Phase 2 Statement Theme	Digitalisation
Statement number	3
Launch Date	04 August 2020
Closing Date for submission	14 September 2020

Title	Automated Model Design Checker
Background	Apart from giving rich data for operations and analysis, Building information Modelling (BIM) models are also powerful for portraying the physical representation of the building. Designers, builders and owners will be able to walk-through the building to discuss and agree on design intent, ability to meet the owners' needs and iron out construction challenges. JTC has a set of Architectural, Civil & Structural, Mechanical & Electrical Building Design Requirements (BDRs) to make clear the design considerations that are to be met and to provide standardised essential building elements & quality of finishes for all JTC industrial buildings. The designers and builders use the BIM model to demonstrate that the building design is aligned with JTC's requirements.
Challenges	The BDRs' rules could number up to several hundreds. In order to check the adherence to these requirements, the human checker will need to keep in mind the huge pool of rules while navigating the entire development, from room to room, corner to corner. This process is tedious and rules are prone to be missed in the process. Being a repeatable task for large volume sets, this is an ideal task to be made automated. However, in contrast to checking of data which are text-oriented, majority of design checks are geometric in nature and require geometric methods to check accurately. For instance, a check of building height (a critical rule for aviation) is more accurate when geometrically evaluated instead of merely reading off a height value which can be entered manually and not updated subsequently. At present, geometric methodologies applied to building requirements checking are lacking. In addition, building requirements are in human language and open to misinterpretation. It requires further clarifications, or codification, for them to be turned into computer logic and enable rule based checks to be combined with geometric methods. (e.g. In order to check a rule to "provide sufficient airflow for a particular space" may be to find the percentage of openings for that space). As with model data checks, while models can be worked on by different disciplines in parallel before being combined in a centralised model to increase productivity, the way the same objects and spaces are modelled are not standardized varying from modeller to modeller. This makes identification of objects to be checked more difficult.
Desired Outcomes	To have a self-service system to allow models to be checked automatically, reliably and accurately for non-compliances to JTC's building design requirements. Designers and modellers can try checking at their own time and select the categories of rules they want to check whenever they complete parts of the model

	to find problems upfront. Issues found can be visualised for users to understand the underlying reason of non-compliance without doubts. These issues can be automatically highlighted and tracked directly back in their native modelling software. Designers and modellers can be guided on a standardised way which is based on industry best practices as they model to smoothen the modelling and checking process. The modelling guides shall be intuitive and not overly onerous to suit checking. The system owner can continually create new rules and edit existing rules for long term maintenance. Through use of the system, the system owner can also retrieve information to perform targeted analysis by building elements and trend these information in a time series analysis. The system shall enable the submitted models as a data source for other systems to make use of the BIM information submitted.
Requirements	• The proposal shall contain enough details to illustrate and convince on how the problem statement is achieved. Details such as specific steps for geometric verifications, manipulations and pseudo object generations to achieve the accuracy of the specific checking results, in addition to reading the parameter values. • Platform and/or rules shall support data requirements from JTC's Employer's Information Requirement (EIR) and fulfil model elements from JTC's Model Content Plan (MCP) (Please refer to **Annex A**) and BDR (Please refer to **Annex B**), both of which references datasets in the Asset Information Model (AIR). • All rules shall be defined clearly after consulting JTC's subject matter experts. • The methodology of design checking shall be based on geometry and space as far as possible, and shall be approved by JTC's subject matter experts and appointed partners. • Modelling requirements shall be intuitive and approved by JTC's subject matter experts and appointed partners. • Rules shall be easy to create, replicate, edit and rolled back to previous versions. • Organisation of rules shall be intuitive in extensive categories, groupings and templates. • Issues flagged out by the checks shall be actionable in the native software. • The solution shall be scalable to cater for increasing needs by JTC and ecosystem stakeholders (e.g. Architecture, Engineering and Construction industry). • Reporting function for rules and checks. • Dashboards that support time-series and cross project trending. • Interconnectivity with other systems to exchange information through open, documented Application Programming Interfaces (API). • Support Revit and IFC formats. • Audit trail for all committed actions in the solution(s). • Caters for JTC and Instruction Manual 8 (IM8) Security and Data Handling Requirements.

Possible Solutions	Applicants are encouraged to propose ways to address the problem statement. One possible set of solutions is as follows: • A server based interface for submission • A back-end checking engine • An interface for rules management and manipulation • An interface for visualization • Semi-automated tools (plugins) for Revit software • Modelling guides • A reporting & dashboard module • Set of APIs for data extraction and connectivity
Development Timeframe	Applicants are encouraged to propose phases of development and delivery. The total project delivery period shall not exceed 12 months. A proposed timeline is as follows: a) 6 months: Capabilities for Geometric Checks, Manage Rulesets, Rules Modification, Design Guides, Issues Visualization and Reporting; and b) 6 months: Capabilities for Complex Checking on Inferred Elements, Space & Zones, Automated BIM authoring tools As shared in the project agreement, we would like to continue to develop and scale up the solution with successful applicants to support JTC's operational needs. Some expected developments are as follows: • Capabilities for interoperable API, dashboarding • Data analytics & Interoperability for operational use cases • Scale to deliver all identified rules in JTC's BDRs • Cater to JTC's data handling & IM8 requirements
Additional Info	NIL