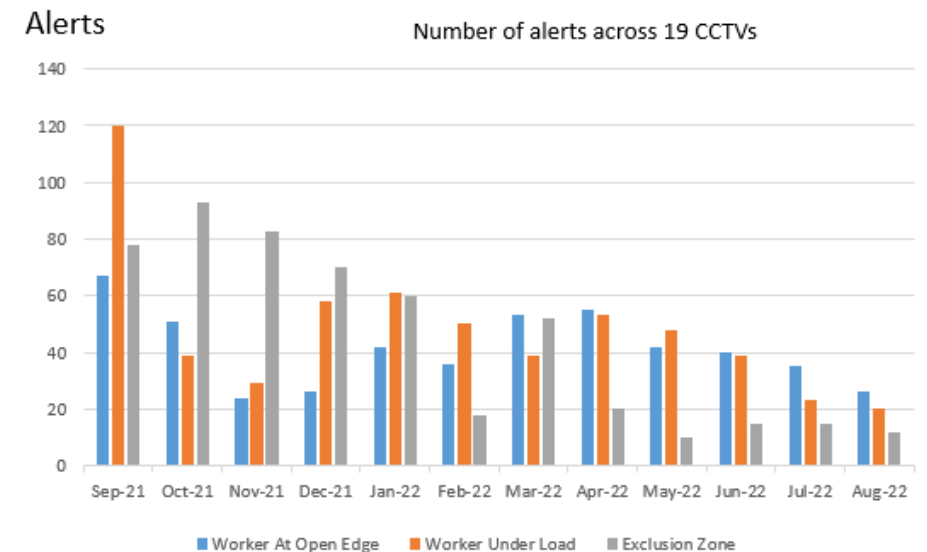
Source: Ailytics

Source: Ailytics

Case study - deployment of video analytics at a local construction site led to less detections of unsafe behaviour over time, and increased safety awareness among workers

3 VA use cases were deployed at a local construction site for 9 months
     1) Detection of worker near open edge
     2) Worker near lifting load
     3) Exclusion zone (geofencing)

Intervention

- The contractor intervened upon detections and worked with supervisors and sub-contractors to improve safety.

- Evidence based detections were useful for communication.

- Over time, the number of detections decreased and workers showed better safety awareness (E.g. looking up to see if there was any lifted load).

Alerts — Number of alerts across 19 CCTVs

Legend: Worker At Open Edge, Worker Under Load, Exclusion Zone

Source: Ailytics

Public sector construction tenders have increased the emphasis on safety and the adoption of WSH Tech

With effect from 1 April 2024, the minimum weightage for safety-related criteria in public sector construction tenders has been raised to 15% of Quality or 5% of the overall Price-Quality-Method score, whichever is higher.

Public sector construction tenders with contract value of $3 million and above have also included requirements for their contractors to leverage WSH technology.

The WSH technology enhancements include:

i) mature WSH Technology solutions such as **electronic Permit-to-Work (ePTW)** and **vehicular safety tech (VST)** as tender requirements, and

ii) broaden the evaluation criteria of tenders to include **innovative proposals for WSH, such as technology adoption**

For more information, please refer to the MOM website .

Electronic Permit-to-Work (e-PTW) streamlines the PTW process, improving safety and productivity

Permit to Work (PTW) is an authorization system that requires selected high risk/hazardous activities to undergo proper risk assessment, clear task assignment and control to ensure safe execution of work. It is part of a systematic approach to prevent WSH incidents from occurring.

The Electronic Permit-to-Work (ePTW) system customizes and streamlines the work processes according to the contractor/project requirements, enables a consolidated view electronically, as well as increase accountability and productivity.

Examples of how ePTW streamlines the PTW process include:

- Pre-configured checklists with required safety measures appropriate for the different types of high-risk work

- Full visibility of which high risk activities are ongoing and which PTWs have closed, when checking for incompatible works (e.g. hot-works and confined spaces)

- Reduced waiting time, e.g. cuts down time spent on filling out and processing paperwork and facilitates communication to ensure everyone is kept informed on PTW statuses or changes

- Improved safety through audit trail – ensures qualified persons approve the PTW

Safety supervision is more effective with ePTW as compared to using pen and paper

Supervisors can check past ePTW records to improve safety supervision.

Example:
- Does the timestamp make sense? i.e. PTW was applied and approved before work starts
- Are the checklist submitted filled in correctly?
- What is the quality of the write-up? i.e. Can the safety measures in the write-up be seen in the photos?
- Are the workers doing the job trained and qualified to do the job?

Photo-taking is required for each PTW application.

Good photos should show:
- What measures are in place before work starts, i.e. barricades, safety lifeline
- Condition of housekeeping, - slips trips falls risk
- Are there other FFH hazards at the location, i.e. uncovered access opening

Make tracking easier through digitalization.

Record inspection findings, progress report and safety lapses in one place.

The dashboard can show which are the high-risk activities across multiple site/locations so safety supervision can be prioritized to these locations accordingly.

Communicate effectively with workers, supervisors and stakeholders, and build confidence on project delivery.

Graphics from Novade

Vehicular Safety Technology (VST) improves driver's situational awareness and monitors signs of fatigue or distraction

On-road solutions				On-site solutions			
Advanced Driver Assistance System (ADAS)	**Driver Status Monitoring Systems (DSMS)**	**Driver Behaviour Monitoring (DBM)**	**Blind Spot Detection (BSD)**	**Access Control**	**360 Degrees Camera**	**Proximity Warning System**	**Stability Control System**
• Forward Collision Warning • Lane Departure Warning • Headway Monitoring Warning • Pedestrian Detection	Alerts driver of: - Fatigue - Distraction - Smoking - Phone usage	• Speeding • Harsh Acceleration • Harsh Cornering • Excessive Braking	Detects vehicles and pedestrians in blind spots when turning or changing lanes	Authenticates worker before operation of equipment	Provides real-time view of area surrounding vehicle	Alerts driver when a person or an object is too close to vehicle	Ensures lifting equipment lift loads within stability limits

Information on Productivity Solutions Grant (PSG) application and success stories are available on WSHC website

From 1 Jan 2025, newly registered lorry cranes must be installed with Stability Control System (SCS) to enhance safety of lifting operations

From 1 Jan 2025 onwards, all new lorry cranes are required to be fitted with a **stability control system** (SCS).

SCS is a proven technology that can prevent overloading and toppling of lorry cranes by limiting its lifting capacity if the outriggers are not fully extended. Over the past decade, among the lorry crane related dangerous occurrences that have happened, 6 in 10 of them could have been prevented if the SCS had been installed.

Lorry crane owners can apply for funding support to install SCS on their lorry cranes, up to 70% of purchase and installation costs, capped at S$7,000 per lorry crane and S$20,000 per company. This is on first come first served basis.

Find out more at www.go.gov.sg/scsgrant

Robotics solutions can automate specific tasks to reduce worker exposure to fall from height risks

Examples of robotic solutions

The DF062 Wall Finishing Robot can reach heights of up to 6m for grinding, sanding and painting works.

Source: DaFang AI

The Jaibot can reach ceiling heights of up to 5m and high walls of 4.8m for drilling activities.

Source: Hilti

The Drillcorpio can drill Ø5-20mm and drill depth of 130mm for ceilings and walls.

Source: CSC Robo

Robotics solutions can also reduce worker exposure to fatigue, heat exposure and work-related musculoskeletal disorders (WRMSDs)

Examples of robotic solutions

The Effibot can carry loads up to 300 kg to support ad-hoc material transportation around the construction site.

Source: Tag Industrial

The Tomorobo is a rebar tying robot that can tie rebars at locations in under 2.7 seconds in a 200mm pitch with two tying tools.

Source: Ken RoboTech

人と共に働く鉄筋結束ロボット

トモロボ

Tomorobo is robot that works together with people

The Productivity Solutions Grant (PSG) provides funding support for SMEs to adopt digital solutions

Overview

All PSG Solutions

FAQ

for. This should be based on the SSIC that you have registered with ACRA.

Accountancy ⌄

Advanced Manufacturing ⌄

Building & Construction ⌃

For more information, please refer to BCA's PSG website ⧉.

IT Solution

- e-Permit-to-work (e-PTW)
- Quantity Surveying and Valuation
- Coordination Tools and Collaboration Platform
- FM Workflow Automation
- 3D Modelling, Immersive Visualisation & Analysis
- Integrated and Smart Worksite Monitoring and Inspection

View the "Solutions for All Sectors" for more solutions

Overview

All PSG Solutions

FAQ

Solutions for all sectors

Select a category to see its relevant solutions. Companies across all business sectors are eligible for the solutions here.

IT Solutions

Human Resource Solutions ⌄

ERP and Standalone solutions ⌄

Fleet Safety and Fleet Management System ⌃

- Fleet Safety Management System
- Fleet Management System

Document Management and Mobile Access System ⌄

https://www.gobusiness.gov.sg/productivity-solutions-grant/all-psg-solutions/

NTUC Company Training Committee (CTC) Grant provides funding support for companies to embark on business transformation projects that lead to improved worker outcomes (opens from 1 Aug 2022 to 31 Jul 2026)

What It Is
- Supports organisations that have set up CTCs to implement transformation projects
- Provides **funding support** of up to **70% of qualifying project cost**, e.g., equipment, software, consultancy etc.

Who Can Apply
- Entities[1] **legally registered or incorporated** in Singapore - companies, societies, non-profit organisations e.g., charities and social service agencies
- Entities need to form a **Company Training Committee (CTC)** with NTUC

Required Project Outcomes
1. **Enterprise transformation**: Enhanced core business capabilities, innovation and/or productivity.
2. **Workforce transformation**: Improved employment outcomes for local workers (SC/SPR) through efforts such as job redesign and training.
   Commitment to worker outcomes include:
   (i) wage increment; and/or (ii) implementation of Career Development Plan (CDP)

[1] Government bodies, statutory boards, organs of state and wholly-owned subsidiaries are not eligible.

New Enhancements to CTC Grant with effect of 1st August 2024

Expanded definition of "Core Business Capabilities"

- Core Capabilities enhancement under Enterprise Transformation can now **allow workplace safety and health (WSH) projects to be eligible under CTC Grant**[1].

Grant expanded to support training tied to transformation project

- Previously, CTC Grant only funds OEM training.
- The programme can now fund **in-house training** so long as it is tied to transformation project.

[1] Project **must still fulfil the Workforce transformation criteria** (subject to exclusion list).
Exclusion list for safety project components include Helmets, Safety vests, Safety boots, Fire extinguisher.

#EVERY WORKER MATTERS | MEMBERSFIRST WORKERSALWAYS

ntuc
National Trades Union Congress

Technology: Improve Productivity & Workplace Safety
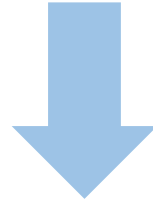

Drone Inspection on building façade
Inspection to hard to reach/ higher risks places

Façade Cleaning Robots
Eliminate falls from height & improve productivity

Video Analytics at the Construction site
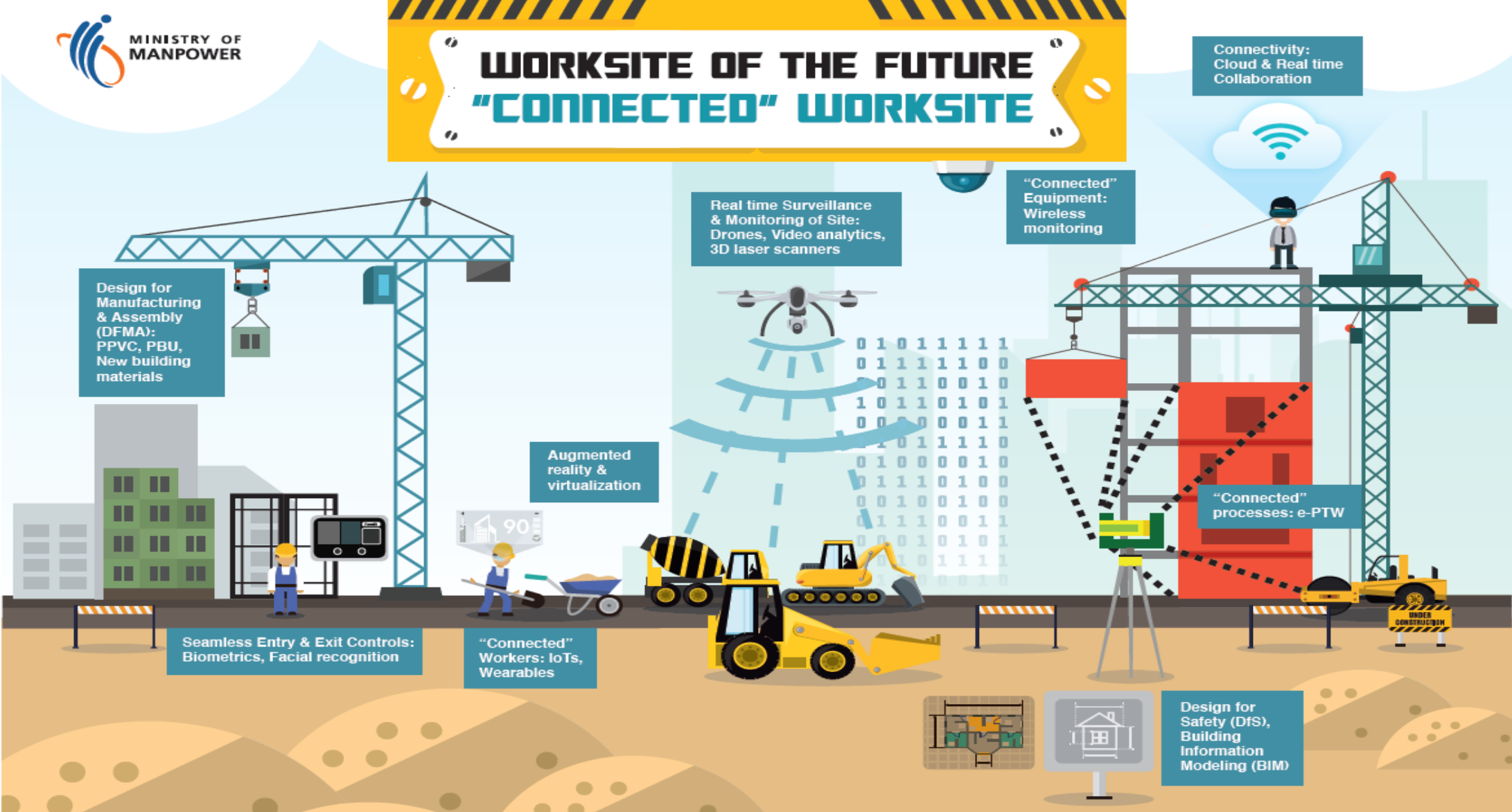Risk detection & construction site monitoring

- **Automate tasks & Improve productivity**
- **Provide opportunities for training & upskilling**
- **Improve workplace safety so as to remove workers from risky activities**

WSH Technology is not the panacea of all WSH issues, but adoption of different technology solutions collectively, can improve WSH

Q & A

Feel free to also contact me at Alvin_tan@wshi.gov.sg.