KPMG ORIGINS

Building Trustworthy Indicator

Methodology version v1.0

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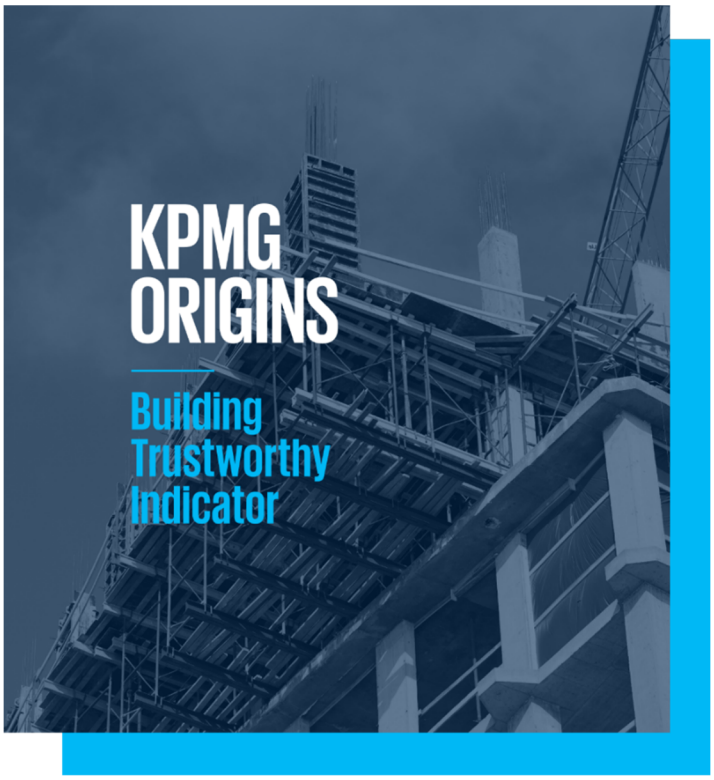
Contents

Glossary

Building Elements	One of the five key system groupings that have the greatest impact on quality and safety of a building. Includes structure, fire safety systems, building enclosure, waterproofing, and building services.
Check	Describes a requirement, condition, analysis, or assessment that must be satisfied for a given construction system to calculate a BTI score.
Class 2 Buildings	Defined by the NCC as a building containing two or more sole-occupancy units; they are typically multi-unit residential buildings.
Class 9b Buildings	Defined by the NCC as an assembly building in which people gather for social, religious, political, or civil purposes, including schools and public transport facilities.
Construction Systems	Building elements that are made of a particular material and/or provide a specific function for building performance.
iCIRT rating	Independent Construction Industry Rating Tool. An independent five-star rating system developed by Equifax to rate players involved in building construction.
Non-rated	A BTI score that indicates that a building has been constructed and/or designed to regulatory requirements.
Trustworthy	A BTI score that indicates confidence in the design and final construction of a building.

Abbreviations

BTI	Building Trustworthy Indicator
CC	Construction Certificate
DA	Development Application
NCC	National Construction Code
OC	Occupation Certificate



1. OVERVIEW

The Building Trustworthy Indicator (BTI) is a market-led digital product that enables the differentiation between trustworthy and non-trustworthy built assets and can bring transparency to building construction processes. This document provides an overview of the BTI methodology and describes the approach that KPMG has used to create the model that powers the indicator.

2. BACKGROUND

2.1 Reduced Confidence in the Sector

The building industry is facing reduced consumer confidence and trust due to a number of recent industry scandals. A significant number of post-completion defects lead to increased maintenance and ownership costs. Insufficient transparency reduces the ability of insurers and financiers to accurately price risk at an asset level and results in higher financing and insurance costs. A means to differentiate between two built assets will enable informed consumer choices, differentiations for developers, builders and trade practitioners, and empower insurers, financiers and regulators to leverage data in their decision-making processes.

2.2 The Building Trustworthy Indicator

In 2021, KPMG Origins, in partnership with the Office of the NSW Building Commissioner and the Department of Customer Service, introduced the Building Trustworthy Indicator (BTI) as a way to differentiate between buildings.

This differentiation is based on combining data about the participants (who), construction materials (what) and certificates/documents (how) involved in the building development across design, construction, and commissioning.

For each building, data about the who, what and how is captured for each of the individual building components and construction elements (e.g. substructure, superstructure, etc.). The data is provided by the construction team participants and reviewed by the developer and builder.

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WHO: Participants

BTI captures key members of the construction team (developer, builder, building practitioners, trade contractors) and uses an established measure of player trustworthiness to determine their historical performance. Currently the iCIRT rating by Equifax is used to determine performance of individual players contributing to the design and construction of a building.

WHAT: Materials

BTI captures information about the materials used in a building and their adherence to appropriate standards and regulations.

HOW: Certificates

BTI captures information about how the building was constructed, collating documents and certificates across design, construction, and commissioning that are provided to demonstrate adherence to appropriate standards, regulations, and relevant QA processes.

Use of BTI is not mandated or regulated at this stage but is instead a market-driven tool created in collaboration with the industry, and can give consumers, insurers, and financiers the ability to differentiate between trustworthy and non-trustworthy built assets.

3. SCOPE

The BTI generates a measure of trustworthiness for built assets during its design and construction based on data provided by the construction team. Currently the following buildings are covered by BTI:

- **Class 2** (multi-unit residential buildings) completed from 2017 onwards (subject to data availability).
- **Class 9b** (schools and social assembly buildings) completed from 2017 onwards (subject to data availability).

Current regulatory requirements used in the BTI are in line with the Australian National Construction Code (NCC) and the NSW Design and Building Practitioners Act 2020.

In consultation with industry, the KPMG Origins team continues to work to extend BTI support to other classes and buildings completed prior to 2017.

4. EXPLAINING THE INDICATOR

The BTI provides measures of trustworthiness at both the design stage (**Trustworthy As Designed**) and final construction stage (**Trustworthy As Built**). This section explains the means by which a trustworthy indicator can be achieved, however, it should be noted that there are multiple means of obtaining an indicator via alternative combinations of evidence different to that shown. A detailed explanation of the calculation methodology is provided in Section 7.

4.1 Trustworthy As Designed

A preliminary BTI score calculated at the design stage to indicate the trustworthiness of the design after a Construction Certificate (CC) has been issued. At this stage of the building development cycle the who, what and how of the design process is used as an input from the construction team to calculate this score.

Figure 4-1. Definition of the Trustworthy As Designed BTI score

Non-rated: Design meets regulatory requirements.

A building design is given a *Non-rated* designation when data is provided that demonstrates how it meets regulatory requirements as stated by the governing jurisdiction. This includes declared design drawings, and any certificates/documents that form part of the Development Application (DA) and Construction Certificate (CC) process. Materials must also be specified in the system for traceability. This level is used as a baseline for the calculation of the *Trustworthy* score.

Trustworthy: Confidence in design to a trusted level of standard beyond regulatory practice.

A building design is scored as *Trustworthy* if the following conditions are met, based on self-reported data:

i. Evidence of achievement of regulatory design requirements is provided.
ii. Players involved have a proven track record of capability, integrity, and reputability in their field in the form of an iCIRT rating.
iii. Comprehensive review of design must be demonstrated by providing self-reported evidence of the rigorous internal review processes put in place OR participants have a high iCIRT rating (+60).
iv. Materials intended for the building must be verified by the construction team that they meet regulatory compliance. Data about materials helps define overall durability, endurance, and trustworthiness of the final built asset.

4.2 Trustworthy As Built

Trustworthiness of the final constructed building is indicated by measuring the who, what and how of both the design and construction process. Basic measures and evidence that is added to the system are calculated as *Non-rated* if the data demonstrates compliance with standard regulations. If measures and evidence are provided that go beyond standard regulation, then the building is scored at three different levels: *Trustworthy* (3 stars), *Leading* (4 stars), and *Benchmark* (5 stars).

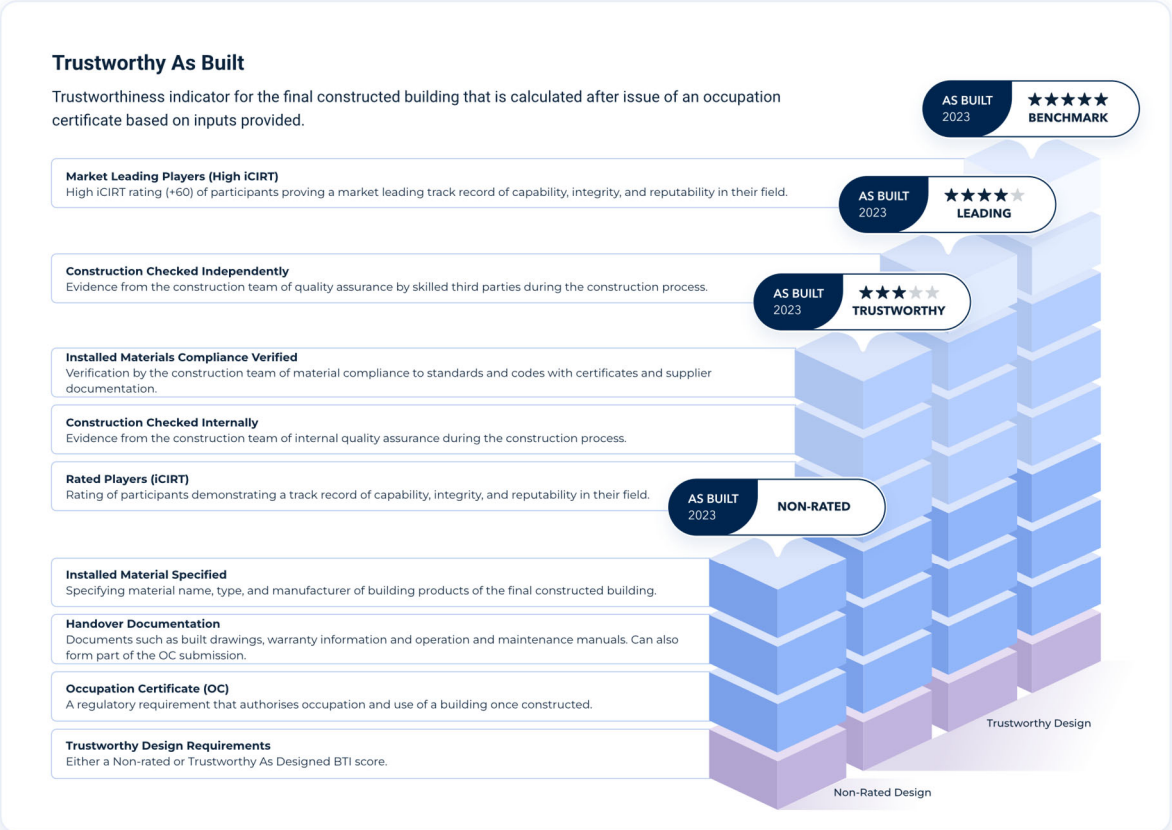


Figure 4-2 Definition of the Trustworthy As Built BTI score

Non-rated: Design and construction meet regulatory requirements.

A building design is given a *Non-rated* designation if the following criteria have been met, based on self-reported data:

i) Design to regulation (a *Non-rated* as designed score as described in section 4.1).
ii) Compliance with Occupation Certificate (OC) requirements and regulation.
iii) Building handover documentation (such as as-built drawings and operation and maintenance manuals) is provided.
iv) Specification of materials in the final constructed building for traceability is added.

Trustworthy ★★★: Confidence in design and construction to a trusted level of standard beyond regulatory practice

A fully constructed building is deemed to be *Trustworthy* if the following criteria are met, based on self-reported data:

i) A trusted design (a *Trustworthy* as designed score as described in section 4.1).
ii) Construction to regulation (a *Non-rated* as built score).
iii) Verification by the construction team of material compliance to standards and codes demonstrated by material certificates, testing approvals and/or documentation from suppliers.
iv) Players involved have a proven track record of capability, integrity and reputability in their field in the form of an iCIRT rating.
v) Evidence collected and uploaded by the construction team of internal quality assurance during the construction process is provided.

Leading ★★★★: Confidence in design and construction to a market-leading level of excellence

A fully constructed building is deemed to be *Leading* if the following criteria have been met:

i) A trusted design (a *Trustworthy* as designed score as described in section 4.1).

ii) Construction to regulation (a *Non-rated* as built score).

iii) Verification of material compliance to standards and codes demonstrated by material certificates, testing approvals and/or documentation from suppliers.

iv) Players involved have a proven track record of capability, integrity, and reputability in their field in the form of an iCIRT rating.

v) Evidence collected and uploaded by the construction team of quality assurance by skilled third parties during the construction process is provided.

Benchmark ★★★★★: Confidence in design and construction to an industry benchmark level of excellence

A fully constructed building is deemed to be at *Benchmark* if the following criteria have been met, based on self-reported data:

i) A trusted design (a *Trustworthy* as designed score as described in 4.1).

ii) Construction to regulation (a *Non-rated* as built score).

iii) Verification by the construction team of material compliance to standards and codes demonstrated by material certificates, testing approvals and/or documentation from suppliers.

iv) Evidence collected and uploaded by the construction team of quality assurance by skilled third parties during the construction process is provided.

v) Players involved have a proven track record of capability, integrity and reputability in their field in the form of a high iCIRT rating (+60).

5. BTI INPUTS

5.1 Building Configuration

The BTI collects data across five key building elements that have the greatest impact on the quality and safety of a building: a) structure, b) fire safety systems, c) building enclosure, d) waterproofing, and e) building services. Users can then configure their building by selecting construction systems and specifying the materials used across these five building elements. Once a building is configured, a checklist is populated across the building elements, with each 'check' describing a requirement, condition, analysis, or assessment that must be satisfied for each construction system.

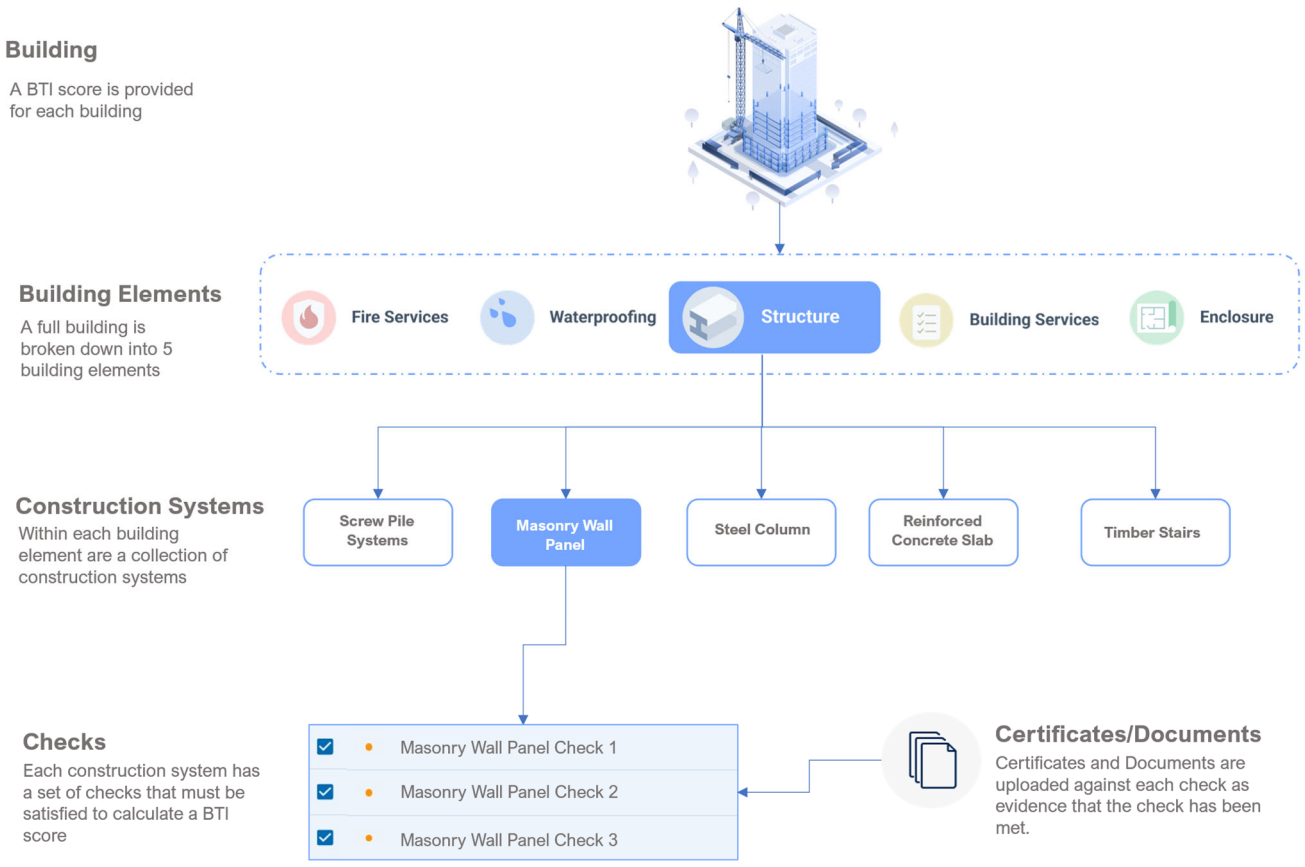


Figure 5-1 Overview of building configuration including building elements, construction systems and check

5.2 Certificates and Documents

Data, in the form of documents and certificates, must be uploaded against each check as evidence that the requirements of the check have been met. BTI itself does not verify the validity of the evidence but serves as a method to capture the inputs for the calculation. By uploading data to each check, the check is considered ‘complete’ and contributes to the overall building indicator score. The calculated score is also affected by the source, independence, and authority of the author of the document/certificate. A building is therefore deemed trustworthy if uploaded data aims to demonstrate that the building has been designed and built with a level of excellence that extends beyond standard regulatory practices.

5.3 Trustworthy Players (iCIRT)

A key input required for the BTI score is an iCIRT rating, a system developed by Equifax that measures the trustworthiness of participants based on their historical performance. The BTI score for a built asset is calculated by considering the iCIRT rating of the developers and builders that were involved in the design and construction of the building. To earn a trustworthy score, a participant must have an iCIRT rating. As the iCIRT system expands to further incorporate designers and trades, the BTI will consider these additional players in the indicator calculation.

6. DOCUMENT REQUIREMENTS

To improve an asset's BTI, evidence in the form of documents and certificates must be uploaded to each check, evidence of which is generated throughout the design and construction of a building.

6.1 Document Types

The following documents can be uploaded to complete a check:

- Audit/Review Report
- Calculation/Simulation Report
- Compliance Certificate/Declaration
- Construction Certificate (CC)
- Data Sheet
- Development Application (DA)
- Discipline/Consultant Report
- Drawings and Specifications
- Handover Documentation
- Inspection Report
- Installation Certificate
- Inspection Test Plan (ITP)
- Manufacturer Report/Certificate
- Occupation Certificate (CC)
- Technical Approval
- Testing Certificate
- Warranty Documentation

6.2 Document Data Requirements

The BTI system captures self-reported data and details associated with each certificate, material and document uploaded against an item in the checklist to demonstrate confidence in the document and calculate the BTI.

The following data requirements (referred to as the document attributes in later sections) must be specified for each document:

a) Document Type: As specified in Section 6.1

b) Author Role: Indicates the level of authority of the author of the document.

c) Approver Role: Indicates the level of authority of the approver of the document

6.3 Material Data Requirements

6.3.1 Material Specification

Materials must be specified for each construction system for traceability. These materials can be found in or added to the 'Product Catalogue'. To do so, the following are needed: a) Name of the product, b) Type of material, c) Name of the manufacturer and d) Place of manufacture.

6.3.2 Material Verification

Additional performance information can also be provided to enhance a BTI score. Such information is required to enable the construction team to verify that materials meet regulatory standards and can be uploaded to the system in the form of documents such as testing certificates, material data sheets or technical approvals. Document attributes as specified in Section 6.2 must also be defined for any documents used by the construction team to verify materials.

6.4 Validation of Checks with Documents

Each construction system has a set of checks associated with them, and these checks must be satisfied for the calculation of a BTI score via the upload of documents against each check. An example is shown below of a masonry wall panel construction system:

i) Table 6-1 shows checks with possible document types and what requirement that check meets for the *Trustworthy As Designed* indicator described in section 4.1.

ii) Table 6-2, Table 6-3 and Table 6-4 show checks with possible document types and what requirement that check meets for the *Trustworthy As Built* indicators described in section 4.2.

Table 6-1 Checks to satisfy Trustworthy As Designed requirements for a masonry wall panel construction system

Checks	Documents	Indicator Requirement	BTI Score
Specify Materials	In-built system product Catalogue (section 6.3.1)	Design Materials Specified	AS DESIGNED 2023 NON-RATED
Compliance declaration/certification that the structural design conforms with relevant building codes and Australian Standards	Development Application (DA) Construction Certificate (CC) Compliance Certificate/Declaration Drawings and Specifications	Development Application (DA) Construction Certificate (CC) Declared Designs	
All materials in approved design conform to relevant Australian Standards and building codes.	Data Sheet Manufacturer Report/Certificate Testing Certificate Technical Approval	Design Materials Compliance Verified	AS DESIGNED 2023 TRUSTWORTHY + NON-RATED
Note: Only one of the following checks needs to be completed to achieve a Trustworthy score			
Proof that design drawings, including plans and elevations, clearly indicate the structural framing and element layout, structurally critical dimensions, reinforcement, strands and concrete cover required for in- service loads and conditions, and connection locations.	Audit/Review Report Calculation/Simulation report Discipline/Consultant Report	Comprehensive design review Trustworthy players (iCIRT)	
Proof of detailed design addressing appropriate tolerances allowed for under relevant building codes and Australian Standards.	Drawings and Specifications		

Table 6-2 Checks to satisfy Non-rated and Trustworthy As Built requirements for a masonry wall panel construction system

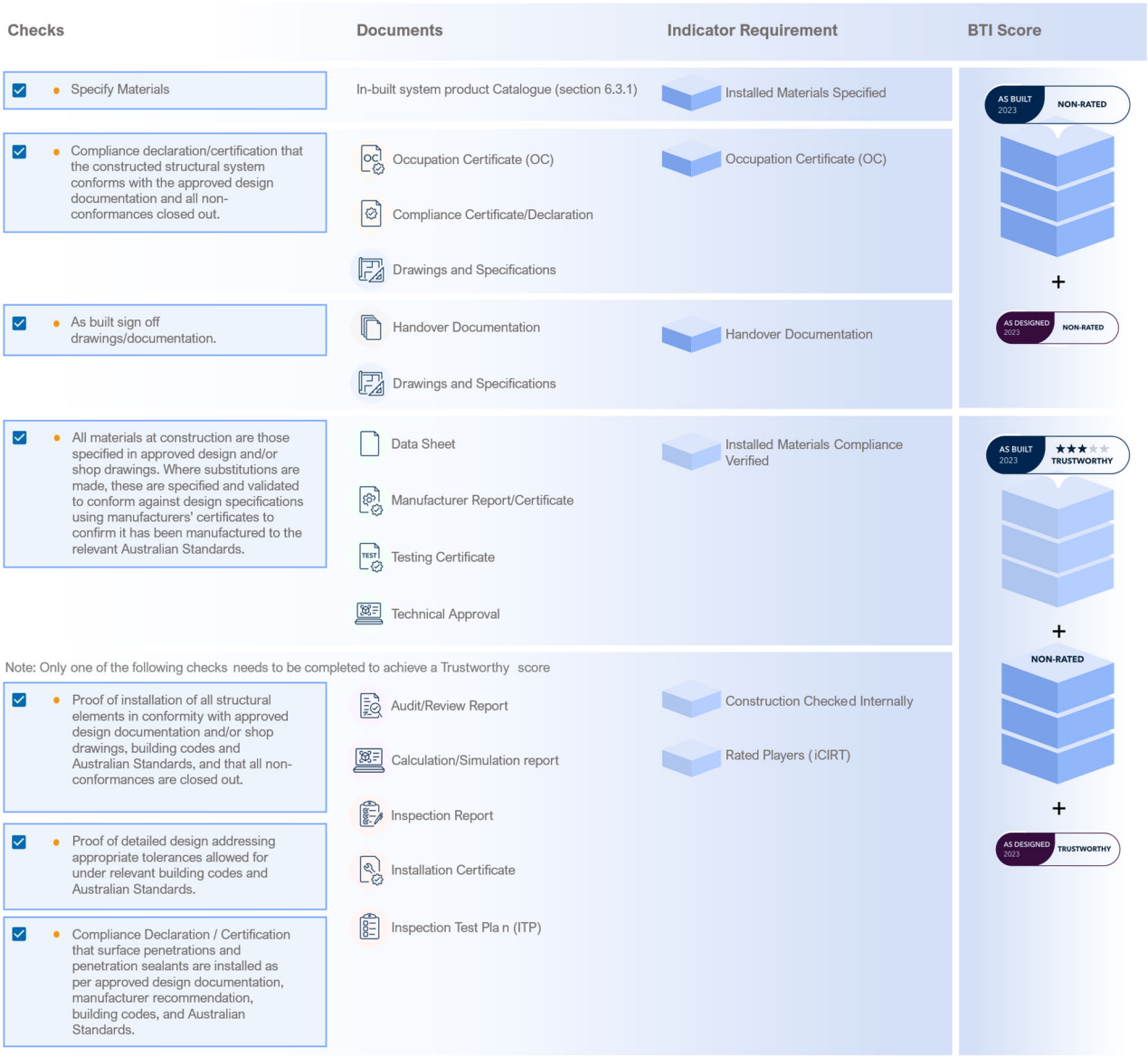


Table 6-3 Checks to satisfy Leading As Built requirements for a masonry wall panel construction system

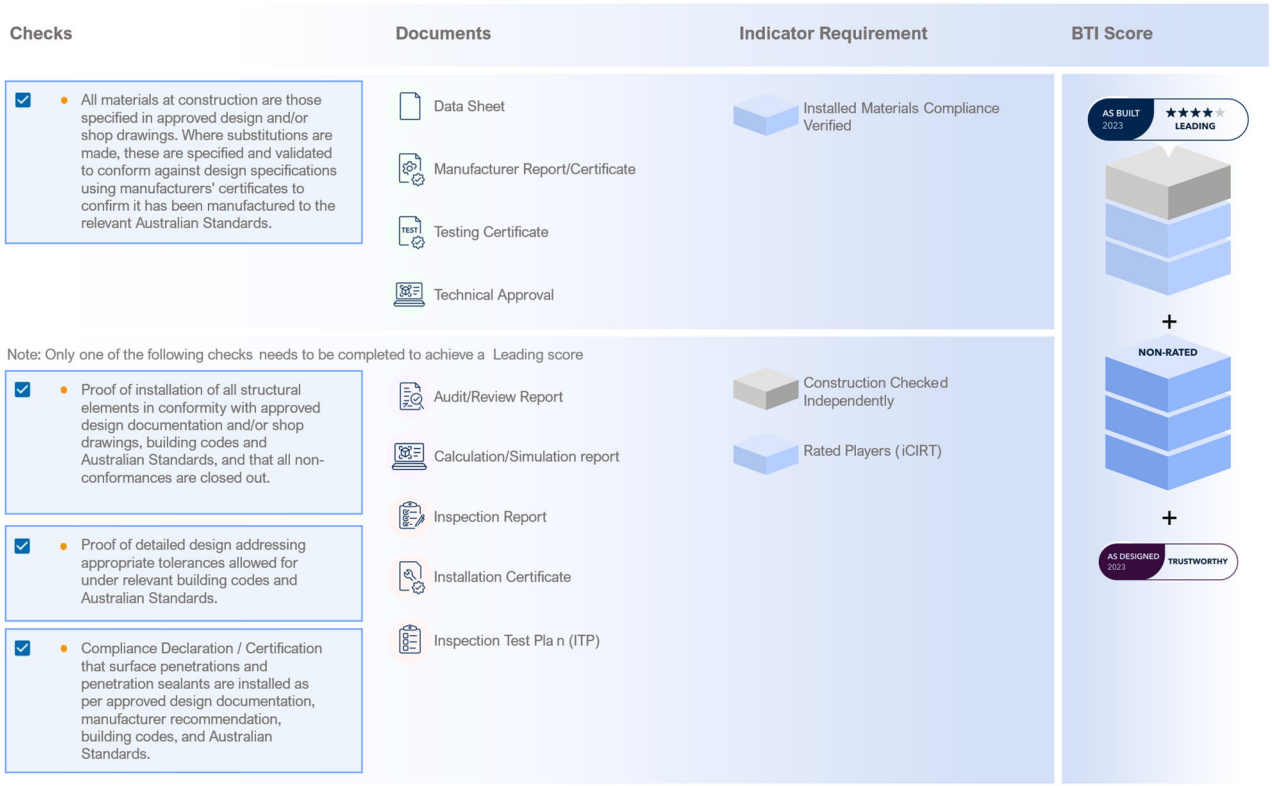
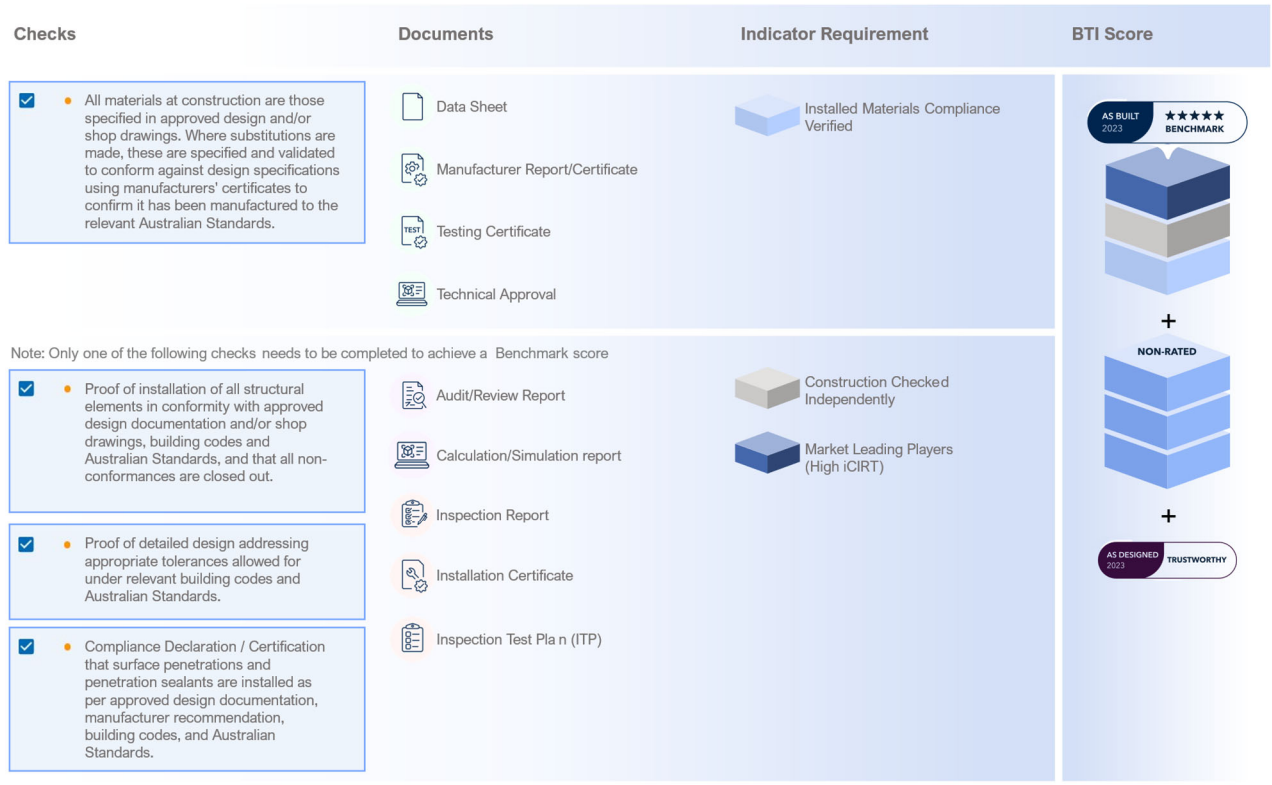


Table 6-4 Checks to satisfy Benchmark As Built requirements for a masonry wall panel construction system



7. CALCULATION METHODOLOGY

The methodology described here is relevant to both the Trustworthy As Designed and Trustworthy As Built indicators.

There are three phases to the calculation of a BTI score (see Figure 7-1):

Phase 1. Conversion of qualitative document properties to quantitative measurements.

Phase 2. Calculation of the indicator including:

- **Phase 2.1** Calculating the trustworthiness of the construction systems from the documents provided against them.
- **Phase 2.2** Calculating the trustworthiness of the elements of a building and their abstractions, starting from the specific construction systems up to the building as a whole.

Phase 3. Scaling the trustworthiness of the asset, by considering the historical performance of participants involved in the design and construction of the building.

7.1 Document Conversion – Calculation Phase 1

Each document must be converted from its qualitative properties (the document attributes as listed in Section 6.2) into a quantitative measurement; this conversion is Phase 1 of the calculation methodology, as shown in Figure 7-1.

Verification of design or construction work done, which is used to satisfy checks within the system, comes from self-reported evidence uploaded to the system from developers and their subcontractors. The degree of 'trust' this evidence provides will differ depending on the properties of the document. Once converted to some quantitative form, the trustworthiness of the evidence supplied for that act of verification by the construction team can then be compared against other evidence.

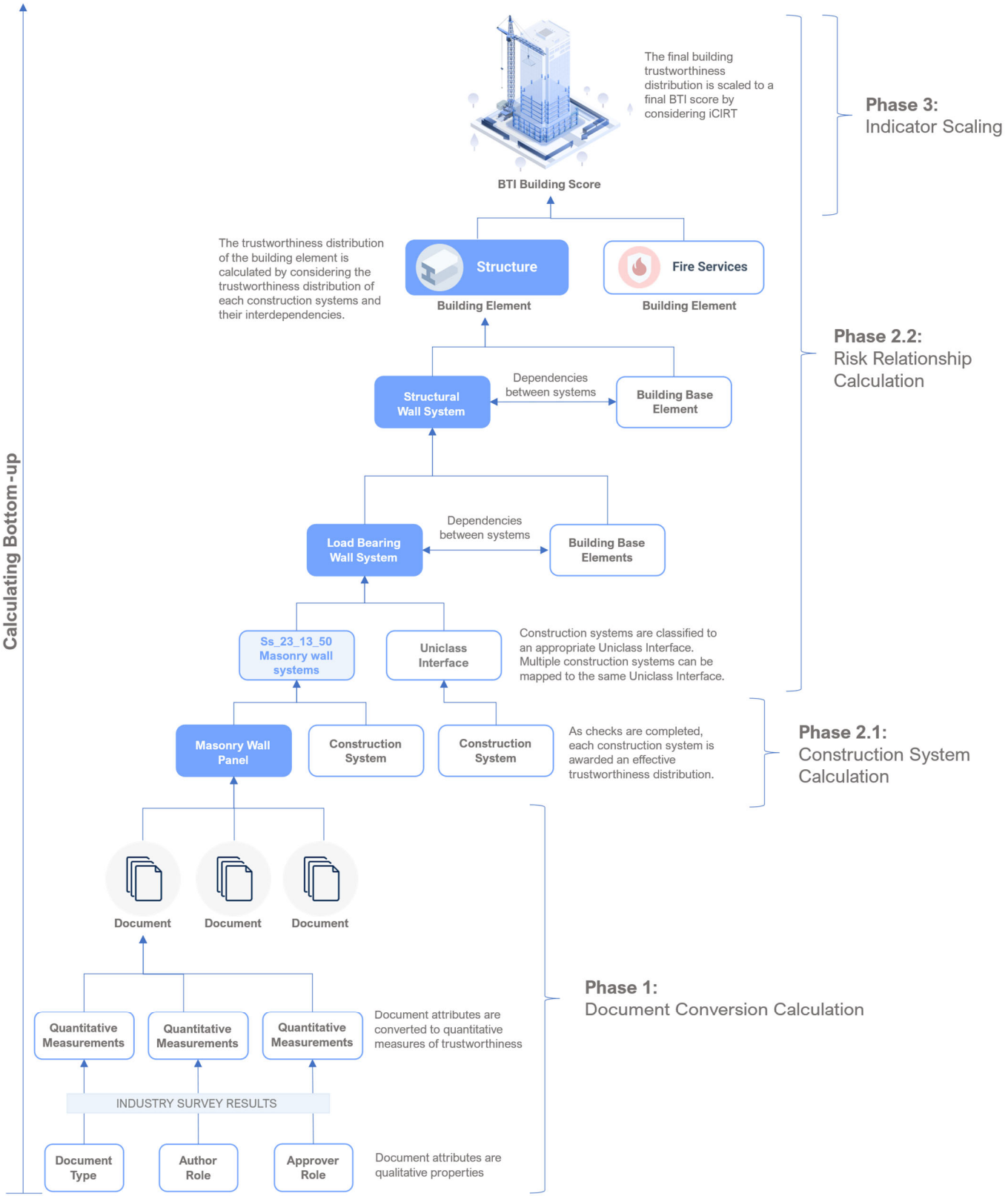


Figure 7-1 Overview of calculation methodology phases

In a large-scale survey, professionals across the construction industry assessed the trust they placed in the ability of distinct types of evidence, authors, and approvers to detect defects in work done in design and construction. This survey captured the industry sentiment of the inherent trustworthiness of any given activity that highlights the work done in the design and construction phase of the building lifecycle. This industry sentiment is captured as a statistical distribution and is then input into the larger model that produces the overall trustworthiness of a designed and/or built asset.

7.2 Indicator Calculation –Calculation Phase 2

Phase 2 is separated logically into two steps. The calculation of construction systems (Phase 2.1) and then the larger building component relational mapping (Phase 2.2) are conceptually separated. Both phases involve the calculation of the trustworthiness of the given building component from dependant components. In the case of construction systems (Phase 2.1) this is evidence applied to checks, and in Phase 2.2 it is from more specific elements into broader, more comprehensive, abstract elements.

7.2.1 Construction System Calculation – Calculation Phase 2.1

Some checks are not relevant at certain stages of the building lifecycle. The conditions to meet at *Trustworthy As Designed* are a subset of the conditions to meet at *Trustworthy As Built*, and as such the below description of the methodology of Phase 2.1 focusses on the *Trustworthy As Built* phase.

For every construction system the following logic applies:

- Once all regulatory checks have been completed, the construction system is awarded an effective trustworthiness distribution centering around that of a *Non-rated* evaluation.
- From this starting state, depending on what acts of verification (checks) it is uploaded against, documents are divided into four categories: a) review of design, b) review of construction, c) review of materials at design, and d) review of materials at construction.
- A review of the design or construction can be completed by an internal or an external party. Reviews by external parties can be significantly more impactful to improving the construction system's trustworthiness distribution.

As documented evidence is uploaded, the weight of the distribution is pushed towards higher levels of trust, thus improving the indicator of the construction system. However, to obtain a distribution that yields an indicator of *Trustworthy* or higher, all check categories (as detailed above) must be completed; these can be completed by internal or external parties.

With each subsequent act of data provided to demonstrate verification, the variance of the distribution will increase, up to that which produces a *Benchmark* indicator. After this, subsequent pieces of data provided to demonstrate verification will decrease the variance of the distribution and improve the certainty of the calculated indicator.

7.2.2 Risk Relationship Calculation – Calculation Phase 2.2

Once the trustworthiness distribution of each construction system is calculated, the process of calculating the individual trustworthiness distributions of each of the constituent building elements commences (Phase 2.2). Construction systems interface with the building model through the universal construction classification system *Uniclass*. This system readily translates common building languages across various construction systems into a consistent, universal model. The trustworthiness distribution of these *Uniclass* interfaces is the weighted joint distribution of all applied construction system distributions.

The trustworthiness distribution of building elements is calculated the same way, from the weighted joint distribution of all its dependent base elements and *Uniclass* interfaces. Interdependencies between these building base elements are mapped via a fault tree analysis. The interdependencies and their relative criticality are the product of an initial review of safety factors established by the industry and professional opinion, and a reinforcement algorithm to ensure expected behaviour.

As these elements build atop each other, abstractions develop. Specific features gradually combine into elements that consider broader, more complete perspectives of the building, eventually into the five key building elements (*structure, fire safety* systems, building enclosure, waterproofing, and *building services*) and finally into the building as a whole.

7.3 Indicator Scaling – Calculation Phase 3

At the third and final phase of the calculation, when the final building trustworthiness distribution is calculated, the historical profile of the participants involved is taken into consideration by the calculation engine. This historical metric of performance and trustworthiness is derived from organisational-level certifications such as iCIRT. A risk

profile is built in line with the industry expectations of the given input metrics (e.g. iCIRT) and the final BTI is conditioned along that profile.

Currently the profile of developers and builders are considered at the building level. However, a planned future extension of this methodology relies on the eventual roll-out of iCIRT ratings for subcontractors and designers.

When sufficient industry uptake has been achieved, indicator scaling will occur at the construction system level, where rated subcontractors and designers have had direct involvement.

7.4 Interdependencies of Building Elements for the same Construction System

It should be noted that some construction systems affect the indicator calculation of more than one building element (*structure*, *waterproofing,* etc.). For example, buildings that include masonry wall panels will produce a risk relationship model that will have dependencies of *structure*, *fire safety systems* and *waterproofing*. In effect, a verification by the construction team of work done on said construction system will affect all three building element indicators (to a varying degree as calculated by the risk relationship model), regardless of the intent of that verification (e.g. a structurally focused check on a masonry wall panel will impact the indicator calculation for the fire safety systems element).

Using the example above, where all structure focused checks have been completed but only minimal *fire safety system* focused checks have been completed, two outcomes arise:

Outcome 1 - A score for the fire safety system building element that is greater than 0.

Outcome 2 - A score for the structural building element that is less than 5.

For Outcome 1, with some measured confidence, the fire safety system building element is calculated to be somewhat trustworthy given the scrutiny that its dependant structural elements underwent. This is because the processes, governance and logistics that enable these verifications to occur are inherent to a holistically trustworthy construction process.

Alternatively, that logic can be inverted for Outcome 2, where a calculation for trustworthiness of the *structure* building element is lower given that the verifications for *fire safety systems* were not sufficiently completed.

8. INDUSTRY CONSULTATION

The BTI was developed from professional opinion from across the construction industry. Construction systems, checks and data taxonomies were derived via iterative consultation with industry participants through industry roundtables, workshops, and subject-matter-expert discussions. These participants spanned a wide spectrum of expertise within the construction industry and included architects, engineers, designers, and project managers.

Once these checks and data points were established, the mathematical model and methodology for the BTI was developed in partnership with Western Sydney University, our academic partner providing global insight and academic rigour to the development of the tool. The mathematical model was validated and refined in collaboration with industry, and together the risk relationship map was developed, which plots the relationship between different building elements, combines their abstract qualities, and then weights these relationships.

In addition, an industry-wide survey was conducted amongst developers and builders to achieve consensus on what evidence confers trustworthiness. This survey allows us to quantify qualitative documents and certificates to produce a final BTI score. More information on the methodology is provided in Section 7.

KPMG continues to engage with the industry and regulatory bodies to further refine the methodology and the checks to keep up with any future regulatory reform, enhancements to industry best-practice and innovations in construction systems.

Industry Participants:

BVN Architects

CQT Services

Dasco Australia

MIRVAC Construction

North Construction & Building

Office of the NSW Building Commissioner

Ross Taylor Associates

Taylor Thomson Whitting

TOGA Development & Construction

Warren Smith Consulting Engineers

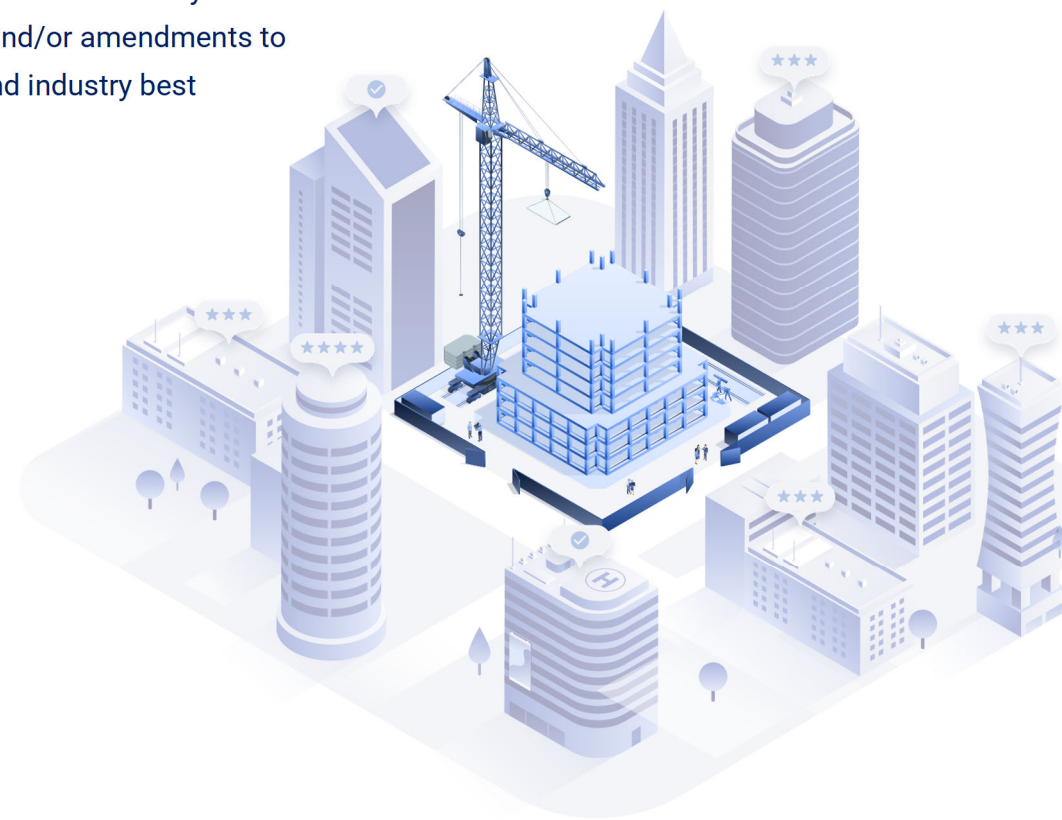
Western Sydney University

Xavier Knight

9. FUTURE DEVELOPMENTS

KPMG Origins continues to monitor and assess the BTI score, with industry participants providing input and feedback to further enhance the process, such as:

- Enhancing the indicator to other building classes beyond Class 2 and 9b, including buildings with multiple classes within the same building footprint.
- Extending the indicator to other states and territories within Australia.
- Calculating trustworthiness of pre-existing buildings constructed prior to 2017.
- Updating the methodology to include trustworthiness of designers and trades as iCIRT develops further.
- Updating checks and construction systems with enhancements and/or amendments to regulatory reforms and industry best practice.



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