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Research Planning and Programmes
Department
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Circular to Professional Institutes / Associations

Dear Sir / Madam,

BUILDING AND CONSTRUCTION AUTHORITY GRANT CALL ON INSPECTION ROBOT FOR ADVANCED CONSTRUCTION INDUSTRY

1. OBJECTIVE

- 1.1 The Building and Construction Authority has launched the grant call for the Inspection Robot for Advanced Construction Industry supported by the MND Research Funding (MNDRF).

2. BACKGROUND

- 2.1 In the construction industry, various building inspections are carried out to deliver quality products that meet both statutory and customer's expectation.
- 2.2 The Construction Quality Assessment System or CONQUAS was developed by the Building and Construction Authority (BCA) to measure the quality level in a completed project and will be used as a reference to measure how the inspection robot improves assessment effort in a building inspection.
- 2.3 Architectural finishing inspection is labour intensive and requires significant assessment effort due to its repetitive inspection checks.
- 2.4 Architectural Finishing Inspection
In a typical CONQUAS Internal Finishes assessment, a team of 2 Quality Assessors (QA) are deployed to site to check the quality of the following items:
- Floor
 - Internal Wall
 - Ceiling

- Door
- Window
- Components (Example: Wardrobe, kitchen Cabinet, vanity top, mirror, bathtub, water closet, shower screen and basin)
- M&E Basic Fittings



2.5 For a residential building, both the QAs will assess their respective items concurrently at each location (living room / bedroom / kitchen / etc) within an apartment unit. The 1st QA will check the door, window, components and M&E basic fittings for any visual and functional defects and the 2nd QA will assess the floor, internal wall and ceiling using hand held tools (1.2m Spirit level, set square and tapping rod). A team of 2 QAs would be able to assess about 8 to 10 units of a typical 3 bedroom apartment unit in a day (8 hours).

Internal Finishes Assessment		
	1 st QA	2 nd QA (Propose to replace with robotics technology)
Items be to assessed	Door	Floor
	Window	Internal Wall
	Components	Ceiling
	M&E Basic Fittings	

3. SCOPE OF GRANT CALL

- 3.1 The key focus area of this grant call is to develop the **inspection robot to perform the role of the 2nd QA** and objectively assess the workmanship quality of the floor, internal wall and ceiling against CONQUAS workmanship standard and specification. Please refer to the **Annex 1A** attached taking reference from the CONQUAS standards for architectural works. This will improve the assessment manpower by at least 50%.
- 3.2 The robot may similarly be used by a contractor or other quality inspection teams to assist them in their quality checks.
- 3.3 Functional Requirements of Inspection Robot:

- 1) The Inspection Robot that is envisioned in this grant call is one where sensing and analytical technologies are integrated into an autonomous/semi-autonomous platform that is suited for the quality inspection of work done at construction sites. It should also be able to use BIM model and link to the actual site, navigate into different rooms within each apartment unit.
- 2) The robot must be compact, lightweight (preferably less than 5kg), portable and autonomous / semi-autonomous and equipped with inspection tools, with the capability to self-maneuver and overcome possible obstacle around the targeted inspection area.
- 3) The fully equipped robot must be able to withstand harsh condition such as dust, rough terrain, direct sun and drizzles at construction sites.
- 4) The robot must have a provision for plug-and-play inspection tools where each combination of tools is customised for quality checks during different stages of construction.
- 5) The robot must be able to capture, store, transfer and analyse field measurement data to conclude compliance against given requirements (Project specifications and CONQUAS standards).
- 6) The robot to be able to compile inspection findings (with photos) and generate a report on site for contractor/consultant to follow-up on the comments. The report should also contain layout plan showing the locations of defects detected. This report will be sent to all stakeholders within 2 hours after inspection.
- 7) A software platform with image analytical tool will be developed to store and analyze the transferred scanned image data. The robot should be able to perform predictive data analytics using artificial intelligence and past inspection data to improve the algorithms to identify defects. Site inspectors should be able to access the information remotely from their handheld device.
- 8) For Architectural stage, Robot should be able to perform the following checks on Floor, Wall and Ceiling:
 - a) Surface finishing and tonality
 - b) Surface alignment & evenness and tile lippage
 - c) Crack and damage (e.g Chip tiles, scratch tiles and stains)
 - d) Hollowness in screed, concrete, tiles or natural stones
 - e) Delamination of timber flooring
 - f) Assess neatness and consistent width of tiling joints / pointing
 - g) Overall cleanliness of unit

CONQUAS criteria can be used as a guide for the above checks.

- 9) The technologies to be considered but not limited to are:

- a) Radio Frequency Technology that breaks through known barriers, bringing highly sophisticated sensing capabilities
- b) Laser Level Technology
- c) Ultrasound Technology
- d) Mobile Imaging System/ Technology

4. ELIGIBILITY

- 4.1 This call is open to Institutes of Higher Learning (IHLs), Research Institutes, private sector companies and not-for-profit organization.
- 4.2 Project shall involve researchers from academic or research organisations to collaborate with at least one relevant industry partners or government agency.
- 4.3 The project should use Singapore as a base to own, manage and exploit all intellectual property right developed.
- 4.4 Project must not have commenced at the time of application.

5. FUNDING SUPPORT

- 5.1 IHLs, research institutes and not-for-profit organisations would qualify for up to 100% funding support of approved direct qualifying costs of a project. Only IHLs and not-for-profit entities would be allowed support for indirect costs. These include up to 20% of qualifying costs for overhead costs.
- 5.2 Private sector companies **would qualify for up to 70% of funding support** of the approved direct qualifying costs of a project.
- 5.3 Proposals should not be funded or be currently considered for funding by other agencies.
- 5.4 Funding awarded cannot be used to support overseas R&D activities. All funding awarded must be used to carry out the research activities in Singapore unless approved in the grant.
- 5.5 There is no cap per project but PIs are requested to propose reasonable budget vis-à-vis the scope of the work and over budgeting is highly discouraged. Project duration should **not be more than 24 months**.

6. SUBMISSION

- 6.1 All applicants have to submit the proposal using the attached proposal template.
- 6.2 All applicants must send in **2 hard copies and 1 electronic copy** of duly signed proposals by **12 April 2017, 1200hrs Singapore time (GMT +08:00)** to the following:

BCA R&I Grant Secretariat
c/o Building and Construction Authority
Research Planning & Programmes Department
200 Braddell Road
ZEB Level 3
Singapore 579700

7. EVALUATION PROCESS

- 7.1 All proposals received by the BCA R&I Grant Secretariat will be submitted to the Technical Evaluation Panel (TEP) for evaluation. The TEP which comprise representatives from public agencies and industry will evaluate and recommend (to award or decline) each proposal.

8. RESULTS

- 8.1 Successful proposals which are accepted and approved by BCA will be notified by **Q3 2017**.

9. INFORMATION

- 9.1 The full details of the scheme and application form can be separately obtained through the below contact,

Mr Tan Lian Huat at Tan.Lian.Huat@bca.gov.sg

Thank you.



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