WORKPLACE SAFETY AND HEALTH (WSH)-TECH SOLUTION TO DETECT AND PREVENT FALLS FROM HEIGHT AND SLIPS, TRIPS AND FALLS IN CONSTRUCTION SECTOR

CONTEXT

Due to high risk activities and a dynamic work environment, the construction sector faces some of the toughest challenges today in managing workplace safety.

The Workplace Safety and Health Institute (WSHI) under the Occupational Safety and Health Division of Ministry of Manpower (MOM) with support from the Singapore Contractors Association Limited (SCAL) is seeking an integrated WSH-Tech solution to detect and prevent falls from height (FFH) and slips, trips and falls (STF), which are the perennial top causes for workplace injuries in the construction sector.

The integrated WSH-Tech solution could use a combination of technology (eg. wearables, video analytics, mobile app) and integrating with backend systems (eg. electronic Permit to Work or risk assessment systems), to detect worksite hazards, unsafe conditions, near misses and unsafe worker behaviour. Upon detection of these hazards and occurrences in real time, the tool would alert the authorized personnel promptly to facilitate early interventions and prevent accidents.

While there are existing solutions such as CCTVs to monitor the worksite and wearables to detect STF and FFH, these solutions have not been widely adopted due to limited functionality. For example, fall detection algorithms are mostly based on hard fall detection, and were not designed to detect a near miss, i.e. worker tripped and almost fell but managed to regain his balance. Video analytics typically only detect whether PPE was worn, but not whether the safety belt or fully body harness was attached to safety lifelines. In addition, some technology solutions require replacement of existing CCTVs.

As such, we are looking for innovations that can enable safety measures and rectifications to be done upstream, to minimise the occurrence of an actual accident. We are also seeking scalable solutions that can be easily deployed (e.g. by tapping on existing infrastructure onsite).

The prototype must also be cost effective, to allow large scale deployment and be sustainable for business operations. Features can be modular, to allow users to start small, with low initial investment but have the ability to progressively scale up to cover more locations or to include more functionalities in the future. To facilitate this, the problem solver will be working closely with test bed firms in the Construction industry to shape the prototype design, including its UI/UX, and the accuracy of the technology solution.

PROBLEM STATEMENT

How might we automatically detect fall-from-heights and slip-trip-fall risks, near misses and alert authorised personnel for prompt intervention, to improve safety in construction sites?

WHAT ARE WE LOOKING FOR?

A scalable prototype solution that can be deployed, quickly and economically, in a dynamic construction site environment. It should automatically detect and alert authorized personnel of FFH and STF hazards, incidents, near misses, unsafe working conditions, and unsafe worker behavior in real time, to facilitate early interventions and prevent accidents. The solution should allow users to incident/hazard manage, such as customize their escalation channels for alerts based on the incident type, and track follow-up actions. Using information of where the hazards are and which workers are performing unsafe acts and where the unsafe conditions exist, the project manager/ supervisor can then engage the contractor to remove hazards or correct workers' risky behaviours.

Below are some of the key functions of the WSH-tech solution to help construction firms detect and track the removal of potential FFH and STF risks:

1. **Worksite hazards and unsafe conditions**
   - Identify potential FFH hazards such as open sides, unsafe barricades, uncovered openings, openings not properly secured, scaffold work platform with no or improper guard-rails, ladder not extended 1m above landing zone
   - Identify potential STF hazards caused by poor housekeeping, wet or slippery surfaces, obstruction to walkways and paths
   - Detect STF, FFH and near misses and alert supervisors

2. **Unsafe worker behaviour**
   - Detect workers working at height without proper use of travel restraint system or fall arrest system or failing to attach the safety belt or full body harness to safety lifelines
   - Detect workers using improper means to reach heights, such as using forklifts or excavators
   - Detect workers removing barricades or climbing over barricades
   - Detect workers not using destinated safe routes to access worksite locations
   - Provide on-demand footage for supervisors to observe how their workers are working

The solution could be using a combination of wearables, video analytics, mobile app, integrating with backend electronic Permit to Work and risk assessment system.

The problem solver should illustrate in their proposal, how the solution meets the following criteria:

Cost effectiveness

- **High return of investment:** There must be a clear value proposition for construction companies to adopt the solution in the form of productivity improvement or cost savings.

- **Low initial investment with the possibility to scale up:** The solution should be deployable to a sizeable number of workers in a worksite. It should ideally be modular and allow users to start small, with low initial investment but have the ability to progressively scale up to cover more locations or to include more functionalities.

User interaction

- **Friendly UI and low administrative effort:** The user interface should be intuitive and require low administrative maintenance. There should be minimal data entry from users.
- **Easy to use:** The solution must be easy to use for both workers and supervisors. It should not create extra work for them but aim to augment productivity and safety instead.

Robustness and functionality

- **Easy to deploy and do not pose additional hazards:** The solution hardware (if any) must not be bulky or become a hazard, e.g. as a STF hazard, distract workers and supervisors or clutter walkways. Wearable components (if any) should not impede movement of workers or their ability to perform tasks.
- **Effective in areas with poor/no network connection:** Some areas in the construction site have poor/no network connection, e.g. underground construction or enclosed space. The solution should account for such scenarios and consider techniques such as edge processing to reduce the amount of data transmission.
- **High accuracy:** The detection algorithm must have high accuracy with low false positive rates, to give confidence to users that alerts are worth following up. False negative rates should also be low, especially for detection of FFH or STF incidents, as it is critical for prompt assistance to be rendered to a worker who had suffered a fall. Its algorithm should incorporate machine learning capability, so that accuracy can be improved over time, and the solution can be easily and effectively deployed across different construction sites.
- **Account for poor lighting and other site conditions:** The solution should consider conditions whereby lighting/visibility is poor. Other environmental conditions that may affect technical performance of the solution include heat, loud noises, vibration, dust, wind and rain.

Data security and system integration

- **Compatibility with existing systems:** The solution should not require users to revamp their existing systems or infrastructure. For example, any video analytics solution should be able to work on existing cameras on site. If edge processing is required, the solution provider must provide an integration method for existing CCTVs.
- **Potential for integration:** The solution can factor in other digital solutions that the construction site may be using, such as electronic Permit to Work (ePTW), risk assessment system or worker tracing technologies for potential leverage and integration with such systems for a more effective system overall.

- **Easy data extraction:** The solution should allow users to draw data for insights and data analytics.
- **Ethical use of data:** If the solution involves data collection and personal data, it must comply with relevant ethical standards and regulations like the Personal Data Protection Act.

There are no restrictions on the geographical location of the problem solvers who may choose to apply to this challenge. However, the POC/prototype must be demonstrated in Singapore.

POSSIBLE USE CASES

1. **Risk of falling from height** – A CCTV with vision analytics was overseeing an area where high risk activities were being carried out. It detected that a worker working at height removed a safety barrier. He also did not attach his fall harness to the safety lifeline. An alert was sent to the supervisor, with a short clip of the risky worker behaviour. The supervisor received the notification on his mobile phone and took action to prevent a potential accident.

2. **Risk of slips, trips and falls** – The worker was carrying a wearable that could detect STF near misses. He tripped over a plank while carrying objects but managed to regain his balance and not fall. An alert, together with an image of the scene was sent to the supervisor. The supervisor investigated the cause of the STF near miss and found out the area had planks lying which could be STF hazards. He instructed some workers to tidy up the place to prevent an STF from happening.

WHAT'S IN IT FOR YOU

- SGD 50,000 of prize money for each winner of this challenge (see Award Model)
- Gain access to IMDA's Technology resources and facility for prototyping
- Gain access to industry mentors and domain experts
- Support WSHI/MOM as the problem owner and SCAL as the industry partner to drive industry solution and fast-track visibility to industry players
- Opportunity to work with multiple contractors as test-bed partners
- Opportunity to test prototype solution at up to 5 construction sites

EVALUATION CRITERIA

The Applicants shall be evaluated in accordance with the evaluation criteria set out below.

Solution Fit	• To what extent does the proposed solution address the problem statement effectively?
Solution Readiness	• How ready is the proposed solution to go to the market? • Is there any evidence to suggest capacity to scale?

Solution Advantage	• Is the solution cost effective and truly innovative? • Does it make use of new technologies in the market, and can it potentially generate new IP? • To share estimated cost for pilot trial, deployment, and software support.
Company Profile	• Does the product have user and revenue traction? • Do the team members possess strong scientific/technical background? • Is the company able to demonstrate financial capability and resources to complete the prototype?

AWARD MODEL

30% of the prize money will be awarded to each selected finalist at the start of the POC/prototype development process, with the remainder 70% to be awarded after completion of the POC/prototype solution, based on milestones agreed between Problem Owner(s) and the solver. Prize money will be inclusive of any applicable taxes and duties that any of the parties may incur.

Note that a finalist who is selected to undertake the prototype development process will be required to:

- Enter into an agreement with Problem Owner(s) that will include more detailed conditions pertaining to the prototype development.
- Complete an application form with IMDA that will require more financial and other related documents for the co-funding support.

Teams with public research performers are required to seek an endorsement from their respective innovation and enterprise office, and submit the attached IEO form together with the proposal.

DEADLINE

All submissions must be made by **29th October 2021, 1600 hours (SGT/GMT +8)**. Problem Owner(s) and IMDA may extend the deadline of the submission at their discretion. Late submissions on the OIP, or submissions via GeBIZ, will not be considered.