Electronic traceability of New Zealand construction products: Feasibility and opportunities
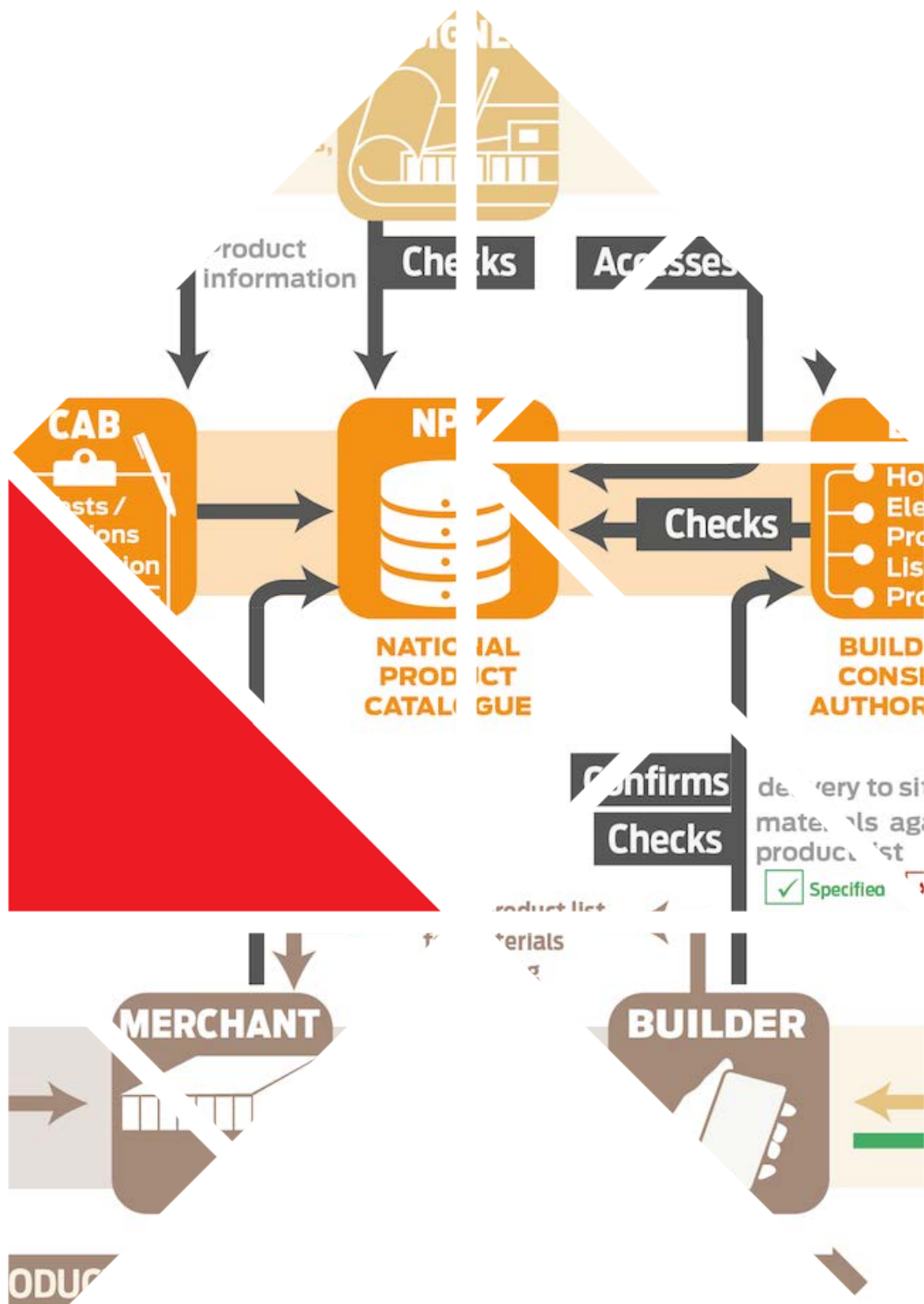
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Preface

This report sets out the findings of a research project that looked at the feasibility of establishing an electronic traceability system in New Zealand for construction products. Media reports, both in New Zealand and overseas, have highlighted the issue of use of construction products that do not meet requirements in building codes – so called non-conforming product (NCP). Use of NCP that is detected during construction may require expensive rework. NCP that remains in buildings and goes undetected may present a health and safety risk to building users, including potential for fatalities during failure.

This report provides an example of how an electronic traceability system for New Zealand construction could look and how existing systems might link to it and use it. Potential costs to the various stakeholders who might engage with this traceability system are presented in addition to the benefits that could accrue from its development and use.

These costs need to be weighed against the direct and societal costs incurred through use of NCP in New Zealand.

This report can be downloaded from the BRANZ website www.branz.nz/study_reports.

Acknowledgements

Electronic traceability of New Zealand construction products: Feasibility and opportunities

BRANZ Study Report SR365

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Reference

Abstract

Electronic traceability of construction products is investigated as a means to reduce product substitution on construction sites and the potential for inadvertent or deliberate use of non-conforming product.

Two approaches have been used to estimate the cost incurred to New Zealand Inc. when non-conforming product is detected and needs repair or replacement. This assessment has produced an annual cost of $95 million (for residential construction only) to $232 million (for residential and commercial construction).

A model electronic traceability system has been scoped in this report, based on a National Product Catalogue, which already exists in New Zealand. This has formed the basis for a financial assessment, which has found:

- the annual running costs of operating an electronic traceability system are covered if the system results in a reduction in incidence of non-conforming product by a conservative 6%
- an estimated net return of $23 million a year with a 30% reduction in non-conforming product.

In addition, non-financial benefits can accrue from reduced reputational damage to manufacturers and reduced risk of accident, injury and loss of life due to failure of non-conforming product.

This research shows that an electronic traceability system looks feasible as a means to reduce non-conforming product. With industry buy-in, more detailed work would need to be undertaken to scope how such a system would operate.

Accompanying this report is an information sheet that provides a summary of its findings to help with increasing awareness of the issue and highlight the potential opportunities.

Keywords

Traceability, non-compliant, non-conforming, product stewardship, provenance, substitution, supply chain

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Acronyms and terms

Australasian EPD® Programme	Independent, not-for-profit EPD programme, based on The International EPD System, which provides a platform for development, verification and publication of environmental declarations (or Type III ecolabels). See www.epd-australasia.com/.
automatic data capture technologies (AIDC)	Refers to the methods of automatically identifying objects, collecting data about them and entering that data directly into computer systems (i.e. without human involvement) – for example, use of barcodes, RFID etc.
barcode	Optical machine readable form of data that provides access to information held electronically about a product. In the context of this report, a barcode provides a means to read a GTIN. May be linear or two-dimensional (such as a QR code).
BCA	Building consent authority.
BIM	Building information modelling.
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora.
COBie	A metadata format for use in BIM that is important for maintenance and management of building assets during operation.
conformity assessment body (CAB)	Organisation that independently tests and provides documentation to support, provide an opinion on or certify (for example) a product's appropriateness (with or without other products) for achieving clauses in the New Zealand Building Code.
counterfeit product	A product that is an unauthorised copy of a building product, often created with the intention to deceive. They are sold to suppliers, builders or even consumers as if the product is genuine (Senior Officers' Group, 2016).
DECLARE	Voluntary product label developed as part of the Living Building Challenge, which provides information on where a product comes from, what it is made of and where it goes at end of life. See https://living-future.org/declare/declare-about/#overview.
Environmental Choice New Zealand	Government-owned and endorsed, independently operated, not-for-profit (Type I) ecolabel scheme for New Zealand. See www.environmentalchoice.org.nz/.
environmental product declaration (EPD)	Voluntary declaration providing quantified environmental data using predetermined parameters and, where relevant, additional quantitative or qualitative environmental information. Also known as a Type III environmental declaration or Type III ecolabel.
FLEGT	Forest Law Enforcement, Governance and Trade.
fraudulent documentation	A recorded claim that a product's performance meets specified standards or codes that, when used or tested, do not meet the performance claim. This may include falsified documentation – for example, fraudulent certification or test results (Senior Officers' Group, 2016).
FSC	Forest Stewardship Council, which operates a certification scheme for wood and other forestry products. See Appendix A for more information.
Global Location Number (GLN)	Unique identifier that can be used by companies to a corporate entity, a physical location. It can be encoded into a barcode.
Global Trade Item Number (GTIN)	Describes a family of GS1 global data structures that can be encoded into various types of data carriers such as barcodes and

	RFID tags. GTIN is the foundation of the GS1 system and is used to uniquely identify trade items (products and services) sold, delivered, warehoused and invoiced throughout the supply chain.
GS1 New Zealand	New Zealand's member organisation of GS1, the global, not-for-profit, supply chain standards development organisation based in Brussels, Belgium. Established in 1979, the organisation assists businesses with supply chain management initiatives based on GS1 global supply chain standards and solutions including barcode and numbering standards and services (adapted from www.gs1nz.org/). GS1 New Zealand is a membership based organisation and an incorporated society under the Incorporated Societies Act 1908.
HSNO	Hazardous substances and new organisms.
ISO	International Organisation for Standardisation.
MBIE	Ministry of Business, Innovation and Employment.
non-compliant product	Building product used in situations where it does not comply with the requirements of the New Zealand Building Code and relevant standards. A building product can be both non-compliant and non-conforming (based on Senior Officers' Group, 2016).
non-conforming product (NCP)	Building products and materials that claim to be something they are not, do not meet required standards for their intended use or are marketed or supplied with the intent to deceive those who use them (Senior Officers' Group, 2016).
NZBN	New Zealand Business Number.
OECD	Organisation for Economic Co-operation and Development.
PEFC	Programme for the Endorsement of Forest Certification, a certification scheme for forest products and sites. See Appendix A for more information.
product stewardship	Responsible management of the environmental impact of a product. It aims to reduce the impact of manufactured products at stages of the product life cycle (from www.mfe.govt.nz/waste/product-stewardship/about-product-stewardship).
product substitution	Can occur when a manufacturer, importer or supplier submits their product for third-party certification testing and, after the certification is granted, alters it without retesting or recertifying the product. Can also occur when a seemingly identical (and potentially non-conforming) replacement building product is offered on a construction site or elsewhere (based on Senior Officers' Group, 2016).
product technical statement (PTS)	Document encouraged by MBIE as a means for manufacturers and importers to summarise key information, technical evidence and relevant compliance pathways for building products. See www.building.govt.nz/building-code-compliance/product-assurance-and-multiproof/product-assurance/product-information-and-evidence/product-technical-statement/.
provenance	Place of origin.
QR code	Type of two-dimensional barcode but in a matrix format (see barcode). QR is short for 'quick response'.
radio frequency identification (RFID)	Technology that uses electromagnetic fields to identify and track tagged products. Unlike barcodes and QR codes, RFID can detect a tagged product without line of sight.

1.   Executive summary

Pressure to manage build costs can provide a strong incentive to source cheaper alternative materials to those specified in the design documentation. Information collected during the development of this report, some of which is anecdotal or based on media reports, indicates that product substitution during construction can provide a source of non-conforming product (NCP). This may be inadvertent or deliberate.

This situation is not unique to the New Zealand construction industry and is an issue that is currently being considered in Australia.

This is a feasibility study of the potential for establishment of an electronic traceability system for construction products used in New Zealand. Traceability schemes have been used in other sectors worldwide, such as food and minerals. This is in order to provide customers with greater assurance that what they are buying is what they think they are buying.

Electronic traceability has several aims:

- Significantly reduce product substitution by products not specified in the design documentation during construction.
- Provide a clear audit trail of which organisations have undertaken what tests and activities to check conformance to the New Zealand Building Code (or other codes and standards used to show conformance). This means that, in the event NCP is found within an electronic traceability system, there is a clear understanding of:
  - o what specific individual products or batches of products were tested, by whom, to what testing standards and where to demonstrate conformance
  - o who shipped the product from manufacturing site to construction site
  - o where the product has been used and how much has been used on builds in New Zealand.
- Potentially provide a hub for additional information about products used on New Zealand builds that can be useful to designers, specifiers and building consent authorities when making design and consenting decisions. Examples may include BIM objects, conformity assessment information, product technical statements, environmental product declarations and environmental certification.

For such an electronic traceability system to function, manufacturers need to assign Global Trade Item Numbers (GTINs) to their products. They need to mark products with machine-readable data carriers such as a linear or two-dimensional barcode or use RFID technology. These unique identifiers need to be populated in one repository named the National Product Catalogue (NPC) along with unique legal entity identifiers such as a New Zealand Business Number (NZBN) and Global Location Number (GLN). This will provide the necessary building blocks to enable traceability outcomes.

The NPC has already been developed in New Zealand and is being used by builders' merchants and for non-construction applications. The model electronic traceability system scoped in this report is based on an expanded version of the current NPC, meaning that significant establishment costs are avoided.

It is proposed that GTINs of specified products and suitable product alternatives are listed in the consent documentation submitted to the building consent authority. Through development of a smartphone app, a builder would make this list available to builders' merchants. They can then scan product barcodes (or two-dimensional

barcodes such as QR codes or GS1 DataMatrix symbologies) at the construction site. This enables a real-time check that products are as specified in the design documentation.

Two approaches have been used to estimate the cost incurred to New Zealand Inc. when NCP is detected and needs repair or replacement. This assessment has produced an annual cost of $95 million (for residential construction only) to $232 million (for residential and commercial construction).

The estimated costs of an electronic traceability system are set out in this report. If the electronic traceability system reduces incidence of non-conforming product by a conservative 6%, the financial analysis set out in this report shows that annual running costs of the system would be covered. A 30% reduction in non-conforming product produces a net return of $23 million a year in addition to other benefits such as:

- reduced risk of accident, injury and loss of life in the event of failure
- reduced risk of loss of business in the event of failure
- reduced risk to manufacturer reputation when a consumer believes that a failed non-conforming product is a genuine product
- potential for speeding up design and consenting by having a central repository of product information linked to GTINs accessible by designers and building consent authorities
- provision of greater assurance to builders that the product they propose to use on a build is acceptable and as specified
- opportunity for BCAs to obtain real-time information of what products and how much are going onto different builds
- in the event that NCP is found, information about the organisations involved (in manufacture and testing, for example) and where the product has been used.

This research shows that an electronic traceability system looks feasible as a means to reduce non-conforming product. With industry buy-in, more detailed work would need to be undertaken to scope how such a system would operate in practice and what information should be required about products. This would need to include greater consideration of the many and varied products and materials used in construction and, ultimately, piloting of such a scheme.

Accompanying this report is an information sheet that summarises the findings. This is intended to help increase awareness of the issue and the potential opportunities.

2.   Introduction

According to the Oxford Dictionary, something is traceable if it is "able to be found or discovered" and "able to be followed on its course or to its origin". The international standard ISO 12931:2012 *Performance criteria for authentication solutions used to combat counterfeiting of material goods* defines track and trace as a "means of identifying every individual material good or lot(s) or batch in order to know where it has been (track) and where it is (trace) in the supply chain".

Traceability has traditionally been used in the food and beverage sector where the ability to be able to track through all stages of production and distribution is important. With such a system in place, the ability to recall product quickly when a food or beverage safety issue is identified can be more easily implemented.

Today, traceability goes well beyond the food and beverage sector. It can now be found for products such as cotton, clothing and textiles, leather, gemstones and minerals, metals, pharmaceuticals, timber and forestry products, and tobacco (for example).

Traceability may be achieved in different ways, for example, through use of tags or stickers to mark products or storage of products in segregated bins. With electronic traceability, the whereabouts of a product can be determined when its unique identifier is scanned. This can be in a machine-readable form such as a linear or two-dimensional barcode, or its presence can be detected through use of radio frequency identification (RFID) technologies.

Scanning in this way can also provide access to accompanying information held electronically about a product. This can include conformity assessment information for example, for which there are different levels in New Zealand, including testing, independent assessment and certification.[1] In this way, a product's unique identifier also acts as a key, providing access to pertinent additional information when scanned.

There is increasing development and application of systems for providing electronic traceability within different sectors. This research project sought to better understand the potential benefits and costs for development of an electronic traceability system for New Zealand construction products.

2.1   What is an electronic traceability system?

In the context of this report, an electronic traceability system refers to the creation of a single repository of uniquely identified construction products manufactured by identified participating companies (brand owners, for example). Additional information about these products would also be available, such as conformity assessment information.

Such a system may also provide the potential for tracking the location of products in the supply chain. This requires other systems and greater functionality to be in place, which is not considered in this report.

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[1] www.building.govt.nz/building-code-compliance/product-assurance-and-multiproof/product-assurance/products-and-building-code-compliance/#jumpto-your-product-assurance-options

2.2 Why consider an electronic traceability system?

The main reason for considering use of an electronic traceability system would be with the aim of reducing use of non-conforming product in New Zealand through product substitution.

Additionally, where product in an electronic traceability system may be subsequently found to be non-conforming, it can provide an evidence base of what tests were carried out to demonstrate conformity. This would also identify who performed the tests and on what specific batch or lot of products. It can also enable identification of where the product has been used.

There may also be other benefits that could be derived from electronic traceability, since such a system may be used to provide additional information sought by customers about building products. This might include, for example, supporting information that attests to sustainability, ethical and wider societal benefits that may accrue through use of particular products.

Section 4 considers stakeholder views on traceability and, in particular, the drivers and barriers for traceability in New Zealand.

2.2.1 Non-conforming product (NCP)

One reason for considering an electronic traceability system is to use it as a means to reduce the incidence of NCP. These are examples of recent media headlines[2] in New Zealand concerning NCP:

- "NZ 'dumping ground' for dodgy building products" [Radio New Zealand, 14 March 2016]. An estimate is provided that 50% of new houses in New Zealand could have plumbing products in them that would fail Australia's plumbing performance standards.
- "Rogue tradies: Building products probed as imported goods raise worries" [*The New Zealand Herald*, 25 May 2016]. Of 134,000 inspections carried out by Auckland Council over a 12-month period, a third failed.

Product may be non-conforming because the wrong product is installed to meet the needs of a particular application (non-compliant product). Accompanying documentation may be inaccurate or misapplied (fraudulent documentation), or a product and accompanying documentation may have been created with the intention to deceive (counterfeit). Minchin et al. (2011) state that "China is the primary source of counterfeit construction goods" comprising part of a global counterfeit product market with a value of US$1 trillion annually.

As part of this research, BRANZ has sought to estimate the cost of NCP to New Zealand construction, set out in section 5. The exercise is difficult since information is anecdotal and requires assumptions to be made. Media reports provided the basis for one method used to estimate NCP costs. It is assumed the reports are an indication of a wider issue. The table footnotes in section 5 have details of how the incidence of NCP was derived for each product, including any assumptions. In most cases, the assumed incidences are for low percentages of the product, and the estimates are believed to be conservative.

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[2] Other examples can be found under Media reports in the References section of this report.

NCP is not just an issue in New Zealand. The Australian Industry Group published a report in 2013 primarily based on a survey of the Australian construction industry. It raised concerns about the incidence of NCP in the Australian building market, creating an uneven playing field and potential effects in terms of quality and safety of buildings. The report "suggests that the lack of independent verification and visible regulatory authority is making the conformance framework ineffective and unfair. The end result is undermined confidence in the regulatory system." (The Australian Industry Group, 2013). It goes on to state that NCP has "been allowed into the market due to inadequate surveillance, audit checks, testing, enforcement and first party certification". It also suggests that "building certifiers bear a disproportionate share of the burden for product conformance".

The report was followed by a report from the Australian Senior Officers' Group in 2016. It recognised the life safety, health, economic, legal and social consequences that NCP can have and focused on strategies to address the issue. It acknowledged that the "current [Australian] system has no inbuilt mechanism to trace building products through the supply chain from manufacture to installation". This "places heavy responsibility on the builder or building certifier/surveyor to ensure the product and its performance is safe and fit for purpose".

In the USA, Minchin et al. (2011) carried out research that involved interviews with organisations such as construction owners, contractors, suppliers, insurance companies, manufacturers and government agencies across North America. From 88 interviews carried out, 76% revealed at least one case of counterfeiting and together described over 140 cases of counterfeit construction products. These are typically found due to failure (31%), inspection (26%) and testing (10%). Of 70 construction professionals interviewed in China, 20% of interviewees stated counterfeit product may come from manufacturers directly. They stated that the remainder came from distributors or stockists who may purchase poor-quality product and rebrand as legitimate product. Another reason is lack of knowledge of standards from other countries that manufacturers are required to meet, instead producing to their national standards. The research concludes that one of the reasons for counterfeit goods in construction supply chains is a focus on obtaining the least expensive materials and equipment.

2.2.2   Compliance with (overseas) legislation

The New Zealand timber industry already faces a driver for traceability of exports as a result of legislation overseas. The purpose of the legislation is to eradicate illegal logging and the significant environmental, social and economic impacts that result. This is a response to the Organisation for Economic Co-operation and Development (OECD) estimate that 5–10% of the global industrial round wood trade is potentially illegally harvested.[3]

This legislation puts actors in the timber supply chain under legal obligation to exercise due diligence and, at a minimum, show that the product being sourced is harvested in compliance with the legislation. Possession of forest certification, such as the Forest Stewardship Council (FSC) or Programme for the Endorsement of Forest Certification (PEFC) are not, on their own, sufficient to demonstrate compliance. Examples of legislation are shown for Australia, Europe and the USA below.

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[3] www.agriculture.gov.au/forestry/policies/illegal-logging

In New Zealand, such a legislative driver does not exist for domestic use of timber. However, under the Building Amendment Act 2013, clause 362Q states that a building contractor or on-seller must remedy the defect notified within 1 year of completion. This came into force from 1 January 2015. Thus if a customer of a domestic build finds fault with materials used in the building, the builder responsible must remedy the fault if notified within the 12-month notice period. This includes work undertaken by subcontractors. In this situation, onus is on the building contractor to prove the work is not defective (MBIE, 2015). Beyond this period, implied warranties and remedies apply for the next 9 years, during which time the onus is on the owner to demonstrate that building work is defective.

The Act puts greater onus on builders to ensure the materials used on the building are suitable for their intended purpose and the standard of workmanship is acceptable.

2.2.2.1   Australia

The Illegal Logging Prohibition Act 2012 came into force in November 2012 and places additional responsibilities on importers of timber or timber products into Australia and those processing logs grown domestically. The Act now:

- makes intentionally, knowingly or recklessly importing or processing illegally logged timber or timber products a criminal offence
- requires that due diligence is carried out by those importing certain timber or timber products or processing domestically grown logs to ensure that risks of using illegally sourced material are assessed and managed. This due diligence includes:
    - collecting information about the timber or timber product being imported or processed
    - assessment against a timber legality framework and guidelines to help inform decision making
    - assessment of risks that the timber or timber product may be derived from illegal logging
    - where necessary, taking extra steps to reduce the risk that the timber has been illegally logged.

Maximum penalties for breach of the Act are 5 years' imprisonment and/or A$85,000 for an individual and/or A$425,000 for a corporation.[4]

2.2.2.2   Europe

In March 2013, the EU Timber Regulation (No. 995/2010) came into effect with the aim of preventing illegally harvested timber being available in Europe:[5]

- Operators (defined as those who first place timber or timber products in Europe) who import timber or timber products into Europe are prohibited from use of illegally harvested sources.
- Operators who place timber products in Europe must exercise due diligence.
- Traders (those who buy or sell timber or timber products already in Europe for commercial purposes) who are already trading in timber must maintain information about their suppliers and customers so the timber is easily traceable.

Imported wood with a FLEGT licence or a CITES permit complies with the regulation, and penalties vary by member state.

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[4] www.agriculture.gov.au/forestry/policies/illegal-logging/what-do-the-new-laws-do
[5] http://ec.europa.eu/environment/eutr2013/why-do-we-need-a-new-law/index_en.htm

2.2.2.3   USA

The Lacey Act was originally passed in 1900 and covered prohibition of wildlife, fish and plants that have been illegally taken. In 2008, it was amended according to provisions in the Farm Bill to include plant-based products (such as paper), timber and timber products.

Under the Act, timber and timber products listed on a schedule of enforcement require a declaration. The declaration requires information on what is proposed for import, country where harvested, the value of the shipment and quantity of material. It does not currently require a chain of custody.

Civil penalties of up to US$10,000 may be imposed with prosecution. Criminal penalties vary from US$100,000–250,000 for individuals, US$200,000–500,000 for organisations or imprisonment up to 1 year to not more than 5 years, or both, for each violation.[6]

2.2.3   Other potential benefits

There are a range of cited or perceived additional benefits that may be derived from traceability.

2.2.3.1   Management of reputational risk to brand

'Responsible sourcing' is a term used to describe the management of sustainability issues for materials in the supply chain, driven primarily by potential reputational risks that may arise due to suppliers' activities. It harnesses the power of procurement as a means to deliver more sustainable outcomes. For example, the Olympic Delivery Authority in the UK required a chain of custody for timber used in the London 2012 Olympic Park and the Olympic and Paralympic Village. This was to ensure only legal and sustainably sourced timber was used in the build (Livesey & Hughes, 2013).

In today's economy, manufacturers may use materials and products from sometimes complex supply chains, which may be largely overseas. This makes it difficult to ascertain the track record of companies in the supply chain with respect to issues such as human rights, health and safety, and ethical and sustainability practices. A company supplying raw material may be revealed in the media as being negligent or grossly deficient in these and other areas. However, it is the main manufacturer (or tier 1 supplier) in New Zealand whose reputation is likely to be most damaged with local customers. This can lead to potential loss of sales and reduced confidence in shareholder markets.

Greater understanding of the supply chain is becoming a requirement of large international developers and banks that provide finance to construction projects. The Equator Principles have been adopted by 84 financial institutions in 36 countries.[7] This risk management framework is aimed at setting a minimum level of due diligence in order to assess the environmental and social implications of a potential investment.

Having a traceability system in place and being part of it can provide greater assurance around suppliers, which, in turn, helps to manage the risk of reputational damage. This can also assist with procurement of new suppliers.

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[6] www.aphis.usda.gov/plant_health/lacey_act/downloads/faq.pdf
[7] As reported at the time of drafting this report (sourced from www.equator-principles.com).

2.2.3.2   Meeting customer demand

Within some sectors, for example, organic food, demand can provide a strong driver as customers seek assurance that the products they are purchasing are what they say they are.

Globally, manufacturers are facing increasing pressure to validate and provide traceability information about their products including origin, chemical constituents and quality controls. There is also an expectation to demonstrate management practices concerning health and safety, ethics and environment. Schemes based on traceability have developed across different sectors in response to the different drivers faced in each sector. Some of these are focused on construction products.

Appendix A provides examples of a range of different traceability schemes globally across different sectors. The list is not exhaustive and provides information about each highlighted scheme.

3.   Objectives and method

This research project seeks to answer the following questions:

- What is the dollar and other value to New Zealand Inc. of having an electronic traceability system in place?
- What traceability models/technologies exist in New Zealand and overseas, why were they set up, how do they operate, who are they for, what do they cost and who benefits?
- What are current attitudes to traceability in New Zealand amongst different stakeholders in the construction supply chain, and what is the potential and rationale for uptake?

The method used is illustrated in Figure 1 with further information in the sections below. A stakeholder group was established comprising industry representatives who expressed interest in the study. The group comprised those in the Acknowledgements section at the front of this report. Its role was advisory. Therefore, the findings in this report do not necessarily reflect the views and opinions of individual members of the stakeholder group.

1. Assess current activities/understanding/attitudes

2. Review existing traceability schemes – why, what, who, how, when, where? Case study examples and learnings.

3. Assess potential $ and other benefits and costs

4. Raise awareness
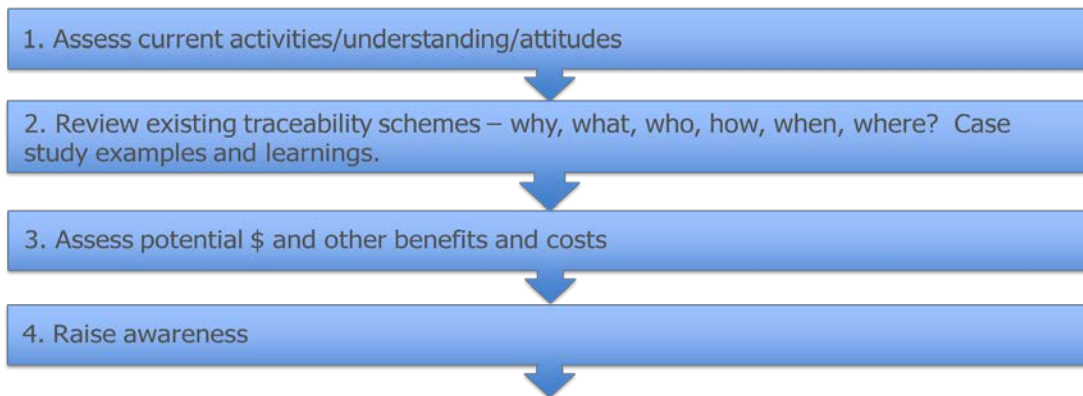
Figure 1. Method used for the research.

3.1   Assess current activities, understanding and attitudes

The first stage of the research was aimed at obtaining a better understanding of the level of knowledge and attitudes towards traceability amongst different stakeholders in the construction industry to establish a baseline. The method used for this is set out in section 4.1. Due to the number of responses, the sample cannot be considered as statistically representative.

Additionally, attitudes amongst consumers (new house owners) towards payment of a premium for assurance on sustainability-related information for products used in a build was surveyed. The number of responses means that the sample can be considered as statistically representative of attitudes amongst new house owners. The method used is provided in section 4.2.

Findings from the surveys have been used to inform a model of what an electronic traceability system for New Zealand construction products might look like, set out in section 6. This provides the basis for a financial assessment to better understand the potential costs if such an electronic traceability system was implemented.

3.2 Review of existing traceability schemes

For this phase of work, a subcontractor (Tenpoint Communications Ltd) undertook the review. Initially, a list of traceability schemes was developed, divided into construction and non-construction schemes. Headline information was identified for each scheme (for example, the sector, type of scheme, its geographical location and a brief description). A total of 32 schemes were initially listed.

From this list, 18 were selected for a more detailed review based on the provided information. A template was developed and populated for each of the selected schemes. This is provided in Appendix A, and aspects have been used to help inform the electronic traceability system for New Zealand construction products in section 6.

3.3 Assess financial and other benefits of traceability

The key aspect of traceability is product conformity (risk of NCP). A further opportunity concerns traceability of source materials (health and safety, human rights, ethics and sustainability).

A financial analysis of the first aspect – NCP – was carried out, which is provided in section 5. The aim of this work was to understand what the overall potential cost of NCP is to New Zealand in terms of substandard performance of products. The assessment is made difficult by a lack of data, so two methods were used.

The analysis focuses on direct costs arising from the need to rectify or mitigate the effects of NCP only. It does not take into account wider potential societal costs that may be incurred in the event of failure as a result of NCP. This includes business losses and potential injury or loss of life.

Willingness by consumers to pay for greater traceability of source materials was tested through a survey, set out in section 4.2.

This assessment was then followed by a financial analysis that focused on the following stakeholders in addition to government:

- Manufacturers/importers.
- Conformity assessment bodies (CABs).
- Architects, designers, quantity surveyors.
- Specifiers
- Building consent authorities (BCAs).
- Builders' merchants.
- Builders and trades.

In order to perform this assessment, a model electronic traceability system needed to be devised, which is set out in section 6. The process for the model electronic traceability system was informed by:

- current systems and processes (for example, use of specification software, conformity assessment of building products)
- developing initiatives (such as use of building information modelling (BIM) in building design and development and use of a National Product Catalogue by builders' merchants)
- survey results (see section 4)
- case studies (see Appendix A).

The model electronic traceability system was developed principally with the aim of reducing the opportunity for NCP through product substitution. It is intended to convey a model of how an electronic traceability system might operate in New Zealand rather than being prescriptive.

The financial analysis has been carried out with support from GS1 NZ and contact with some stakeholders. It is not a detailed assessment and is indicative only. For example, actual costs borne by a specific manufacturer will be dependent on a range of factors associated with the product being manufactured. This includes type of product, ease with which technology can be introduced to provide unique identification (on the product directly or on packaging, for example) and type of traceability systems that might already be operating.

The cost to manufacturers in particular should be considered against the loss of sales that may be incurred because of incidence of NCP. Manufacturers producing compliant product and incurring costs arising from testing, appraisals and/or certification to demonstrate compliance with the Building Code are disadvantaged by NCP.

3.4 Raise awareness

The results of this research are contained in this study report. Furthermore, a summary information sheet is available.

All outputų can be downloaded from the BRANZ website www.branz.nz/study reports.

4.   Understanding and attitudes to traceability

During 2015, BRANZ carried out a dedicated survey of construction industry stakeholders concerning traceability and also inserted a traceability-related question in the BRANZ New House Owners' Satisfaction Survey.

The results from these surveys are presented in this section.

4.1   Survey of construction industry stakeholders

The purpose of the survey was to:

- better understand what traceability means to construction industry stakeholders as a whole and by group
- ascertain attitudes towards traceability and what features may be viewed as desirable.

A link to complete the survey (using SurveyMonkey) was sent via email to 2,760 stakeholders obtained primarily from a BRANZ database and Building Industry Federation (BIF) members. Of this, 307 stakeholders filled in the survey, giving an 11% response rate.

Respondents were categorised into the following groups:

- Architects, designers and specifiers (design side).
- Construction product providers (manufacturers and importers).
- Builders and trades.
- Builders' merchants.
- Tool or platform providers – for example, the New Zealand Green Building Council and CIL Ltd.
- Local government.
- Banks and insurers.
- Central government.

The number of responses received, broken down according to these groups, is summarised in Figure 2.

Due to the number of respondents, findings cannot be considered as statistically representative. Nevertheless, the findings provide some useful insight about the level of knowledge of traceability that currently exists amongst different stakeholder groups involved in construction and where those groups see the priorities being.

Construction industry stakeholder survey questions are reproduced in Appendix B.

Legend:
- Architects, designers and specifiers
- Construction product providers
- Builders and trades
- Builders' merchants
- Tool or platform providers
- Local Government
- Banks and insurers
- Central Government
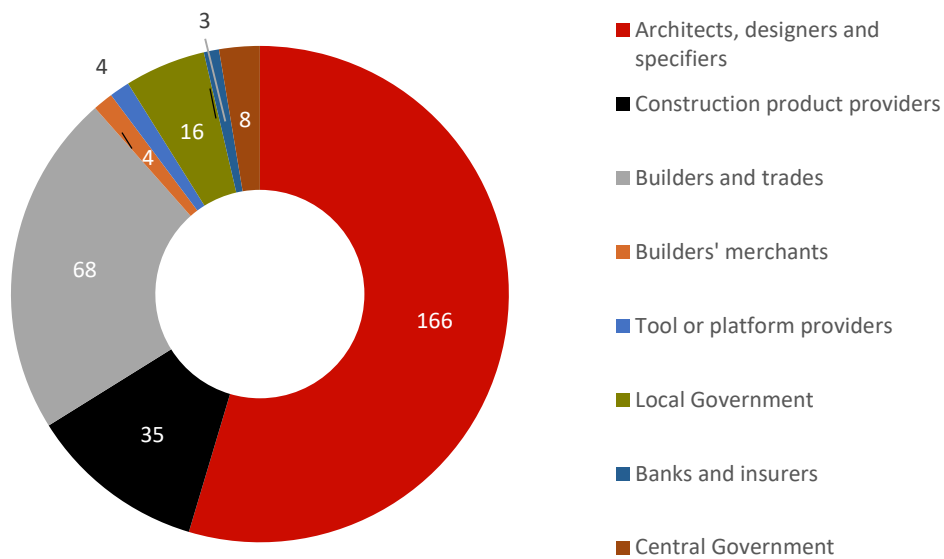
Figure 2. Survey responses received by stakeholder group.

4.1.1   What type of traceability system could we have (if at all)?

Figure 3 shows that more than half of respondents thought a traceability system for construction products should be a combination of both a chain of custody and authentication-based system.[8] With such a system, requirements for provision of independent documentation (for example, independent certification) confirming the appropriateness of a product would vary. This would depend on whether a product would be deemed of high or low risk with respect to NCP.

Construction products with a lower risk of NCP may be based on a chain of custody system in which they are traceable. There could be an option of access to supporting documentation such as laboratory test reports from accredited laboratories, where these are available.

Construction products deemed as being of high risk of NCP would be based on an authentication-based system. This would have the same features as the chain of custody system. There would be additional requirements for provision of supporting information such as product certification or other form of conformity assessment in order to manage the risk appropriately.

Just over a quarter of respondents thought that a traceability system should be either authentication based or chain of custody based, with the split in opinion being about even.

In every group, more than 80% of respondents thought that a traceability system is needed. This compares to 8% of respondents (in total) who felt that a traceability system was not needed. The largest share of those who felt a traceability system is not necessary were from central government and builders and trades.

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[8] For an explanation of chain of custody and authentication-based systems, see section 4.1.2.1 and section 4.1.2.2 respectively.
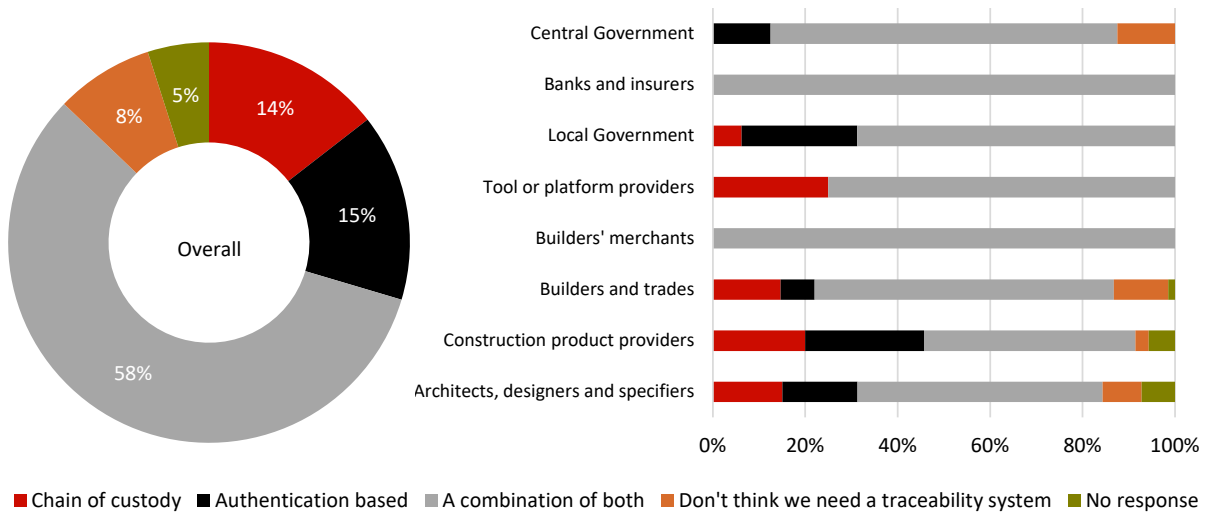
Figure 3. Summary of responses on what a traceability system could look like.

4.1.2　What information should be available?

4.1.2.1　Chain of custody

Respondents were asked whether a traceability system for construction products should be primarily a chain of custody or authentication-based system or both. A chain of custody system allows users to track product in the supply chain, thereby knowing where it has come from. Additional information can also be made available, although this information is not independently checked, verified or certified. It can therefore be false or misleading.

An authentication-based system operates like a chain of custody system, except key additional information must have some form of conformity assessment such as a verification or certification. Therefore, the user of the information has assurance from a third party that the information is correct.

A traceability system that features both a chain of custody and authentication relates to risk of NCP. Under such a system, products considered as high risk would operate under an authentication-based traceability system. Essentially, this would place greater requirements for provision of information that has some form of accompanying conformity assessment. High risk in this context may be considered as:

- materials where there has been a known incidence of NCP
- risk of failure in a building with potentially dangerous and/or fatal consequences in the event NCP is used (and could subsequently fail) – an example could be use in a building's structure
- difficulty and/or cost associated with removing NCP from a building and replacing with product that conforms to the New Zealand Building Code.

Conversely, products considered as low risk would operate under a chain of custody system.

Respondents were able to select one or more options, and therefore the percentages displayed in Figure 4 do not add up to 100%.

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The top five information categories respondents wanted to see available in a chain of custody traceability system (or a system that included a chain of custody system), in order of importance, were:

- New Zealand Building Code compliance (selected by about 83% of respondents)
- provenance
- product stewardship
- product constituents, including amounts and types of constituent materials in products including materials that are classed as hazardous under the Hazardous Substances and New Organisms (HSNO) Act 1996
- product-related environmental certification.

Fewer than half of respondents thought that information about environmental management, ethical management or health and safety management at the organisation level was a priority.
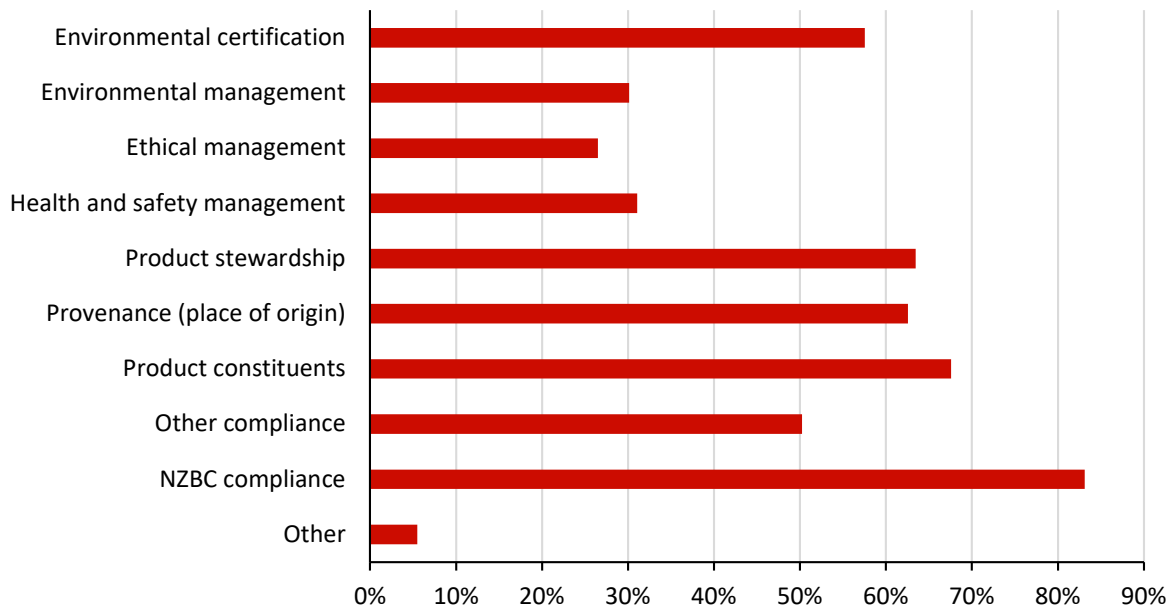
Figure 4. Summary of responses on information priorities in a chain of custody traceability system.

Figure 5 breaks down results further into responses by individual stakeholder groups. This shows the following:

- All banks and insurers and local government respondents felt that provision of information about compliance with the New Zealand Building Code was needed. More than 80% of respondents on the design side (architects, designers and specifiers) and builders and trades also felt that this was important.
- Respondents amongst central government and builders and trades also felt that information about product constituents is important, with more than 80% of responses in these groups highlighting this as an issue. Architects, designers and specifiers and banks and insurers also signalled this as important compared to other groups.
- Around 70% of central government and architects, designers and specifiers respondents indicated provenance is important. These two groups, together with builders and trades and banks and insurers, also felt that information about product stewardship was additionally important, compared to responses from other groups.

- No group indicated that organisational information concerning health and safety management, ethical management and environmental management is a priority. About half of builders' merchant respondents indicated health and safety management and environmental management as important. About half of local government respondents also indicated that information about health and safety management would be useful.
- Builders' merchants and banks and insurers felt information about product environmental certification would be useful, with around 70% or more of respondents indicating this. This compares to all other groups where 60% or less viewed this as a priority.
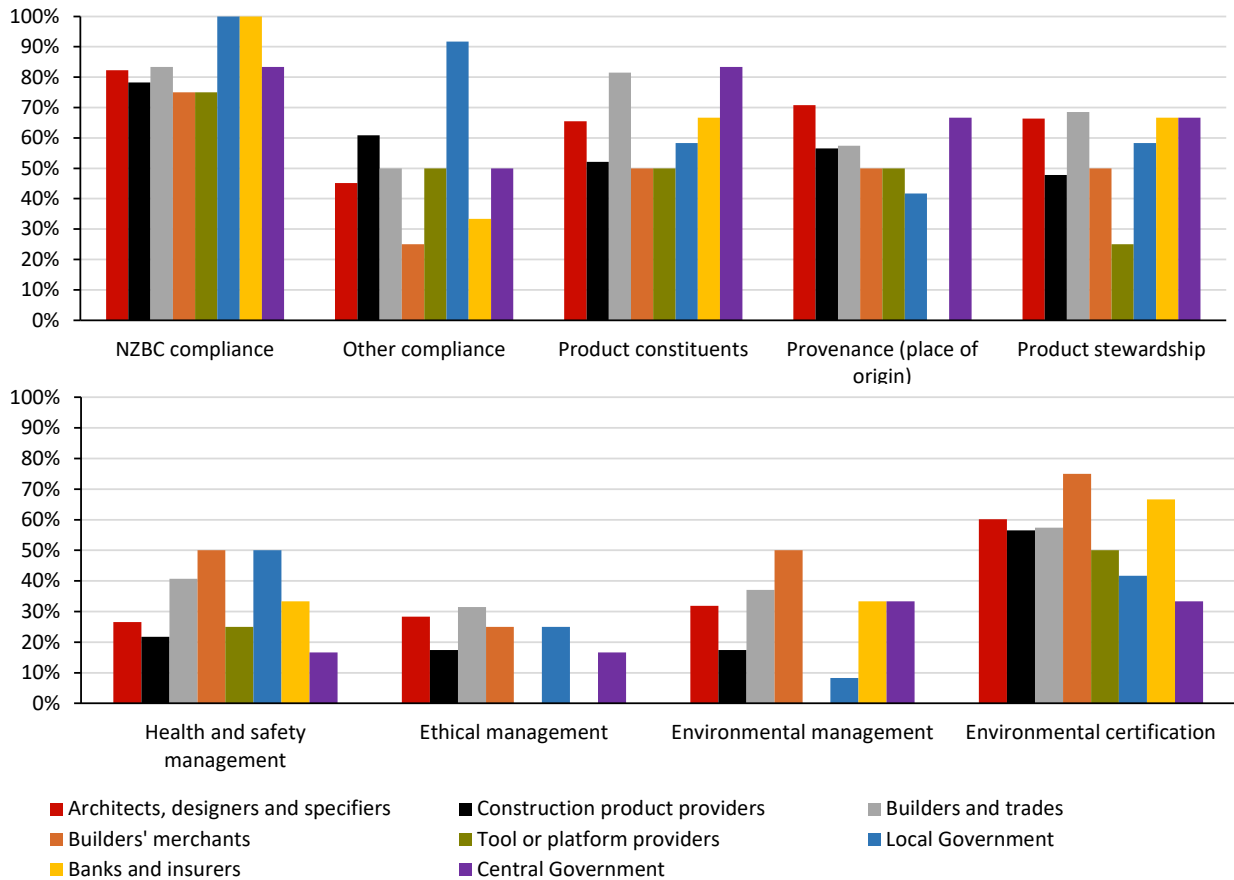
Figure 5. Information priorities by stakeholder group.

4.1.2.2   Authentication based

Those respondents who selected either an authentication-based traceability system (or a system that included an authentication-based system) were asked what information available on the system should have some form of conformity assessment.

They were also asked whether they felt that certification should be considered as essential, nice to have, less important or not important.

Figure 6 shows that over 85% of respondents thought certification for compliance with the New Zealand Building Code would be essential, with the remainder stating this is nice to have.

Over 70% of respondents felt that certification of product constituents would be essential, compared to almost 60% for product stewardship and provenance and almost 50% for environmental certification.

When grouping essential and nice to have responses and following New Zealand Building Code compliance, respondents felt that priorities were product constituents, compliance certification (other than the New Zealand Building Code), product stewardship, environmental certification and provenance (in that order).

Certification of information concerning ethical management, health and safety management and environmental management by organisations in the supply chain were seen as the least important amongst the choices provided.
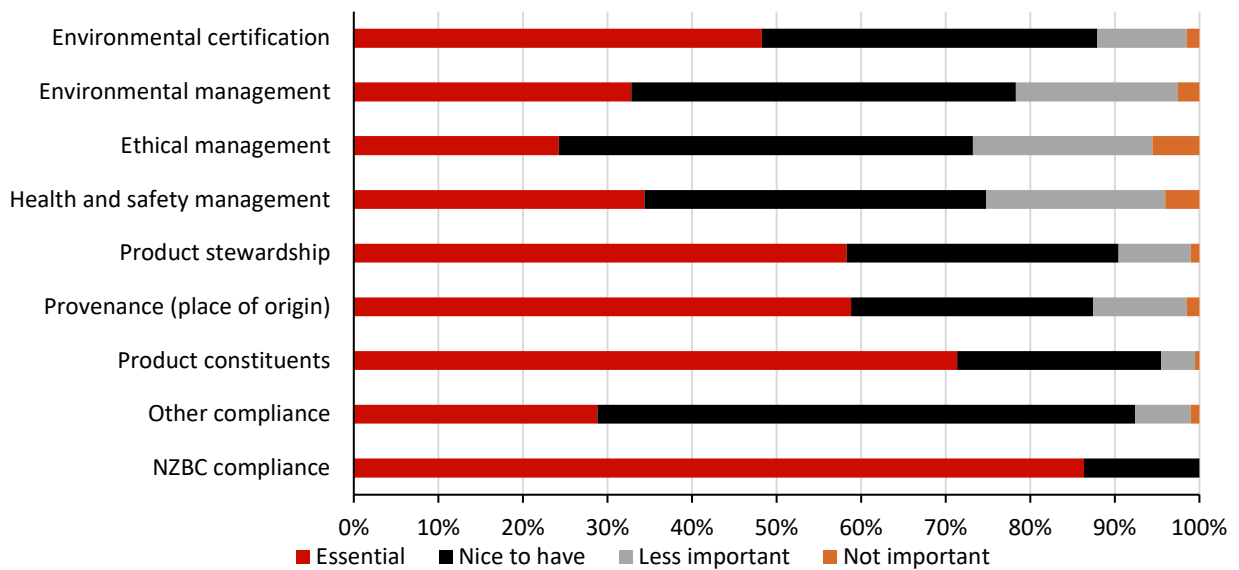
Figure 6. Summary of responses on certification priorities in an authentication-based traceability system.

Figure 7 looks at certification priority responses received by group.

Banks and insurers judged certification to the New Zealand Building Code, product constituents and product stewardship as essential. Central government also viewed certification to the New Zealand Building Code would be essential in an authentication-based traceability system.

All other groups rated certification of New Zealand Building Code compliance and product constituents very highly.
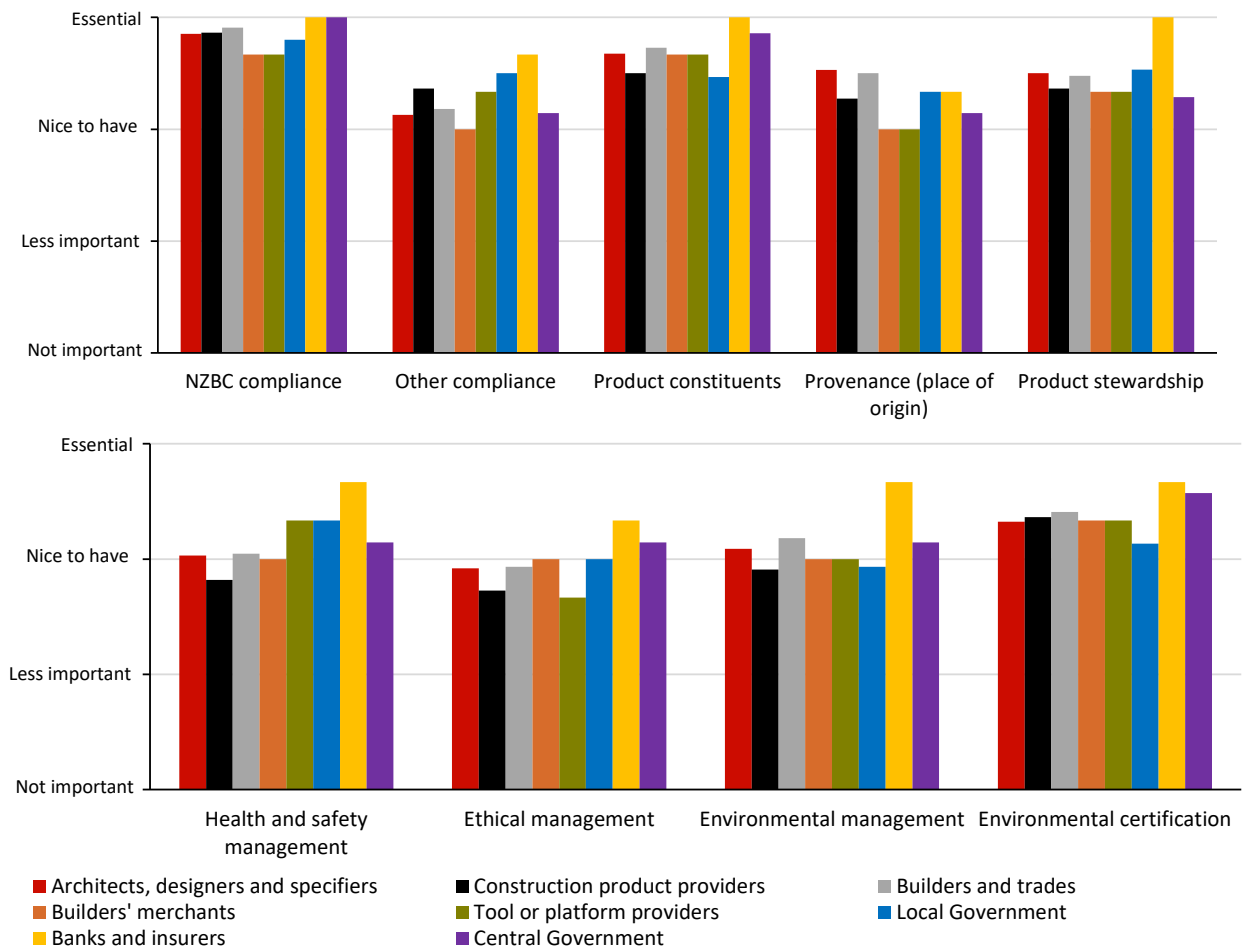
Figure 7. Certification priorities by stakeholder group.

Amongst the eight groups, those involved in design (architects, designers and specifiers) and builders and trades viewed certification of provenance information as the most valuable relative to other groups.

Banks and insurers were the group that consistently responded that certification of information available on a traceability system would be important, in comparison with other groups. This may be due to the small number of respondents (three) in this group.

4.1.3   Who should lead development of a traceability system?

Figure 8 shows that almost half of respondents stated that sector bodies/trade associations are best placed to lead the development of construction product traceability in New Zealand. A quarter thought that this would be best undertaken by the government.

Central government, builders and trades and local government were most in favour of development being led by sector bodies. Banks and insurers and builders' merchants were most in favour of government leading such a development.

- Individual companies for their own products
- Local authorities/councils
- Other
- Sector bodies/trade associations on behalf of their members
- The Government
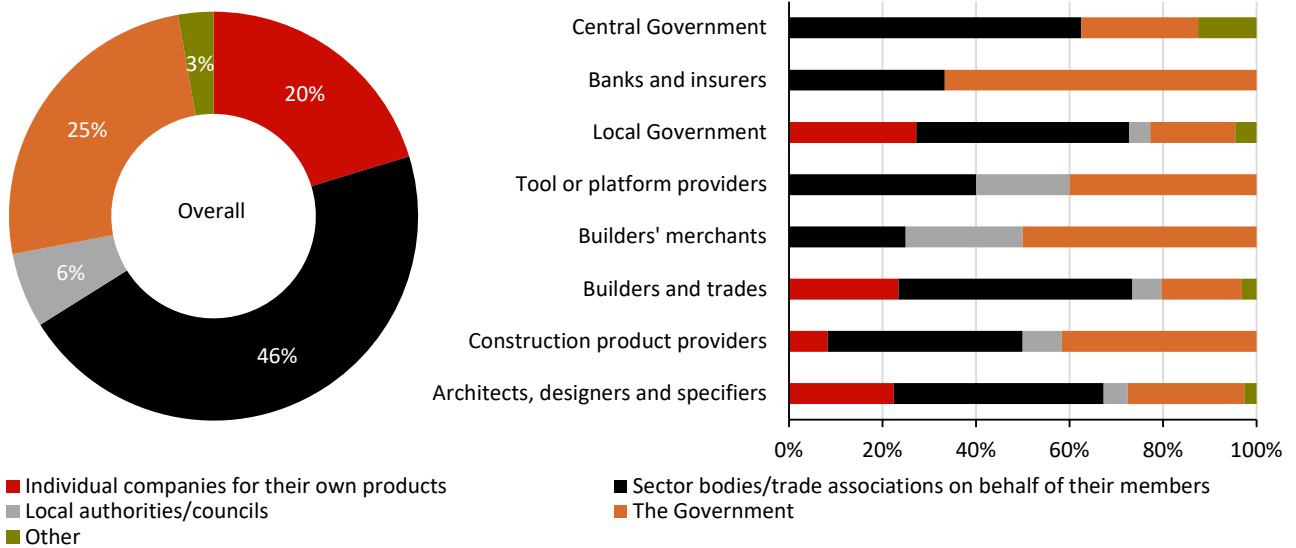
Figure 8. Summary of responses on who is best placed to lead development of a traceability system.

4.1.4 What are the drivers for a traceability system?

Figure 9 clearly shows that NCP is the most significant issue for establishing a traceability system, with around 85% of respondents rating this as a strong driver. Demand from customers and the potential for easier and quicker building consents were also seen as strong drivers by 70% or more of respondents.

- Strong driver
- Weak driver
- Not a driver
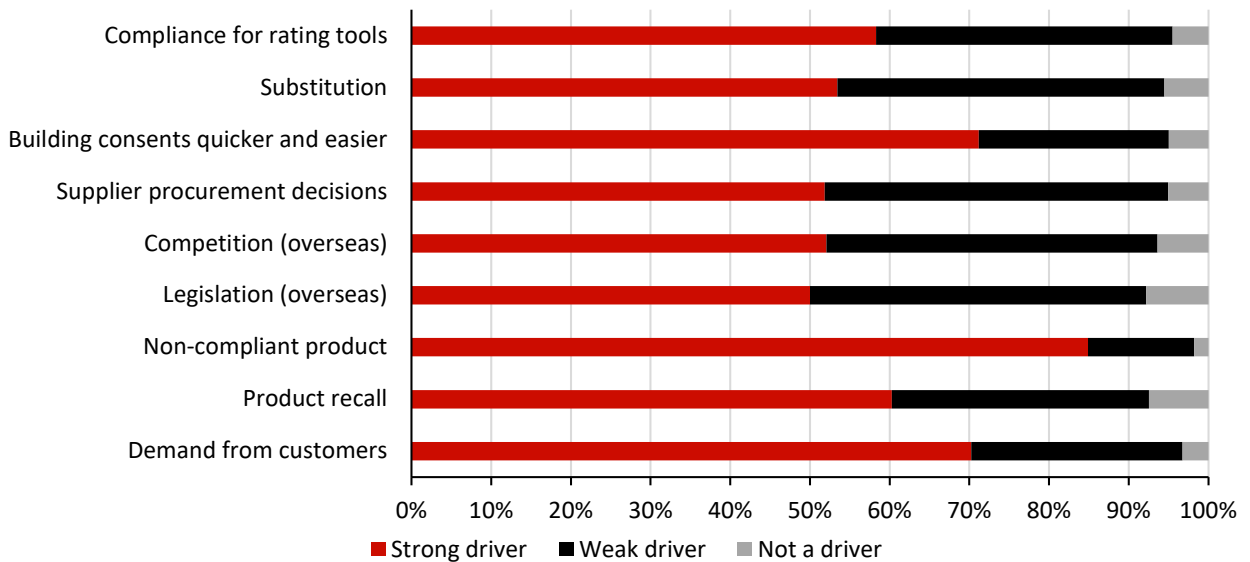
Figure 9. Summary of drivers for a traceability system.

Figure 10 focuses on drivers for traceability by stakeholder group. It shows that NCP is viewed as providing a strong driver across all groups. There are differing views concerning other potential drivers:

- Central government, tool or platform providers and builders' merchants all view demand from customers as providing strong drivers. This view was not shared by banks and insurers.

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- Local government saw potential benefits to the consenting process (in terms of time and ease) as providing a strong driver. This was not seen as a strong driver by the banks and insurers.
- Banks and insurers viewed overseas legislation and competition from overseas as important drivers, although other groups did not have such a strong opinion.

The architects, designers and specifiers group felt that the strongest driver would be non-compliant product. They also thought that building consents being quicker and easier would be a strong driver.

Builders' merchants suggested that demand from customers and non-compliant product would be the strongest drivers for traceability.

The tool or platform providers and central government groups agreed on demand from customers being a strong driver.

However, the local government group felt that the strongest driver was building consents being quicker and easier.

The banks and insurers stakeholder group felt that the strongest drivers were non-compliant product, overseas legislation and overseas competition.
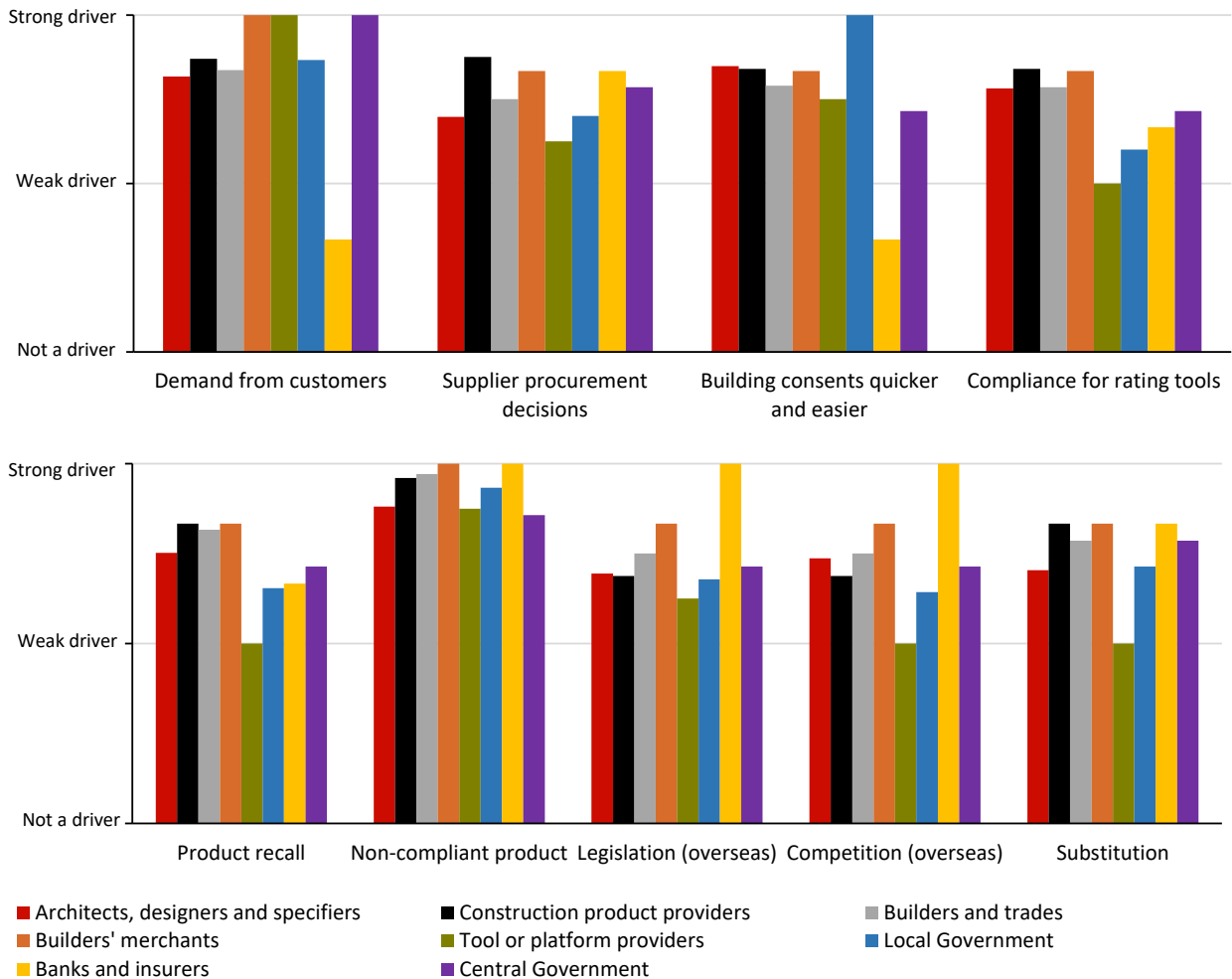
Figure 10. Summary of drivers for traceability by stakeholder group.

4.1.5   What are the barriers to a traceability system?

Figure 11 shows that extra cost was seen as providing the largest potential barrier to establishing a traceability system for construction products in New Zealand. Lack of resources and the potential administrative burden were also seen as important potential barriers.

Figure 12 drills down further by analysing responses by groups. All central government, banks and insurers and tool or platform providers who responded agree that extra cost is a barrier. Tool or platform providers also see the potential administrative burden as prohibitive, whilst builders' merchants see lack of resources as a barrier to adoption.

In general, a perception of no value and apathy were seen as the least important barriers compared to other choices provided.
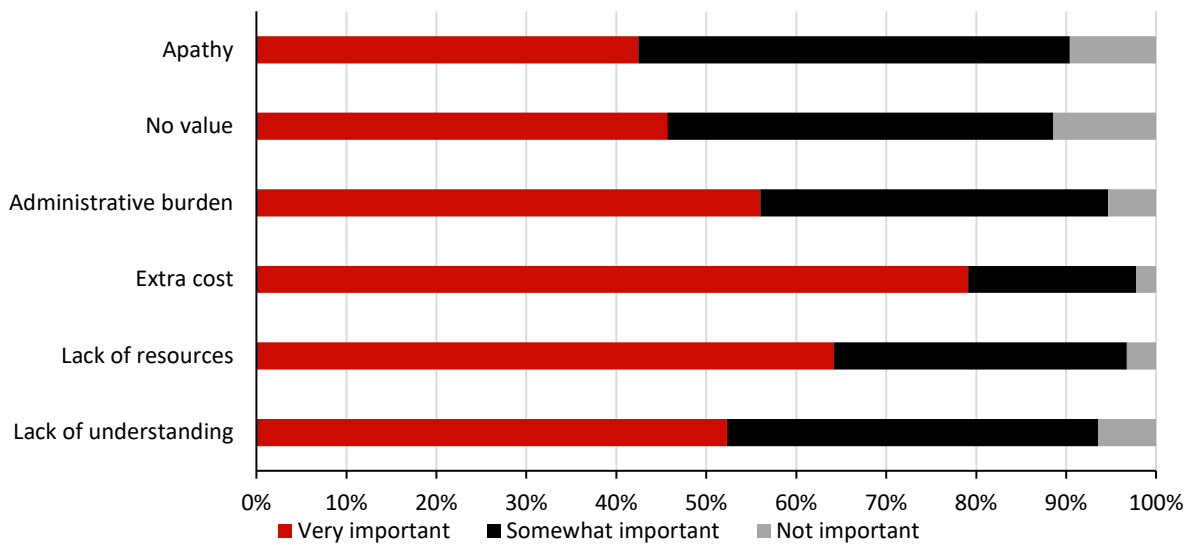
Figure 11. Summary of barriers for a traceability system.
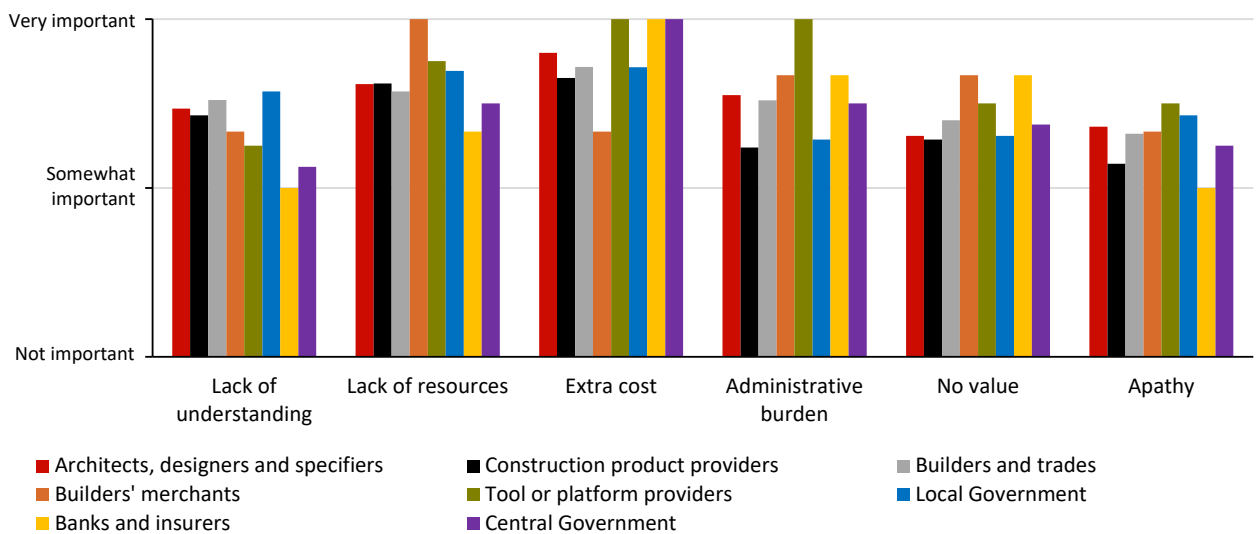
Figure 12. Summary of barriers for traceability by stakeholder group.

4.1.6 What is the reason and scale of product substitution on construction sites?

Product substitution at construction sites is when a specified product is replaced on the build with an alternative. The alternative should be equivalent to the specified product, in terms of compliance with relevant clauses of the New Zealand Building Code. Depending on the situation, the alternative product may need consent by the BCA before it is used.

Figure 13 shows that almost 40% of builders and trades stated that product is substituted often (defined as being on more than half of jobs).

The majority (over 50%) stated that construction products are rarely substituted (defined as being on less than half of jobs). Only 5% stated that product is never substituted.

The perception amongst other stakeholders was that product substitution occurred often on more than 60% of construction sites, with the remainder believing that it occurs rarely.
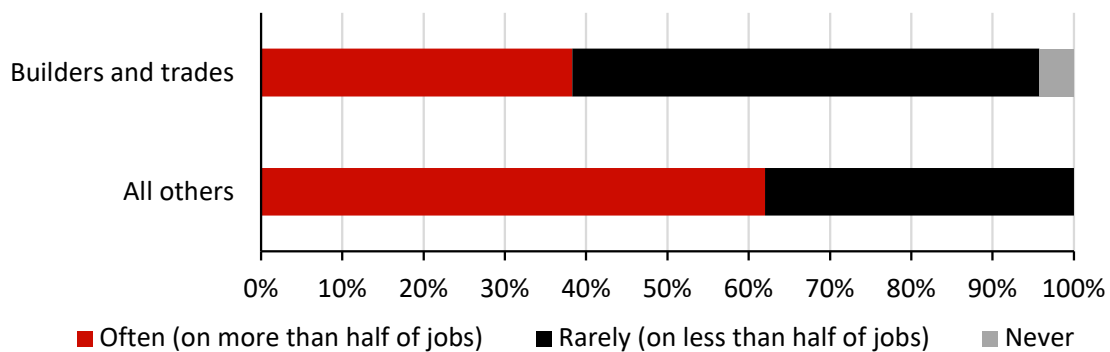
Figure 13. Respondents' views on frequency of product substitution during construction.

The survey also asked for views on the reasons for product substitution, the results of which are summarised in Figure 14.

The most common reason given for product substitution by builders and trades was availability of a more convenient alternative.

A quarter of builders and trades stated that the main reason was problems with the supply of the specified product, and just over 20% stated that the main reason was availability of a better product.

Other stakeholder groups felt that products were rarely substituted for a better product. Over 40% believed the primary reason for product substitution was 'other', with most stating the reason being availability of a cheaper alternative.

Close to 40% stated that a more convenient alternative is the reason.

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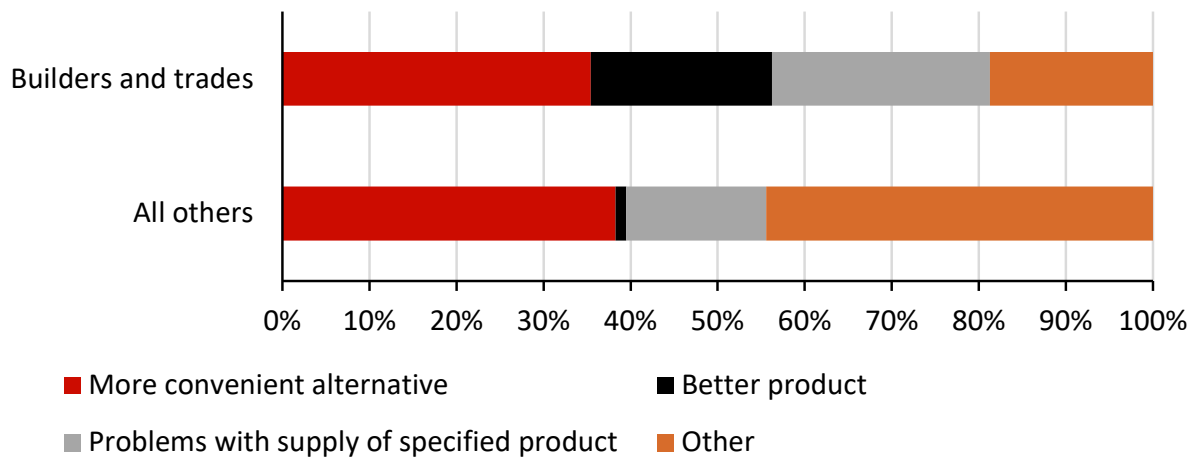
Figure 14. Respondents' views on the reasons for product substitution.

These results cannot be taken as statistically representative due to the insufficient sample size. They do appear to indicate amongst those who responded that product substitution is fairly common. Product substitution is acceptable if approached properly, for example, as set out in the *Quick guide to product substitution* (MBIE, 2016b). However, it can also be a route for NCP if not done properly or if supporting product documentation for the substituting product is misleading or false.

4.2   New House Owners' Satisfaction Survey 2015

The New House Owners' Satisfaction Survey has been running annually since 2011. This is a BRANZ research project and is funded by the Building Research Levy. The aim of the survey is to find out from owners of new builds how they thought their builder performed in delivering their new house. It gathers opinions and impressions of those who have engaged a builder to construct a new home.

The survey is one of the few measures of quality of new builds. As such, it is an important tool and provides evidence that we do not otherwise have.

Each year, a sample of over 2,800 new house owners are invited to participate in the BRANZ New House Owners' Satisfaction Survey. The source for the sample is building consents. For the 2015 survey, those building houses who applied for a building consent between April 2014 and March 2015 provided the pool of possible participants. Consents issued to a spec builder, consents where the building owner and builder shared a last name and consents where builders were also owners were removed from the pool of potential participants.

In total, 708 completed responses were received, meaning a 25% response rate based on sample size. However, a number of surveys were undelivered for a range of reasons including the house being unfinished at the time of delivery or because the street name or number had changed. Taking into account the number of undelivered surveys, the response rate is closer to 35%.

The 2015 survey, for the first time, contained a question on willingness to pay for product assurance on sustainability-related information about the materials used in the build.

Figure 15 shows that there was a 20% positive response regarding willingness to pay, with the most common premium being up to 2%. Among the rest, 55% were not willing to pay, and 25% were unsure. The number of responses received means the sample size is statistically significant at a 90% confidence level.
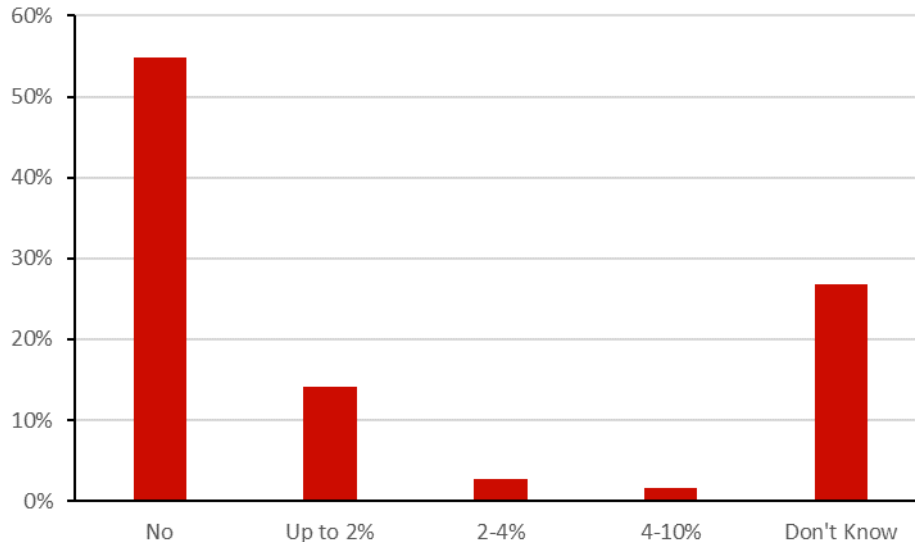
Figure 15. New house owners' willingness to pay for product assurance about sustainability.

A more detailed survey carried out in the USA (McGraw Hill Construction, 2014) considered willingness to pay for healthy home products. The results, which looked at willingness to pay by age group, found the following:

- More than half of respondents in the 20–39 age group indicated they would pay a premium of 3%. The proportion willing to pay this premium decreased as people got older, down to 17% from age 60 plus.
- The proportion willing to pay a premium of 4–6% generally increased with age from 12% in the 20–39 age group up to 26% in the 70 plus age group.
- 16% of respondents in the 20–39 age group indicated they would pay a premium of 10% or more. The 40–69 age group would pay less, but 26% of the 70 plus age group would pay more than a 10% premium.
- The 50–59 age group had the largest proportion (21%) that would not pay extra. They were also the age group with the largest proportion (25%) who were undecided.
- The survey also reported that homeowners without a degree were more likely to be unwilling to pay for healthier home products (21% compared to 13%). Also, those making US$50,000 a year were found to be more willing to pay a premium of 10% or more in comparison with other income groups (23% compared to 13%).

5. The scale of the NCP issue

It is difficult to gauge the extent and cost of NCP to New Zealand construction, as information is primarily anecdotal. Cost here is defined as the direct additional cost incurred in order to remedy the NCP once detected. It does not attempt to quantify indirect or societal costs that may be incurred through business loss, injury or fatality as a result of failure of NCP, for example.

Two methods have been used to estimate the dollar cost of NCP in New Zealand:

- **Method 1:** Media and other reports[9] on product failure in New Zealand and elsewhere were used to derive a list of NCP together with an estimate of incidence and cost to remedy. This method uses a bottom-up approach. Its limitations are the difficulty to estimate incidence in some cases, and since the method is based on reported failures, it omits NCP that has avoided detection. It is also focused primarily on residential construction. It is therefore likely to represent an underestimate.
- **Method 2:** Australian suppliers and manufacturers were surveyed on their experience of NCP in Australia and the findings summarised in a report by The Australian Industry Group (2013). The findings in this report were assumed to represent a similar case in New Zealand on the basis that there is nothing significantly different in New Zealand. This uses a top-down approach and encapsulates non-residential construction in addition to residential construction.

Table 1 summarises the assessment carried out using method 1, which used media reports and industry knowledge on failures of materials or use of substandard materials in building work. Therefore, this is not based on any systematic survey data on product failures. The cost estimates are either repair costs or replacement, using published construction cost data.[10]

Based on the assessment, an annual total cost of $95 million was derived including materials and labour.

Table 2 summarises the results of the same assessment but carried out using method 2. This method takes the survey results from The Australian Industry Group (2013) report concerning experience of NCP, in particular, the percentage of respondents experiencing NCP and the percentage market penetration of that product.

This model estimates the volume of product in the New Zealand market in column 1. The calculations at the bottom of the table are estimated using the total value of work in each of residential and non-residential buildings. These total values are multiplied by the percentage material share obtained from the Rawlinsons on-line cost dataset. Columns 2 and 3 provide percentages obtained from The Australian Industry Group (2013) report. Column 2 is the percent of members in a subindustry who have experienced problems with NCP. A flat rate of 30% penetration by NCP is assumed for all products in column 3, except a lower rate was used for windows. The latter is because residential windows are almost all made locally. The product of the three columns gives the estimated loss of sales by manufacturers.

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[9] A list is provided under Media reports in the References section.
[10] Rawlinson cost consultants at www.qvcostbuilder.co.nz.

The result is a loss of sales by New Zealand manufacturers of about $116 million per year. With an assumption that labour costs for installing product, demolition and disposal is about 50% of the total cost,[11] the total in place cost is $232 million per year.

The two methods provide a cost range of between $95–232 million annually. The annual cost of construction is about $25 billion at present (buildings plus civil works), so the cost of NCP is a small percentage. However, there are additional costs apart from reconstruction, such as redesign costs, extra council fees, loss of reputation and disruption to business. These are likely to be significant and in some cases may be as large as or exceed the reconstruction cost.

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[11] The labour cost percentage is based on breakdowns from Rawlinsons for the various factors of production.

Table 1. Method 1 evaluation of the cost of NCP.

Potential product failures in the absence of traceability	Instances	Consequence	Required action	Discount Factor (to bring future costs to to-days values)	Occurrences per yr (before remedied) Number	(1)	Cost per site $000 (materials + labour)	Cost/year $m (materials + labour)
Cement (2)	Sub-standard imported	Below strength concrete	Dug out and replaced		15	0.5% non-res/civil sites	50	0.75
Concrete (2) Panels	Sub-standard	Below strength panels	Early replacement	0.3	5	sites	200	0.3
Steel								
Structural steel (3)	Sub-standard imported	Below strength structure	Replace		15	0.5% non-res/civil sites	500	7.5
Structural steel fabricated (4)	Sub-standard imported	Below strength structure	Replace			non-residential		12.0
Re-bars (5)	Excessive bending	May break in brittle fashion	Tests / replace some		800	1% precast panels	2	1.6
Mesh (5)	Low ductility	Brittle fracture at design load	Early replacement 20 yrs	0.3	125	0.5% new houses	50	1.9
Bolts (5)	Low ductility/ strength	Brittle fracture, replace wall, beam, etc	Replace	0.3	138	0.5% new houses &non-res	50	2.1
Timber								
Framing (6)	Straightness problems	Asethetics of linings	Packing		10,000	20% new houses	0.2	2.0
Framing	Not sustainable sourced doc.	Entry barred to overseas markets	Have a scheme		20	Lost profit in Australia, etc.	1000	20.0
Panels and engineered joists/ beams (7)		Inadequate durability	Early replacement 20 yrs	0.3	250	1% new houses	50	3.9
Plywood (7)		Inadequate durability	Early replacement 10 yrs	0.6	125	0.5% new houses	10	0.7
Insulation (8)	Sub-standard imported	Lower thermal performance	More heating energy	15.8	1,250	5% new houses	0.2	3.9
Underlays/tapes (9)	Sub-standard imported	Early failure/ leaks	Early replacement 10 yrs	0.6	250	1% new houses	80	11.2
Plasterboard (10)	Sub-standard imported	Shorter life	Early replacement 20 yrs	0.3	500	2% new houses	25	3.9

(1) Occurences of faulty materials are based on media reports and BRANZ assumptions, as stated below.   New housing per year   25000 New non-res bldgs per year =   2500   **Total $M**   71.8

(2) Cement. Imports are only 3% of use, mainly from China. Hence poor concrete incidence is very low. Concrete panels origin possibly misrepresented.

(3) Structural steel sections. About 92% is from Australia, the remainder from China and Japan. Hence poor steel properties are low % of total.

(4) Steel fabrications for bldgs and civil are significant, about 48,000 tonnes per year, with 45% from China. Assume 5% of imports are suspect =   2400 tonnes   Replace at $5,000/tonne

(5) Rebars, mesh, bolts. Two mesh importers have stopped selling re more tests. Small number of houses may need new floors in 20 years. Some bolts tested below specified strength.
      Concrete panels (80,000/yr) have re-bent start bars NZH Nov 2007- assume 1% failure rate.

(6) BRANZ New house construction quality survey 2014 found a significant proportion (40%) of new houses with some out of spec stud and plate bowing. Extra effort to straighten/ pack for lining ave $200/hse.
      Sawn framing timber exports to the Australian market require certification re sustainably sourced.

(7) Mainly local manufactur are used but a small quantity is imported.

(8) Insulation. Tasman is 70% share, Knauf and Bradford 20% together. So 10% is small importers, assume 50% of these are suspect. Cost are calculated as below code performance at $200 extra per year heating bills.

(9) Underlays/tapes. Most have BRANZ appraisal. About 3% source unknown based on BRANZ surveys..

(10) Main suppliers are Winstones, Elephantboard, Knauf, CSR and together have over 95% of market. Assume 3% is sub-standard board.

Potential product failures in the absence of traceability	Instances	Consequence	Required action	Discount factor (to bring future costs to to-days values)	Occurrences per yr (before remedied) Number (1)	Cost per site $000 (materials + labour)	Cost/year $m
Claddings (11)							
Metallic roofing	Metal thin, inadequate coating	Corrosion/ leaks	Early replacement 20 yrs	0.3	125 0.5% new houses	30	1.2
Asphalt shingles	Auckland Council	Early failure/ leaks	Early replacement 10 yrs	0.6	25 0.1% new houses	10	0.1
Fibre cement sheet system	School buildings (excl leaky bldgs)	Early failure/ leaks	Early replacement 10 yrs	0.6	2 0.5% school buildings	100	0.1
Windows, frame and glazing (12)	Poor quality	Leaks/ blow-out	Early replacement 10 yrs	0.6	125 0.5% new houses	25	1.7
Plumbing (13)							
Shower doors	No safety glass	Unsafe	Replace immediately		2,500 10% new houses	0.5	1.3
Taps/ fittings	Shoddy	Inadequate performance	Early replacement 5 yrs	0.7	3,750 15% new houses	0.8	2.2
Copper piping	Poor quality	Corrosion/ leaks	Early replacement 10 yrs	0.6	13 0.5% non-res bldgs	200	1.4
Spouting/downpipes (14)	Sub-standard imported	Material UV failure	Early replacement 10 yrs	0.6	500 2% new houses	1	0.3
Rubber ring seals (15)	Poor quality	Leaks	Early replacement 5 yrs	0.7	25 1% non-res bldgs	20	0.4
Waste pipe	Poor quality	Poor durability	Early replacement 10 yrs	0.6	250 1% new houses	1	0.1
Electrical fittings (16)	Sub-standard imported	Unsafe, poor durability	Early replacement 10 yrs	0.6	5,000 20% new houses	2	5.6
Cabling	Sub-standard imported	Unsafe, poor durability	Early replacement 10 yrs	0.6	138 0.5% houses+non-res bldgs	10	0.8
Miscellaneous (17)							
Sealants	Sub-standard imported	Early failure/ leaks	Early replacement 10 yrs	0.6	250 1% new houses	3	0.4
Floor tiles	No slip resistance	Falls/ injuries	Health costs/ tile treatment		250 1% new Houses	10	2.5
Bracing	Substitution	Weaker bracing	Early replacement 20 yrs	0.3	125 0.5% new House	30	1.2
Aluminum sandwich panels	Fire risk	Fire	Replace immediately	1.0	3 0.1% non-res bldgs	1000	2.5
Waterproofing membranes	Sub-standard imported	Early failure/ leaks	Early replacement 10 yrs	0.6	125 0.5% new houses	30	2.1

(1) Occurences of faulty materials are based on media reports and BRANZ assumptions, as stated below.   New housing per year   25000 New non-res bldgs per year =   2500   23.9

(11) Isolated reports of cladding failures on housing and other buildings. The incidence of failures is unknown but believed to be very low.   New civil const sites per year =   500   Previous page   71.8

(12) Isolated reports of window failures on housing and other buildings. The incidence of failures is unknown but believed to be very low. Alum frame imports abt $12m/yr, i.e. small.   **Total $M**   95.7

(13) Plumbing fittings. Media reports from plumbers estimate 50% new homes have fittings that would be banned in Australia, mainly taps and showers glass. Assume 20% of new houses are affected.

(14) Spouting. Industry reports of inspection of failures reveal the failure is in unknown imported products, not in locally produced product.

(15) PVC pipes/ wastes. Skellerup v Marley damages claim.

(16) Electrical contractors say they have a similar issue to the plumbers re suspect imports and lack of checking of compliance of electrical fitting imports. Assume 20% of houses are affected.

(17) Miscellaneous. Mainly one-off reports of failures of specific products. However, sealants, adhesives and membranes are commonly reported as being of unknown origin, and poor quality.

Table 2. Method 2 evaluation of the cost of NCP.

Volume of non-compliant products (NCP)	Volume of NZ market for product $M (excl installation) (1)	% of industry with complaint (2)	Non-compliant products market penetration (3)	Loss of sales by NZ manufacturers $M col (1)x(2)x(3)
Structural steel fabrication (a)	150	49%	30%	22
Steel connectors (bolts)	10	50%	30%	2
Panels and engineered (b)	526	5%	30%	8
PVC pipe/fittings (c)	448	5%	30%	7
Electrical (cables/ fittings) (d)	304	50%	30%	46
Windows (e)	618	48%	5%	15
Paint (f)	132	3%	30%	1
HVAC equipment (g)	122	45%	30%	16
				116

(a) Steel fabrication. Report for HERA estimates the market for fabricated steel in buildings at

     60,000 tonnes per year @ $2500/tonne =   150 $ M fabricated material only

		% for materials only			$M
		Residential	Non-res bldgs	Total materials sales	6480
	Total bldg cost/yr $M	10100	6100	Non-compliant as %	1.8%
(b) Timber panels EWP	Timber floor/ joists	4%	2%		
	$M	404	122		
(c) Plastic building products.	Piping / wastes	2%	3%		
	Spouting/downpipes	0.5%	0.2%		
	$M	253	195		
(d) Electrical cable/ fittings		1.5%	2.5%		
	$M	152	153		
(e) Windows		4.0%	3.5%	Assume % industry with NCP windows is much
	$M	404	214	lower than in Australia which had 48%.
(f) Paint		1%	1%		
	$M	101	30.5		
(g) HVAC		0%	2%		
	$M	0	122		
Total %		13%	14%		

(1) The calculation of product value is as above using % component value x total value of all new buildings per year.

(2) % of Australian members in the sub-industry whom had experienced NCP. We assume the same % applies in NZ.

(3) % NCP penetration is from the Australian Non-conforming products report November 2013 by the AIG.

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6.   A model for electronic traceability

An aim of this research project is to make a financial assessment of electronic traceability for different stakeholders in the supply chain. This is in order to better understand the potential costs of implementing such a system in New Zealand against the benefits that New Zealand Inc. could accrue with implementation of such a system.

The stakeholders being considered for this assessment are:

- manufacturers and importers
- conformity assessment bodies (CABs)
- builders' merchants
- architects, designers, structural engineers and quantity surveyors
- specifiers
- building consent authorities
- builders/developers.

In order to make such an assessment, a model electronic traceability system needed to be defined, outlined in this section. This provides a representation of what an electronic traceability system might look like and how stakeholders in the construction supply chain could interface with it.

The model electronic traceability system has been developed taking into account current industry developments, such as the National Product Catalogue.[12]

6.1   Key objectives of an electronic traceability system

These are the key objectives of an electronic traceability system:

- It should significantly reduce or stop use of NCP through product substitution.
- It can provide a means for conformity assessment information to be linked to products. The scope of conformity assessment necessary is specific to individual products, how and where they may be used in a building and the consequences if they were to fail. This is set out in the *Product assurance decision tool* (MBIE, 2016a). If conformity assessment information were to be accessible via an electronic traceability system, the system would need to be able to deal with different types of conformity assessment. This would include technical opinions, test reports from accredited laboratories, appraisals or CodeMark certification.
- It may provide a common platform for reference by different tools and documentation used in the process of design, consent and build including BIM objects (with traceability metadata), product technical statements and specifications.
- It should be as easy as possible for users whilst maintaining a level of rigour and security. In particular, it should not place an administrative burden on builders and their subcontractors.
- It should assist BCAs to check use of appropriate product and provide early warning of discrepancies. Ideally, it should speed up the consenting and inspection process whilst making it easier for building inspectors to check that materials used on the build are as specified.
- It should help the customer get the product they are paying for.

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[12] www.gs1nz.org/services/npc/

A report by KPMG and GS1 UK (Cartwright et al., 2014) concerning the tobacco industry set out key features of traceability from a practical perspective. Those reported can be considered as applicable to a traceability system for construction products as follows:

- Unique identification numbers – built on international standards, unique to individual units and non-predictable.
- Marking technologies – this is the means by which data about a product is captured. It can vary depending on the product but should conform to a standard.
- Aggregation of units – use of a parent-child relationship to establish links between unique identification numbers of units and the lot, batch, pallet or container load in which they may be located for distribution purposes.
- Data capture – allows for the ability to access additional information such as a product description and provenance, for example.
- Supply chain events – points in the supply chain where each shipper and receiver is required to validate units as they change hands.
- Data transfer – the means by which data is transferred and stored and the ability to access data by users.

In practice, the means by which unique identifiers are physically added to products will vary depending on the product. The assessment in this section does not consider this level of detail. The exact nature of the technology will vary by product, the manufacturing process and how companies in supply chains are already set up. For example, a printed barcode (linear or two-dimensional) on an RFID tag attached to the product or product packaging would enable a product (or lot, batch, pallet load or container load) to be identified and tracked.

Barcode technologies require a physical line of sight since the technology uses light to read the code.

RFID does not require direct contact or line of sight to track products and provides another option, which is increasingly being adopted across sectors including in construction. The technology uses radio signals at different frequencies to identify targets in real time. Multiple RFID tags can be read simultaneously, saving time and increasing efficiency. Since it does not require any contact or line of sight, it is especially useful in harsh environments (Sun, Jiang & Jiang, 2013). The technology (and application software) has also been tested for use in automated project scheduling and inventory monitoring on construction sites (Gajamani & Varghese, 2007). Such an application enables a product to be tracked from manufacture to the construction site. It can also be tracked in its storage location prior to installation and in its installed position in a building (with updating of the progress schedule and BIM model in real time).

The system set out below provides the basis for a financial assessment for different industry stakeholders. It uses a system that already exists in New Zealand, called the National Product Catalogue (NPC).

The system described in this section reflects an expanded version of the NPC, which provides a repository for listing products with unique identifiers and accompanying information. Such a system can also provide the basis for chain of custody through the supply chain. This functionality is not part of the scope of the traceability system used for the financial assessment but could be with additional functionality and features.

The proposed system is intended to make it more difficult for product substitution on construction sites. It focuses on identifying products and provision of conformity assessment (and other) information. Through use of a smartphone app, it provides a means for a builder to check and declare that a product being used on a build is as specified.

Where New Zealand Building Code compliance relies on a combination of specific products to be used, the proposed system can check that appropriate products, as specified, are used to make constructed systems. However, it cannot check workmanship issues, which would need to continue to be the focus of inspections by BCAs.

6.2   The model electronic traceability system explained

Figure 16 illustrates the model electronic traceability system devised for this work, with further explanation provided below. This model forms the basis of the financial assessment in section 7 and is illustrative only. It represents one way that such an electronic traceability system may operate. Variants on this are possible, with additional information options, functionality and costs. The detail of these variants has not been investigated. The purpose of this work is to assess feasibility of a simpler system and facilitate understanding of electronic traceability and its potential benefits to New Zealand Inc.

With sufficient interest in electronic traceability from the construction industry, the architecture of how such a system would operate would need further development and testing with input from stakeholders.

6.2.1   National Product Catalogue (NPC) [1 in Figure 16]

The NPC is implemented in New Zealand, having been developed by GS1 NZ and GS1 Australia. It already contains over 1 million (construction and non-construction) products across Australia and New Zealand, 82,000 of which are do-it-yourself (DIY) and building sector products. Each product in the NPC is uniquely identified with a Global Trade Item Number (GTIN).

The NPC is currently being used by builders' merchants as a means of identifying products held in stock for purchasing and procurement functions. It also provides a standardised set of additional information about each product to support business functions. The NPC has provision for over 400 master data fields for this purpose and includes information such as trade item description and dimensional specifications of different packaging units, for example.

For imported products to New Zealand, the NPC can provide data fields for various classification, quality and regulatory coding identifiers.

The model electronic traceability system illustrated in Figure 16 can be supported using NPC data as follows:

- Participating manufacturers and importers providing construction products to the New Zealand market (and listed in the NPC) are required to have a unique legal entity identifier. Similarly, organisations involved in conformity assessment also have a unique legal identifier. These include laboratories undertaking tests to New Zealand Building Code or overseas legislation used to show compliance and

verification or certification bodies. The identifiers will either be a New Zealand Business Number (NZBN)[13] or a GS1 Global Location Number (GLN).[14]

- For individual plants or sites where product is manufactured for use in New Zealand, a GLN can be used to identify 'ship from/ship to' type transactions, whether in New Zealand or overseas.
- Each product (including packaging hierarchies such as cartons and pallets) populated in the NPC is identified by a GTIN. As outlined, the GTIN is a unique product identifier that provides a necessary building block to track a product through the construction supply chain. The GTIN is also the key that unlocks access to additional information about the product. This information, some of which is broader than that currently held on the NPC, may include the following as a minimum:
  - o Product identifier (based on the GTIN).
  - o Legal entity identifier (based on the NZBN or GLN).
  - o Unit of measure and product packaging hierarchies.
  - o Clauses of the New Zealand Building Code for which the product claims compliance and means by which this compliance is supported or demonstrated. This could include links to compliance information showing the type of compliance testing undertaken, by who, where, when, on what products (a listing of GTINs of tested products) and to what standards (New Zealand or overseas). (For further information, see section 6.2.3.)
  - o Link to a product technical statement, if developed.
  - o Link to a safety data sheet.
  - o Dangerous goods information and HSNO classifications.
- There could be an option to widen the scope of the NPC still further so that it provides additional supporting product information (for example, through use of links) such as:
  - o declaration of chemical constituents of the product – for example, a DECLARE label, if developed
  - o an environmental declaration such as an Australasian EPD® Programme environmental product declaration (EPD) or environmental certification (for example, Environmental Choice), if developed
  - o provenance of materials contained in the product, if declared
  - o the environmental management, health and safety, sustainability and ethical policy of the manufacturer, if declared
  - o maintenance information
  - o product stewardship information – for example, how to recycle at end of life
  - o a building information modelling (BIM) object, if available.

Within the context of this analysis, the NPC is a repository of manufactured construction products used in New Zealand. The NPC is not a traceability solution. Rather, the NPC supports traceability outcomes by providing the necessary building blocks to achieve this, namely:

- GTIN – unique identification of products (providing the 'what' dimension)
- NZBN/GLN – unique identification of legal entities and physical locations (providing the 'who' and 'where' dimensions).

The process of recording the physical movement of products moving through a supply chain (a tracking event enabled by GTIN) associated with recording where a product

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[13] www.nzbn.govt.nz/
[14] http://gs1nz.org/standards/identify/

has been seen (identified by the NZBN/GLN) and time stamped (time/date) provides the basis for establishing traceability outcomes.

With additional information (as described above), which would need to be defined by user requirements, the NPC could become a repository of information about construction products available for use in New Zealand construction.

Table 3 summarises the possible expansion of the NPC with content. This has the following benefits:

- It already exists, meaning much of the costs of set-up have already been incurred.
- Construction products listed on the NPC can be tracked and their current location traced if traceability systems are in place and enabled by sector stakeholders.
- Manufacturers and importers can provide information about their products linked to unique identifiers (GTINs), and conformity assessment bodies can link the outputs of their assessments to these same identifiers.
- Stakeholders involved in design and consenting could access the NPC to obtain product information via an app or interface that meets their needs, drawing on real-time information in the NPC.
- In the future, there is the possibility for the regulatory authority to set minimum requirements for accepted conformity assessment documentation, which could be reflected in the NPC. This would be based on an assessment of the level of risk of NCP associated with any product or sector.
- Customs can more easily obtain packaging unit information about products arriving at the border to facilitate checks.
- Having one repository for New Zealand construction products, constantly synchronised between sector stakeholders/trading partners, means that multiple stakeholders do not need to look for the same information in different places, This will improve efficiencies and save time.

Table 3. Possible NPC expansion options.

	NPC (current)	NPC (expanded)	NPC (expanded, with additional information)
Users	Builders' merchants, some manufacturers	More manufacturers, designers, specifiers, BCAs, builders' merchants, builders	More manufacturers, designers, specifiers, BCAs, builders' merchants, builders
Manufacturer (entity)	Exists	Exists	Exists
Manufacturer physical location	Exists	Exists	Exists
Unit size (packaging hierarchy)	Yes	Yes	Yes
Dangerous goods information/HSNO	Yes	Yes	Yes
New Zealand Building Code clauses and conformity assessment	No	Yes	Yes
Overseas building codes and conformity assessment information	No	Yes	Yes
Safety data sheet (link)	No	Yes	Yes
Product technical statement (link)	No	Yes	Yes
Declaration of chemical constituents such as DECLARE (link)	No	No	Yes
EPD (link)	No	No	Yes
Environmental certification such as Environmental Choice (link)	No	No	Yes
Materials provenance information	No	No	Yes
Information about manufacturer environmental management, health and safety, sustainability and ethical policies	No	No	Yes
Product maintenance information	No	No	Yes
Product stewardship information	No	No	Yes
BIM object (link)	No	No	Yes

6.2.2   Manufacturer/importer [2 in Figure 16]

A manufacturer or importer is able to populate the NPC with product master data by subscribing to the NPC. GTINs are licensed by GS1 to a brand owner (for example, a manufacturer) who in turn allocates GTINs to their products and packaging.

The GTIN is represented as follows:

- On a product or its packaging (on-product route) by the use of barcodes and/or RFID tags. A GTIN (encoded into a data carrier such as a barcode) should be assigned to all packaging hierarchies (consumer unit, carton, pallet load and so on), if relevant for the product, to provide for robust traceability outcomes.
- As information in documentation about the product, which may be in hard-copy or electronic formats (documentation route). Examples could include:
    - o metadata to accompany BIM objects provided by manufacturers and downloaded by designers during building design
    - o safety data sheets (SDS), where the GTIN provides a linkage with the product (other than the name, which may be misread or confused with other products)
    - o product technical statements, which are encouraged by MBIE as a means for manufacturers and importers to summarise "key information, technical evidence and the relevant compliance pathways"[15] for building products.

The cost of providing GTINs for on-product applications and in accompanying documentation will vary depending on the number of GTINs required. Set-up costs will be necessary for those requiring AIDC capability/systems if not already implemented.

These costs need to be considered in the context of potential for lost sales and revenues due to incidence of NCP within each sector. Potential reputational damage also needs to be considered – for example, where customers incorrectly believe that failing NCP installed on a new house is a manufacturer's legitimate product.

On-product GTINs are able to be read as a linear or two-dimensional barcode (for example, a GS1 DataMatrix or GS1 QR code) or potentially through use of RFID technology. By providing a unique product identifier in a machine-readable form on a product, the recipient could also potentially access information about the product in the NPC.

Section 6.2.4 describes the documentation route, and section 6.2.8 describes the on-product route.

6.2.3   Conformity assessment body (CAB) [3 in Figure 16]

Conformity assessment bodies are involved in testing and providing documentation that may support, provide an opinion or certify a product's appropriateness (with or without other products) for achieving clauses in the New Zealand Building Code. In the model electronic traceability system in Figure 16, CABs would have the facility to read information on the NPC and write to it.[16]

Details of any testing, appraisal, verification, certification or other form of conformity assessment demonstrating compliance is provided against the relevant New Zealand Building Code clause data field in the NPC. Similarly, conformity assessment information against overseas building codes and standards that is provided as a means to demonstrate compliance with the New Zealand Building Code can also be provided.

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[15] www.building.govt.nz/building-code-compliance/product-assurance-and-multiproof/product-assurance/product-information-and-evidence/product-technical-statement/quick-guide-to-understanding-product-technical-statements/

[16] It is envisaged this would be limited to CABs in New Zealand. Conformity assessment information supplied from overseas providers would be added to the NPC by importers.

The conformity assessment information could be provided as a link in the NPC by the conformity assessment body itself, which is identified by their NZBN (or a GLN) for example. This conformity assessment information would be provided against specific clauses of the New Zealand Building Code, set up as data fields in the NPC.

Stakeholders in design and consenting (such as an architect or BCA) could access this information on the NPC. This would allow them to check clauses of the New Zealand Building Code for which compliance is claimed and what has been done, by whom, to demonstrate this compliance (laboratory tests, opinion, appraisal, certification and so on).

The conformity assessment body provides the GTINs of the products that have been tested, appraised or certified (for example) by referencing the GTINs on tested products, for transparency.

In this way, the NPC provides the opportunity for a single source of product conformity information linked to specific GTINs, accessible by those that require this information.

6.2.4   Documentation route

The documentation route concerns the following stakeholders, for which further information is provided below:

- Architects, designers, structural engineers and other professionals involved in design who may use BIM (building design) – see section 6.2.5.
- Specification – see section 6.2.6.
- BCAs – see section 6.2.7.

6.2.5   Building design [4 in Figure 16]

Those involved in building design would have read-only access to the NPC, via an interface and format that meets their information needs.

During the design process, those designing in BIM may download BIM objects from product manufacturers for use in their BIM models.

A GTIN, provided as metadata associated with the BIM object, would allow the designer to check that the proposed product has a listing on the NPC. It may also provide access to accompanying information about the product (depending on whether the expanded NPC with additional information is developed), examples of which are provided in section 6.2.1. Some of the suggested information is informed by survey responses (see section 4).

A precedent for inclusion of traceability information in BIM object metadata already exists overseas in the UK National BIM Library.[17] Here, a barcode listing is included as a component property within COBie.[18]

Use of such a field provides an opportunity to include a GTIN that can link the digital product (in a BIM model) to the physical product (in the build).

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[17] Available at www.nationalbimlibrary.com.
[18] The Construction Operations Building Information Exchange (COBie) provides a metadata format that is important for maintenance and management of building assets during operation.

6.2.6   Specification [5 in Figure 16]

Specification software would have access to the NPC either directly or even as read only.

Currently, there is usually no direct link between a BIM model and a specification. This is, in part, because of the way that BIM is currently used in New Zealand. There is a lack of integration and a lack of completeness and accuracy concerning representation of materials in BIM models. This should change in the future.

Under the current system (when BIM is not integrated with specifications) but with inclusion of traceability, the specification would include product listings and GTINs (displayed as linear or two-dimensional barcodes, for example). This would ensure that information about a product in the NPC is accessible. The specification would also include any acceptable alternative products with GTINs.

The products with GTINs would be listed automatically in the specification as a product list, which would be available in an electronic format.

With future development and use of accurate, representative and complete BIM models of buildings, with traceability information available in BIM object metadata, there may be potential to base specifications direct from the BIM model.

Specifiers who do not use specification software would need to add GTINs to specifications ideally accessed using the NPC in the same way this is needed for specification software.

6.2.7   Building consent authority (BCA) [6 in Figure 16]

BCAs would have access to NPC data even if read only.

The specification, with other consent documentation, is submitted to the BCA for building consent approval. Included in the specification would be a product list, with GTINs listed next to each product (in a machine-readable format such as a linear or two-dimensional barcode). This would allow the BCA to check conformity assessment and other information about specified products.

The product list provided to the BCA as part of the documentation for obtaining building consent would comprise:

- the specified product's name
- the specified product's GTIN, accessible with a printed linear or two-dimensional barcode (for example)
- ideally, the quantity of specified product required for the build (excluding waste)
- the above information for possible alternative specified products that may be used.

The product list would be provided in an electronic format. On receiving consent, the BCA would assign a unique project identifier, which links the product list to the build project. The product list would be available on a server under the project identifier. This provides a reference list of suitable products, which is checked automatically as the builder scans product that is intended for the build.

Further information about how this would be used is provided in section 6.2.10.

6.2.8   On-product route

The on-product route concerns the following stakeholders, for which further information is provided below:

- Builders' merchants – see section 6.2.9.
- Builders – see section 6.2.10.
- Customers/clients – see section 6.2.11.

6.2.9   Builders' merchant [7 in Figure 16]

Builders' merchants would have access to NPC data even if read only.

Most major builders' merchants in New Zealand are currently using the NPC. Extra information could be made available in the NPC that would enable these stakeholders to have access to additional product information, such as environmental product declarations and certifications.

Products populated in the NPC would help ensure that ordered and stocked products have industry-required levels of product compliance and assurance.

Once consent is provided by the BCA, the builder could provide the product list from the specification electronically to the builders' merchant for each build. The builders' merchant would use this to scan the products being assembled for an order (including quantities). When the linear or two-dimensional barcode is scanned, a real-time check is made to ensure that the scanned product is as specified. If it is as specified, a notification is provided such as a green tick. If it is not, a notification is provided such as a red cross.

In putting the order together, the builders' merchant is confirming that the assembled products for a specific build are as specified. This is done by checking that the GTINs on the assembled products match those listed in the product list. The builder can then collect or the order can be delivered to site. The time and date that the order is delivered or picked up is time stamped.

6.2.10   Builder [8 in Figure 16]

A builder[19] may not need to access the NPC directly but could access product information using GTIN as the primary identifier using a mobile app (for example) connected to NPC data.

Following consent, the builder would receive the product list electronically from the BCA under a project identifier provided by the BCA. This product list can be forwarded on to subcontractors (who may undertake some of the work and order materials for this purpose) and builders' merchants (who may put together the order).

Using a smartphone app, the builder could have the option to state quantities of materials required (for example, using a slider bar next to each material) for an order. They could also indicate a date for delivery or collection. Alternatively, types and quantities of materials can be provided by the builders' merchant (see section 6.2.9). Where a builder or trade is ordering for multiple builds, this could be done for each.

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[19] Where the term 'builder' is used, this also encompasses trades such as electricians or plumbers, for example.

On receipt of the electronic order, the builders' merchant could assemble the required products and scan the linear or two-dimensional barcodes against the materials list to ensure they are as specified. This would also provide a list of what products are in the order and the quantities against what was received in the order from the builder or trade.

When the order is delivered to a construction site or collected from the builders' merchant, the transaction will be time stamped. By scanning the products with a smartphone app, the builder can check that they are as specified and is confirming that the products received will go into the build project.

By scanning a product with a smartphone app, the builder can check that a product is as specified (for example, using the green tick or red cross display described in section 6.2.9). This system would provide the builder with real-time assurance that the product is as specified and they can proceed with installation.

When the builders' merchant and builder scan the products, the BCA can be notified with real-time information about the materials and quantities going into the build. Where products are not scanned by the builder or the quantity scanned is significantly less than the quantity on the product list, the BCA can make enquiries to the builder and make checks during site visits.

Products not listed on the NPC may also be used but would be listed on the BCA's system as a data gap and therefore could receive greater scrutiny during inspections. The process for checking that the product is acceptable would also, most likely, take longer.

In rare occasions, scanning barcodes is either difficult or problematic (for example, if barcodes are damaged or unreadable). To mitigate this, the builder would need an alternative process (such as manual data input of the GTIN into a smartphone app data field).

There is also the potential that the order assembled by the builders' merchant for the builder can link to the builder's accountancy or financial systems.

6.2.11   Customer/client [9 in Figure 16]

There is the option that the end customer could be provided with an information pack about their building, which might include:

- a list of the actual products used on the build
- documented evidence that specified materials were used or, where not (for example, if a product does not have a GTIN), supporting evidence these other materials were checked and found to be suitable for the application concerned
- maintenance information for the products incorporated in the building
- supporting information about the products obtained from the NPC, such as product constituents, provenance, product stewardship and environmental information.

Figure 16. A model electronic traceability system used for the financial assessment.

2 — Manufacturer/importer

Manufacturer/importer	Key features
Creates GTINs that identify product, batch/lot (if required)	Is a legal entity and has a NZBN or GLN.
Prints/adds GTIN to product or packaging (eg. linear / 2D barcode)	Provides a unique identifier that can be machine-read down to batch/lot level (if required).
Adds GTINs to product documentation eg. PTS, MDS.	When read, allows cross checking to ensure product is on the NPC.
Provides GTINs for specification eg. tools, software.	Ensures linkage between information flow (on drawings, specifications etc) and product flow.
Adds GTIN to BIM objects in metadata	

Product information

4 — Building design

Building design	Key features
Use manufacturer/importer supplied BIM objects with meta-data that includes GTIN	During design, the design team can check if a product proposed for use is listed on the NPC. The design team can potentially access other product information that may inform the design e.g. product constituents, provenance, product stewardship.

Choice of materials informs specification (now)

BIM model with traceability meta-data (future?)

1 — NATIONAL PRODUCT CATALOGUE (NPC)

NATIONAL PRODUCT CATALOGUE (NPC)	Key features
Hub for construction products in NZ	Provides a repository for construction products used in NZ.
Already exists and being used by builders' merchants.	Provides a repository for entities involved in product traceability who may provide GTINs or need to access them.
Contains a listing of legal entities supplying construction products to New Zealand and other entities e.g. conformity assessment bodies, building consent authorities etc, using NZBN or GLN.	Makes linkage between product and test reports, appraisals etc. Makes it easier to check that product is what it is supposed to be.
Incentive to manufacturers is that presence on the NPC makes it easier to check that product meets required standards and reduces risk of substitution. Potential for quicker consenting.	

5 — Specification

Specification	Key features
Specification software provides GTINs for specified products, including acceptable alternative products. Specification software needs to access GTINs from NPC.	The specification sets out the products to be used in the build (plus acceptable alternatives) in a product list. Provision of GTINs in the specification provides the opportunity to check that specified products are being used by the builder.

Specification includes a product list (in electronic format)

Specification to builder following consent

7 — Builders' merchant

Builders' merchant	Key features
Scans GTINs of products arriving to store.	Quick, easy way to check the product is what it should be.
Scans GTINs of products leaving the store (sales)	Can check products are as specified for each build.
Gets notified if the product is not listed on then NPC.	No/less paperwork.

Product with linear or 2D barcode

1D Barcode   QR Code

3 — Conformity Assessment Body (CAB)

Conformity Assessment Body (CAB)	Key features
Undertakes laboratory tests, appraisals, certification (or other types of conformity assessment) on a sample of products manufactured at a specific site to specific standards/New Zealand Building Code clauses	Is a legal entity and has a GLN. Checks GTINs exist on NPC. References the on-product GTINs on which tests/appraisals/certification carried out on the conformity assessment documentation. Can be linked to batches/lots (where required) Has access to the NPC in order to check that product continues to be manufactured at the same site as has been tested. Automatic alerts set up if any change. Able to add test, appraisal, certification (or other type of conformity assessment) to the NPC product listing.

6 — BCA

BCA	Key features
Receives specification and can check proposed products on product list by accessing information on NPC via GTINs. Builder scans products used on build as build progresses, and these are checked off against specification automatically. Red flag created where scanned product GTIN does not match specification.	Gives BCA greater ability to check products are suitable. Notifies BCA if an alternative product is proposed for use that is not listed on NPC. Quicker and more complete assessment. Can put more focus on products not on NPC. Record of information about product stewardship for when build becomes end of life.

Product with barcode/QR code   *Product list sent on to builders' merchant*

8 — Builder

Builder	Key features
Scans GTINs of products arriving on site for use in the build (using a smart phone app).	Quick, easy way to get okay that product is correct.
Gets notified if the product is not listed on the product list.	No/less paperwork. Notified if product not acceptable, and requires alternative process for acceptance. Greater assurance for builder.

Materials information pack for materials used on build (future?)

9 — Customer / client

Customer / client	Key features
Provision of an information pack about the new building.	Based on GTINs scanned by the builder, can get a listing of all significant products used in the build. Opportunity to use this to provide maintenance information, plus information about products' constituents, provenance, product stewardship, and other useful information for the customer.

KEY

- Traceability covered in product information
- On-product traceability e.g. barcode, QR code
- Read-only capability to NPC
- Read and write capability to NPC

7. Financial analysis by stakeholder group

7.1 Initial and on-going costs of implementation

The primary purpose of the model traceability scheme in section 6 is to ensure that materials used on site are as specified in the construction documents used by the builder. The specifier may be the designer or a specialist specifier. It is assumed they have adequate knowledge and experience to correctly specify materials that are New Zealand Building Code compliant and can be readily incorporated on site into the works.

Usually the designer does not calculate quantities. That would continue to be a separate task for the builders' merchant or the quantity surveyor as at present. The emphasis of the electronic traceability scheme described in section 6 is on exact product specification and delivery. However, as identical product could be delivered in stages, the app would (ideally) keep a running total of the quantity of deliveries. This would ensure the full order of the specified product is delivered without substitution.

Based on the expanded NPC in Table 3, the estimated costs of implementing this model traceability system are provided in Table 4, divided into GS1 NZ costs and stakeholder internal costs. The notes in the table are further amplified as follows.

7.1.1 Item 1 – number of firms and persons

The number of firms and persons in each stakeholder group is obtained from the Statistics NZ Business Demographic Survey. For designers, the two subcategories are architectural services and engineering design and consulting services. These total about 8,040 firms, and it was decided to reduce this number to 65% since some engineering services involve site investigations and supervision rather than design.

The main approximation is for manufacturers/importers since the business survey does not have details at the building materials manufacturing level. It only goes to the three-digit industry level. Relevant subindustries are:

- wood products
- ceramic products
- cement, plaster, concrete products
- structural metal products
- sheet metal products
- other fabricated metal products.

These total 630 firms, although not all are involved in producing building materials. In addition, importers are a significant source of material. Construction Information Limited recommended a higher number, based on the firms on their database. It was decided to use 1,000 firms, which includes building material importers estimated at about 300 firms.

Table 4. Estimated cost of implementing the model traceability scheme.

	COSTS TO STAKEHOLDERS TO PUT PRODUCT ON GS1 NPC DATABASE AND DEVELOPMENT OF AN APP FOR ON-SITE USE								
		Manufacturers/ importers	Merchants	Designers	Specifiers	CAB	BCA	Builders	Central Govt	Total
	Annual GS1 costs									
(1)	Number of firms	1000	5	5,200	3	5	70	53,520		
	Number of persons		5000	21,500	15		800	190,900		
(2)	Update existing/add new products/yr	$ 200,000	$ 200,000							$ 400,000
(3)	GS1 Annual fee	$ 92,000	$ 92,000			$ 4,000	$ 10,000		$ 6,000	$ 204,000
	One-off costs									
(4)	Specifiers obtain GTINs for all their products.				$ 150,000					$ 150,000
(5)	Phone App development		$ 19,000	$ 83,000			$ 3,000	$ 245,000		$ 350,000
	Users internal costs									
(6)	Obtaining enhanced traceability info	$ 417,000	$ 139,000							$ 556,000
(7)	Conformity Assessment Body (CAB)					$5,000				$ 5,000
(8)	Designers schedule of materials			$ 1,258,000						$ 1,258,000
(9)	Builders costs checking products on-site							$ 2,548,000		$ 2,548,000
	One-off costs	0	$ 19,000	$ 83,000	$ 150,000		$ 3,000	$ 245,000		$ 500,000
	Plus annual costs $/year	$ 709,000	$ 431,000	$ 1,258,000		$ 9,000	$ 10,000	$ 2,548,000	$ 6,000	$ 4,971,000
										5,471,000

(1) Number of firms / persons are from the Statistics NZ Business Demography database. NPC = National Product Catalogue

(2) BRANZ estimate of products going on the NPC 10,000 products /year, including existing products not currently registered + new products.

The cost to place product on the NPC is approximately $40 per product. Assume this cost is shared between manufacturers and merchants.

(3) Annual GS1 fee to maintain database. (Traceability share) $1.70 Assume 120,000 products, and cost shared between manufacturers,

merchants, BCAs and Central Government. $1.70 is based on 50% of the GS1 catalogue fee per GTIN. CAB charges are annua

(4) Involves development of common terminology between Specifiers for converting their product database to GTINs, allow $50,000 each for 3 specifiers..

(5) Phone App for tracking the origin & use of materials on-site. Total is $350,000 shared in proportion between users. App cost/user = $ 3.8

(6) Extra costs to manufacturers for tech literature assembly for a traceability scheme $56 /product.

(7) Conformity Assessment Body (CAB) costs to put links to appraisals, tests, opinions in the NPC. Assume per yr 250 entries @ $20 per product

(8) Designers extra costs in putting GTINs in all schedules of materials. $17 per project.   Projects per year= 74,000

(9) Builders compare Schedule with barcode on materials delivered, via smart phone.   Allow an extra $/delivery = $7 364,000 deliveries/ year.

7.1.2   Item 2 – number of products per year

Item 2 in Table 4 shows an estimate of 10,000 products per year populated in the NPC. GS1 NZ's NPC implementation currently has about 80,000 building-related products populated in it. GS1 NZ estimates a further 30,000 products can be loaded to achieve critical mass. However, given the nature or the DIY/hardware retail environment with continuous new product development and increased imports, this estimate is speculative. The annual number, estimated at 10,000 products per year, is in two parts.

Approximately 5,000 products per year already on the NPC have additional information added on origin of the product. This information includes GLN and conformity assessment (as links), plus, if they exist, links to other information suggested in section 6.2.1. Priority would be given to the more common and significant products.

The other 5,000 products per year are for new products and allow the database to grow by 7% per annum.

Larger manufacturers/importers enter their own data into the NPC in a structured/standardised way. While the repository provides for over 400 data fields, the current industry-defined data set is significantly less than this (around 90–100 data fields). New fields may need to be defined and added for efficacy purposes by the stakeholder community.

We have used the figure of $40 per product for entering into the NPC. This is an approximate price GS1 NZ offers to small users. It is likely the large users, who do their own data entry into the NPC, are able to do this somewhat cheaper. They have staff dedicated to the task, and the authors estimate their costs could be as little as 50% of the $40 figure used in Table 4, due to economies of scale. Therefore, the costs in item 2 are conservative.

7.1.3   Item 3 – GS1 NZ annual fee

The annual GS1 NZ fee allocated to traceability is for maintaining the database and facilitating user downloads. The annual fee is assumed to be shared between four parties, namely manufacturers/importers, merchants, BCAs and central government. At present, only manufacturers and merchants pay this annual fee. It is based on the current GS1 NZ cost of $3.45 per product, which is then assumed to be halved. The reason for this is that allocation of all NPC costs to a traceability scheme would be an overestimate because the merchants in particular derive wider benefits. They use the NPC as the store of their pricing and stock information, which would otherwise require separate systems to process and record this information.

Allocation of this between parties is unclear at this time, and we have assumed the majority of the cost is shared between the manufacturers/importers and the merchants. However, given the existing community of suppliers in the DIY sector currently supporting the NPC, inclusion of additional data recipients (data users) would be viewed favourably by them. The cost to supply additional data recipients is negligible for a supplier, but savings through such things as administrative efficiencies would be significant as would the opportunities an increased network effect provides. Also, it is expected the BCAs and government will find the NPC database useful, hence their charge.

7.1.4   Item 4 – cost to specifiers

In item 4, we have estimated the cost to the specifiers for enabling GTIN coding of their products. The amount allows for an intermediary to bring the specifiers together and to chair their meetings to arrive at an agreed common method of product definition and classification. The three main specifiers (Masterspec, EBOSS and Productspec) each have about 5,000 products in their databases. It is assumed the specifications they produce for clients will provide a product list with accompanying GTINs (as linear or two-dimensional barcodes, for example) electronically.

7.1.5   Item 5 – smartphone app development

Item 5, smartphone app development, is to link a linear or two-dimensional barcode reader with an electronic list of materials[20] to check that GTINs on products and in the product list align. Further work is needed on the exact format and functionality of the smartphone app. It is envisaged to provide the following:

- Allow the builder to call up a product list for each building project.
- Provide access to subcontractors who might be ordering materials for the build.
- Allows the user to estimate quantities of materials for ordering purposes and provide this to builders' merchants.
- Provide access to builders' merchants who would use the list to assemble materials for delivery or pick-up.
- Enable checking of on-product linear or two-dimensional barcodes to those in the product list to ensure they are the specified materials. Scanned products that are specified could receive a green tick on the smartphone display, and unspecified materials could receive a red cross (for example). The building inspector could also receive this information on their smartphone.
- Record the transaction between the builders' merchant and the builder.
- Provide evidence of a builder's intent to use the materials on the build.
- Provide the ability to download material receipts data into the builder's accounting system and hence aid automation of invoicing.

We have estimated the app development costs using a current project in BRANZ on a virtual clerk of works app. The app development cost is shared between users as set out in Table 4, and it is assumed only one-third of builders need the app. The app cost per user is about $4. Alternatively, government may decide to fund the app development and provide it free of charge to users to ensure wide uptake.

7.1.6   Item 6 – extra cost to manufacturers

Item 6 is an estimate of how onerous a traceability scheme would be for manufacturers, given that they already provide performance data to persuade designers and BCAs to accept their materials. First, we need to estimate the cost of providing technical data at present, and this is done in Table 5. We assume a traceability scheme will add to these costs by 5% because the data requirements of such a scheme may mean more testing and checking of products, particularly for imports.

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[20] For the purposes of this model traceability scheme, we assume the electronic list of materials is held on BCAs' servers. There is the option that these would be located elsewhere.

Table 5. Current cost to provide technical data for BCA acceptance.

COSTS TO OBTAIN DATA AS REQUIRED FOR ADDITIONAL FIELDS IN THE NPC					
(1) Product information need	*% in risk*	*Obtaining and*		*Expected*	
Risk/ data needs (2)	*group*	*assembling data*		*average cost*	
Low (3)	95.5%	$600		$573	
Moderate (4)	4.0%	$6,000		$240	
High (5)	0.5%	$60,000		$300	
	100%			$1,113	= average cost per product
(6) Additional costs involved in putting links on NPC: Assume			5%	$56	=additional cost with traceability
(1) BRANZ estimate of data needs based on risk					
(2) This estimate was developed using the MBIE doc as a guide. See "Product assurance decision tool, 1st Edition, March 2016", MBIE.					
(3) Low risk and low data requirements are simple mass produced products such as nails, screws, paints, tiles, floor vinyls, hardware, cables, piping, etc. These generally do not need testing or can be simply tested.					
(4) Medium risk/data requirements, are products requiring simple tests or opinions on 1 to 2 performance aspects. These may require research into the product chemical components, eg insulation, underlays, adhesives, etc.					
(5) High risk/ high data requirements. These products require a variety of tests covering more than one clause of the NZ Building Code. Eg sheet linings and claddings tested for bracing, weather tightness and/or fire resistance.					
(6) Additional costs involved in adding links to NPC.					
Why are there extra costs? These arise because the more data is required. This includes additional data on:					
Manufacturing site, origin of components, quality control procedures, and details of the manufacturer's H&S policy.					
Also the PTS may need to be enhanced for some products since traceability entails more accountability than currently exists.					

7.1.7   Item 7 – conformity assessment bodies

Item 7 in Table 4 allows for CABs to insert links in the NPC to their appraisals, tests and opinions.

7.1.8   Item 8 – designer extra costs

Item 8 in Table 4 allows for designers to obtain and insert GTINs in their specifications for each project. The unit cost at $17 per project assumes 5 minutes per project at $150 per hour. Designers tend to use a palette of the same products on different projects and hence they will already have most of the GTINs in the specifications that they are adapting.

The total amount at $1.3 million per year is quite high due to the large number of projects each year, as estimated in Table 6.

Table 6. Number of building projects undertaken per year by the industry.

HOW MANY PROJECTS AND DELIVERIES PER YEAR?						
Current number of projects, based on building consents, and fixed capital formation data:						
Year end June 2016	Residential	Non-res bldgs	Civil			
Number of projects	#	#	#			
New Consents	29,100	5,470	7,500	BRANZ estimate for civil		
A&A consents	26,100	5,510	-	construction projects/ yr		
	55,200	10,980	7,500	Total=	74,000	(rounded)
Average value/ project	$	$	$			
New Consents	340,263	843,626	1,000,000	BRANZ estimate for civil		
A&A consents	68,435	277,441	-			
	408,698	1,121,067	1,000,000			
Number of deliveries per project (1)				(1) Assume 1 delivery per $70K.		
New Consents	5	12	14			
A&A consents	1	4				
Total deliveries per year						
New Consents	143,000	66,000	107,000			
A&A consents	26,000	22,000				
	169,000	88,000	107,000	Total=	364,000	per year

7.1.9   Item 9 – builder checking costs

Under the model traceability scheme in Figure 16, materials arriving on site are scanned and checked using the smartphone app against the product list (held on a server by the BCA) as they are delivered. Alternatively, the order as a whole may be scanned, in which case, more reliance is placed on the builders' merchant supplying the order to provide the right materials for the specification.

Item 9 in Table 4 allows for the costs associated with builders using the app to check that correct products have been delivered as per the list of materials. Material checking potentially becomes more intensive than current practices on site. An estimate of this is an extra 5 minutes per project for this barcode checking or an extra $7 per project assuming an hourly rate of $80 per builder. The extra time could be justified because current checking is believed to be inadequate on many projects. Totalled over 364,000 projects per year, this extra cost is large at $2.55 million.

However, it could be argued that app checking should speed up site checking, compared to the current manual methods used, and therefore result in cost savings. As well, the app could enable downloading to the builder's accounting records. This will potentially have a time saving, when doing the accounts, over the current manual entry methods. An app with this provision would likely be a significant incentive for builders to use it.

We have conservatively ignored these potential benefits and have allowed for the full extra estimated cost of $2.55 million per year.

7.2   Implementation costs versus estimated benefit

The estimated cost of NCP for all of New Zealand is estimated in section 5. The range is between $95 million and $232 million per year. An electronic traceability scheme such as that outlined in section 6 is expected to reduce this cost. If the damage caused by NCP is reduced by 6%, that is a saving of at least $5.7 million a year, which covers the expected annual cost of running the traceability scheme. This saving is from a reduction in early replacements and is an annual saving.

If more than 6% of NCP is eliminated, there is a net gain in value from an electronic traceability scheme. For example, if such a scheme resulted in a 30% reduction in NCP, the model electronic traceability scheme is estimated to achieve a net return of about $23 million per year.

8. Conclusions and recommendations

Pressure to manage build costs can provide a strong incentive to source cheaper alternative materials. Information collected during the development of this report, some of which is anecdotal or based on media reports, indicates that product substitution during construction can provide a means for use of NCP. This can be inadvertent or deliberate. This situation is not unique to the New Zealand construction industry, with the same issue currently being considered in Australia.

This study provides a feasibility assessment into the potential for the establishment of an electronic product catalogue containing supplier-originated product master data based on global data standards for construction products used in New Zealand. This provides the basis for a model system that aims to reduce the incidence of product substitution with NCP while providing building blocks for traceability outcomes in the sector.

Traceability schemes have been used in other sectors worldwide, such as food and minerals. This is in order to provide customers with greater assurance that what they are buying is what they think they are buying.

Electronic traceability has several aims:

- Reduce product substitution by products not specified in the design documentation during construction.
- Provide a clear audit trail of which organisations have undertaken what tests and activities to check conformance to the New Zealand Building Code (or other codes and standards used to show conformance). This means that, in the event NCP is found within an electronic traceability system, there is a clear understanding of:
    - o what specific individual products or batches of products were tested, by whom, to what testing standards and where to demonstrate conformance.
    - o who shipped the product from manufacturing site to construction site
    - o where the product has been used and how much has been used on builds in New Zealand.
- Potentially provide a hub for additional information about products used on New Zealand builds that can be useful to designers, specifiers and BCAs when making design and consenting decisions. Examples may include BIM objects, product technical statements, EPDs and environmental certification.

For such an electronic traceability system to function, manufacturers need to assign GTINs to their products. They need to mark products with machine-readable data carriers such as a linear or two-dimensional barcode or use RFID technology. These unique identifiers need to be populated in one repository named the National Product Catalogue (NPC) along with unique legal entity and physical location identifiers such as NZBNs and GLNs. This will provide the necessary building blocks to enable traceability outcomes.

The NPC is implemented in New Zealand and is being used by builders' merchants and users in other industry sectors. The model electronic traceability system scoped in this report is based on an expanded version of the current NPC. By using this, establishment costs are avoided.

It is proposed that GTINs of specified products and suitable substitute products are listed in a product list (ideally, also with quantity information) in the consent

documentation submitted to the BCA. From this, the product list for each build would be held electronically by the BCA and assigned a unique identifier.

Through use of a smartphone app (which would need to be developed), a builder would be able to make this list available to builders' merchants and trades. They can then make materials orders and can scan the on-product linear or two-dimensional barcodes at the construction site in order to perform a real-time check that the material is as specified.

To encourage builder uptake and use of the app, it should be able to download information into the builder's accounting system. This is to enable easier and quicker record keeping and production of accounts for materials delivered in the period.

This would also provide the BCA with information about what materials are going into the build and how much of them. Where there is a significant gap between the amount of a material going into a build and the specified amount of material (if available), this would flag areas of focus for the BCA to follow up.

In order to understand the benefits and costs of such a system, the cost of NCP to New Zealand Inc. has been estimated, as have the costs of setting up and operating a model electronic traceability system. To estimate the cost of NCP to New Zealand Inc. that subsequently needs repair or replacement, two approaches have been used. This has produced an annual cost of $95 million (for residential construction only) to $232 million (for residential and commercial construction).

The estimated costs arising from such a system are set out in this report. If the electronic traceability system reduces incidence of NCP by a conservative 6%, the annual running costs of the system are covered. A 30% reduction in NCP produces a net return of $23 million a year in addition to other benefits such as:

- reduced risk of accident, injury and loss of life due to failure of NCP
- reduced risk of loss of business due to failure of NCP
- reduced risk of the perception that a product is poor quality because of a belief that the genuine product is being used when it is not
- potential for speeding up design and consenting by having a central repository of product information linked to GTINs accessible by designers and BCAs
- provision of greater assurance to builders that the product they propose to use on a build is acceptable and as specified
- opportunity for BCAs to obtain real-time information of what products are going onto different builds, enabling them to target checks on products not included in the system
- in the event that NCP is found, it would provide a clear audit trail of organisations involved, how the product was transported and where it has been used.

Accompanying this report is an information sheet that provides a brief summary of the findings of this study in order to assist awareness raising.

This study has shown that an electronic traceability system as a means to reduce the incidence of non-conforming product looks feasible. A recommendation of this report is that consultation is required with stakeholders in the construction industry. With sufficient support, further detailed work would need to be undertaken on the functionality, scope and envisaged operation of such a system (including app features and development and interoperability of systems). Based on a favourable outcome from this detailed assessment, a prototype system should be developed for testing.

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Media reports

There have been a large number of media reports on imported building products that are alleged to not conform to the requirements of the New Zealand Building Code or to the relevant New Zealand standards. Below are some of these media reports and releases from 2016 and early 2017, which have been used in deriving the likely incidence of substandard products:

- NZ 'dumping ground' for dodgy building products (Radio New Zealand, 14 March 2016). Interviewees (retired plumbers) estimate 50% of new houses have poor quality fittings. Part of the problem is said to be inadequate local standards for fittings. www.radionz.co.nz/news/national/298848/nz-'dumping-ground'-for-dodgy-building-products
- Non-compliant electrical products is a growing problem (Electrical Contractors Association of New Zealand, 16 March 2016).
- Steel & Tube shares slump on mesh label error (*New Zealand Herald*, 17 March 2016). Steel mesh sales stopped by the Commerce Commission for three firms due to incorrect certification of tests. Resumed again in June. www.nzherald.co.nz/business/news/article.cfm?c_id=3&objectid=11607164
- NZ the 'wild west' of steel testing (Radio New Zealand, 22 March 2016). Steel anchor bars used in transmission towers are 80% of the specified strength. www.radionz.co.nz/news/national/299574/nz-the-'wild-west'-of-steel-testing
- Concerns over imported safety glass (Radio New Zealand, 5 May 2016). Some imported safety glass has bogus testing stickers, as picked up in local testing. www.radionz.co.nz/news/national/303099/concerns-over-imported-glass-safety
- Rogue tradies: Building products probed as imported goods raise worries (*New Zealand Herald*, 25 May 2016). Of 134,000 inspections carried out by Auckland Council over a 12-month period, a third failed. Electrical wiring, shower doors, roofing tiles and wastepipe are among imported products with substandard performance. www.nzherald.co.nz/business/news/article.cfm?c_id=3&objectid=11643993
- Steel for Huntly bypass bridges fails test (Radio New Zealand, 1 June 2016). 1,600 tonnes of imported steel piles for the Huntly bypass are understrength and need replacing or reinforcing with concrete. Inadequate and/or fraudulent testing is suspected. www.radionz.co.nz/news/national/305313/bypass-bridge-steel-found-to-fail-tests
- Skellerup in $7m stoush over faulty rubber rings (*New Zealand Herald*, 29 July 2016). Faulty rubber rings for irrigation pipes fail. Court case resolved with compensation of $1.6 million payment. www.nzherald.co.nz/business/news/article.cfm?c_id=3&objectid=10904920
- Proposed class action of 100 new home owners with suspect faulty steel mesh (Stuff, 21 November 2016). The same article mentions imported plumbing materials, shower doors and bolts with sub-standard performance (not in class action).
- Lyttelton Port Company said it replaced steel piles on the Cashin One wharf 2 years ago, due to below strength steel (Radio New Zealand, 24 November 2016).
- Six years of concrete fraud – four accused (Radio New Zealand, 31 January 2017). Four men charged with selling Chinese concrete panels as Australian made. www.radionz.co.nz/news/national/323478/six-years-of-concrete-fraud-four-accused

Appendix A: Example traceability systems worldwide

Introduction

Traceability schemes can be clustered into four broad groups based on their purpose and target audience that they serve (Mol & Oosterveer, 2015):

1. Management traceability – related to logistics and quality management for the purpose of product quality. Target group: internal and limited actors in the supply chain.
2. Regulatory traceability – related to legal and policy requirements, the purpose is disclosure of information to regulators and public authorities. Target group: regulators and public authorities.
3. Consumer traceability – related to the quality or other characteristics (such as sustainability) of processes and products as specified in public or private labelling and certification. The purpose is to verify claims on consumer products and is aimed at price premiums and niche market competiveness. Target group: consumers (or a segment of them).
4. Public traceability – related to public scrutiny of production processes and product characteristics. The purpose is to safeguard brand reputation and gain a competitive advantage in the public domain. Target group: public.

Traceability case studies from different parts of the world and in different sectors are provided in this section for information. Table 7 lists the case studies according to the definitions above. Most are considered as examples of consumer traceability, and none provide public traceability (which is excluded from the table).

Traceability schemes may be considered as based on a chain of custody (or track and trace), which solely documents the movement of products through the supply chain. It can provide information that has no conformity assessment or authentication-based assessment, in which additional information has some form of conformity assessment such as a verification or certification.

Authentication-based traceability may be further subdivided into the following types:

- **Product segregation** – certified materials are kept physically separate from non-certified materials at all stages of the supply chain. There are two types of product segregation:
  - *Identity preservation* – there is no mixing of certified products from different suppliers, and certified products can be traced from the final product or user back to a specific primary producer.
    Common example: Fairtrade bananas.
  - *Bulk commodity* – certified materials from different producers can be mixed but are separated from non-certified materials.
    Common example: Organic vegetables.
- **Mass balance** – certified and non-certified materials can be mixed. The exact volume of certified material entering the supply chain is controlled, and the equivalent volume of product is sold as certified. In the certified product, it is not known whether it specifically contains certified, non-certified or a mixture.
  Common example: Fairtrade cocoa.

- **Book and claim** – does not seek traceability at each stage of the supply chain. The link is made between the volume of certified material entering at the beginning of the supply chain and the amount of certified product purchased at the end. This is via credits that are issued to the producer and purchased by the final seller. This is similar to mass balance, except that credits are traded independently of the product through the supply chain.
  Common example: Renewable energy credits trading.

There were no book and claim traceability schemes in the case studies.

Table 7. Case study traceability schemes by type.

Management	Regulatory	Consumer
Produce Traceability Initiative	Dairy Traceability Working Group	Aluminium Stewardship Initiative (asi)
	National Animal Identification and Tracing (NAIT)	Australian Certification for Reinforcing and Structural Steels (ACRS)
		BES 6001
		Conflict Free Smelter Program (cfsi)
		Ethical Tea Partnership
		Fairtrade
		Forest Stewardship Council (FSC)
		Leather Working Group
		New Zealand Merino
		Programme for Endorsement of Forest Certification (PEFC)
		Responsible Jewellery Council
		Responsible Steel
		Engineered Wood Products Association of Australasia
		Concrete Sustainability Council
GS1 Traceability Standard – can be a foundation of any type of traceability scheme.		

Case studies

ALUMINIUM STEWARDSHIP INITIATIVE (ASI)

LOGO/LABEL/IMAGE:	WEBSITE: www.aluminium-stewardship.org

DESCRIPTION:

The scheme is currently in development. The ASI is intended to apply to all stages of aluminium production and transformation, specifically: bauxite minim, alumina refining, primary aluminium production, semi-fabrication (rolling, extrusion, forging and foundry), conversion, and refining and re-melting of recycled scrap.

The ASI performance standard has been set and covers governance, environmental and social requirements. The performance standard will apply at the **site or company** level.

The ASI Chain of Custody Standard is in development. It is intended to be used as a responsible sourcing tool for aluminium.

GEOGRAPHICAL COVERAGE:
Global

TYPE OF SCHEME:
Certification – Mass Balance

SET UP BY:
The scheme is being set up by the Aluminium Stewardship Initiative (an international multi-stakeholder group) and the International Union for Conservation of Nature (IUCN).

OPERATING SINCE:
The development process commenced in 2009.
The ASI Performance Standard was set in 2014. The ASI Chain of Custody Standard and Assurance Model, including how standards will be audited and certification granted, are currently under development.

ISSUE SCHEME DESIGNED TO ADDRESS:
The scheme is being designed to:
- enable the aluminium industry to demonstrate responsibility and provide independent, credible and verifiable proof of its environmental, social and governance performance
- reinforce and promote consumer and stakeholder confidence in aluminium products
- provide the basis for a system that would identify suppliers and materials throughout the supply chain, based on their sustainability
- reduce reputational risks concerning aluminium and aluminium industry players
- address the expressed needs by end-use customers and consumers for traceability of aluminium throughout the value chain.

The ASI scoping report found that a market-orientated scheme that addresses stakeholder concerns and creates market differentiation is desired.

METHOD OF PRODUCT RECOGNITION:
In development.

FRAUD PREVENTION MEASURES:
In development.

EVIDENCE SCHEME SUCCESS:
Not yet operating.

EVIDENCE OF PREMIUM FOR PRODUCTS:
Not yet operating, however market research conducted for the ASI found that 65% of end user companies questioned would change to an alternative aluminium supplier if it could demonstrate better sustainability performance.

EVIDENCE OF REDUCED COSTS FOR SCHEME PARTICIPANTS:
Not yet operating.

EVIDENCE OF WIDER BENEFITS EG. MARKET ACCESS, BRAND PROTECTION
Not yet operating.

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REFERENCES
- ASI website: http://aluminium-stewardship.org
- The Responsible Aluminium Scoping Phase Report, Track Record Global Ltd, 2010.
- http://aluminium.trackrecordglobal.com/report.html

AUSTRALASIAN CERTIFICATION AUTHORITY FOR REINFORCING AND STRUCTURAL STEELS (ACRS)

LOGO/LABEL/IMAGE:

WEBSITE:
www.steelcertification.com

DESCRIPTION:
The scheme certifies manufacturers and suppliers of reinforcing, pre-stressing and structural steels to Australian and New Zealand Standards. The scheme offers **product** certification with supply and manufacturing facilities gaining certification for specific products from that facility.
Product sampling, testing, reporting and assessment are undertaken by ACRS expert assessors. The ACRS reviews and verifies production every three months throughout the year via independent testing, as well as an annual site assessment. Certificates are re-assessed annually.

GEOGRAPHICAL COVERAGE:
Global, certifies to conformity to AS/NZ Steel Standards.

TYPE OF SCHEME:
Certification - Product Segregation (Identity Preservation)

SET UP BY:
The ACRS was set up by industry groups and government associations on behalf of the construction industry. The ACRS is a self-funding, not-for-profit organization governed by a board and run by an executive director.

OPERATING SINCE:
2000

ISSUE SCHEME DESIGNED TO ADDRESS:

The scheme was designed to ensure that the manufacture and supply of construction steels[21] could be independently and expertly demonstrated to meet the requirements of AS/NZ Standards. Globalisation of the steel industry, as well as an increase in the numbers of domestic suppliers and processors in Australia, created the potential for the supply of steel of unconfirmed origin and quality.

Non-conforming materials found their way into the market causing project delays and product failures leading to consequential costs and litigation.

Specific issues the scheme seeks to address include:

- inadequate product traceability
- misleading and false supporting documents
- excessive variation in materials properties
- inappropriate product markings.

METHOD OF PRODUCT RECOGNITION:

Certified manufacturers and suppliers have ACRS certificates and ACRS tags to attach to certified products.

FRAUD PREVENTION MEASURES:

The ACRS website provides for verification of supply claims. The website provides the following information about all current ACRS certified suppliers:

- company name and location
- certification status
- certification number
- a pdf of current certificate
- visual details of product markings (for most, but not all suppliers)
- scanned example of actual product tag from the supplier (for most, but not all suppliers).

EVIDENCE SCHEME SUCCESS:

Approximately 70% of steel reinforcing materials and 40% of structural bars, sections and hollow sections supplied into the Australian market are ACRS certified.

Non-conforming product has been identified as an issue in the Australian steel product sector. A survey conducted for the Australian Industry Group found that 95% of respondents indicated that their market had non-conforming product with 64% basing their assessment on building site product failure or visual inspections. Half of respondents believed that the non-conforming product penetration of their market was between 11% and 50%. However, respondents reported that the incidence of non-conforming product had decreased where third party certification schemes (e.g. ACRS) were present. Steel fabricators indicated a high prevalence of non-conforming product in their sector, primarily due to the lack of verification around first party certification.

EVIDENCE OF PREMIUM FOR PRODUCTS:

None found.

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[21] Products that may be certified under the scheme include reinforcing steels, general steels and related products. This includes, but is not limited to: common metals and their alloys, metal building materials, transportable buildings of metal, materials of metal for railway tracks, non-electric cables and wires of common metal, ironmongery, small items of metal hardware, pipes and tubes of metal, goods of common metal not included in other classes.

EVIDENCE OF REDUCED COSTS FOR SCHEME PARTICIPANTS:
The ACRS reports that compliance costs are measured in cents per tonne.
- A survey conducted for the Australian Industry Group found that steel product sector respondents considered margins to be low and under intense pressure. Further, respondents indicated that margins are reduced by maintaining conformance with standards and specification requirements (generally, not the ACRS scheme in particular).
- ACRS certification can simplify the audit process under the Australian National Structural Steel Compliance Scheme for general structural fabrication and bridges.

EVIDENCE OF WIDER BENEFITS EG. MARKET ACCESS, BRAND PROTECTION
None found.

OTHER:
A survey for the Australian Industry Group found that 64% of steel sector businesses have been negatively affected by non-conforming products. Forty percent of all businesses in the steel sector reported losing revenue, margin and employment numbers due to non-conforming product.
Other businesses say they are downgrading their product quality and service offer in order to remain viable. However, another 8% of businesses say they have been positively affected by non-conforming products because they obtain rectification work and this is often at higher margins because of the tight deadlines involved.

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REFERENCES
- ACRS website: www.steelcertification.com
- Australian Steel Institute ASI Technical Note TN010 V1 July 2012 - http://steel.org.au/media/File/TN010_v1_final.pdf
- Steelwork Compliance Australia - www.scacompliance.com.au/learn-more/acrs-scheme/
- A quest for a level playing field – the non-conforming building products dilemma, The Australian Industry Group, November 2013 - www.nahb.org/~/media/Sites/NAHB/SupportingFiles/2/Aus/Australiathenonconformingproductsdilemma01242014_20140129052155.ashx?la=en

BES 6001	61

LOGO/LABEL/IMAGE:

WEBSITE:
www.greenbooklive.com

DESCRIPTION (SCOPE):

BES 6001 is a framework standard for responsible sourcing. It describes the organisational, supply chain and sustainability aspects to be addressed when certifying the responsible sourcing of construction products in the United Kingdom. The scheme certifies **products** rather than sites or companies.

The traceability component of the scheme requires that 60% of constituent materials be traceable through the supply chain (typically by BS EN IS9001) and from organisations with documented environmental management and health & safety management systems.

Where constituent materials are sourced from suppliers outside of the EU, or from states not declaring adherence to the OECD Guidelines for Multinational Enterprises, the organisation must undertake risk assessments and due diligence to monitor compliance with the International Labour Organisation's Declaration on Fundamental Principles and Rights at Work.

The scheme uses a points system. All compulsory requirements must be met in order to gain certification (a pass). Additional points are awarded for performance above compulsory requirements – with performance levels set for good, very good or excellent. Certification is valid for three years, with an annual verification. Certification audits are conducted by BRE, who developed and administer the standard.

As a framework standard, specific sector standards can be derived from BES 6001 that reflect issues within an individual sector. To date, the only one of these to be developed is the Eco-Reinforcement Standard for Steel Reinforcement in Concrete (2009).

GEOGRAPHICAL COVERAGE:
United Kingdom

TYPE OF SCHEME:
Certification – Identity preservation

SET UP BY:
BRE, an independent research-based consultancy, testing and training organisation specialising in the built environment. BRE is owned by the BRE Trust, a charity.

OPERATING SINCE:
2008, Issue 3.0 released in May 2014.

ISSUE SCHEME DESIGNED TO ADDRESS:
Drivers for creation of the scheme included:
- increasing awareness and demand across professions and by consumers for certified construction products (as available in other sectors e.g. food)
- limited scope for demonstrating responsible sourcing outside the timber sector
- creating a level playing field – a generic responsible sourcing standard for all construction sectors
- UK government target that 25% of construction products be responsibly sourced by 2011

(Strategy for Sustainable Construction)

- UK Contractors Group target that 75% of construction products will be responsibly sourced by 2015.

METHOD OF PRODUCT RECOGNITION:
BRE Global Certification Mark on products, including the Responsible Sourcing Certificate Number.

FRAUD PREVENTION MEASURES:
All certified products are listed on BRE Global's Green Book Live directory and product certification labels include Responsible Sourcing Certificate Number.

EVIDENCE SCHEME SUCCESS:
Around 92% of the UK concrete industry and 90% of the brick sector were certified by 2012. As at March 2014, 84 valid BES 6001 certificates across 12 sectors have been issued, broken down as follows (with category of certificate obtained):

Product	Pass	Good	Very Good	Excellent	Total
Plastic products			4		4
Blocks		1	3		4
Plasterboard			3		3
Aggregates, sand, gravel, asphalt and ready mixed concrete	1	4	11		16
Reinforcing steel bar, coil and mesh		7	2		9
Stone		1	2		3
Structural steel products			3		3
Roof tiles	1	1	3		5
Cement		4	9		13
Precast concrete, concrete products		3	8		11
Steel products		1	2		3
Bricks			5		5
Other		2	3		5
Total	2	24	58		84

EVIDENCE OF PREMIUM FOR PRODUCTS:
No evidence found.

EVIDENCE OF REDUCED COSTS FOR SCHEME PARTICIPANTS:
BES 6001 certification provides specifiers with a means for gaining credit within the materials section of the Building Research Establishment Environmental Assessment Methodology (BREEAM), an international building sustainability certification scheme,
The typical cost for certification of a single product manufactured at a single UK site is around £7,000.

EVIDENCE OF WIDER BENEFITS EG. MARKET ACCESS, BRAND PROTECTION:
In 2013/14 the first certificates were issued to companies based outside of the UK. A range of products are now certified from Luxembourg, Spain, Romania, France, Poland, Germany, Finland, Portugal and Ireland**.**

OTHER:

Across all sectors very good certificates dominate over good by around 2:1. There are very few pass certificates and no excellent certificates (2013/14).

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REFERENCES:

- BES 6001 website – www.greenbooklive.com/search/scheme.jsp?id=153
- BES 6001 Annual Report 2013/14 – www.greenbooklive.com/filelibrary/responsible_sourcing/Annual-Report-2013-14-Final.pdf
- Analysis of responsible sourcing performance in BES 6001 certificates – www.researchgate.net/profile/James_Upstill-Goddard/publication/273386865_Analysis_of_responsible_sourcing_performance_in_BES_6001_certificates/links/551babc80cf251c35b50a09d.pdf
- The BES 6001 Framework Standard for Responsible Sourcing of Construction Products, Derek Hughes, APRES Conference, 24 November 2013 – http://label.vinylplus.eu/uploads/Infopack/BRE%20company%20presentation%20for%20VinylPlus%20label%20nov%202013.pdf

CONFLICT-FREE SMELTER PROGRAM (CFSP)

LOGO/LABEL/IMAGE:

An initiative of the EICC and GeSI

WEBSITE:
www.conflictfreesourcing.org

DESCRIPTION (SCOPE) :
The scheme applies to tantalum, tin, tungsten and gold (conflict minerals) and certifies smelters and refiners as they are pinch-points in the global supply chain. The scheme offers **site** level certification. The scheme involves an independent third-party audit to identify smelters and refiners that have systems in place to assure sourcing of only conflict-free materials. The audit consists of both a business process review and a material analysis review. Audit protocols are differentiated according to the risk of the respective country of origin of the minerals the site is processing.
Actors downstream in the supply chain can then use the conflict-free smelter compliant smelter/refiner list as a reference source for due diligence information on their minerals supply-chain.

GEOGRAPHICAL COVERAGE :
Global

TYPE OF SCHEME:
Certification - Product Segregation (Bulk Commodity)

SET UP BY:
The Conflict-Free Smelter Program was established by the Conflict-Free Sourcing Initiative (set up by the Electronic industry Citizenship Coalition and the Global e-Sustainability Initiative).

OPERATING SINCE:
2010

ISSUE SCHEME DESIGNED TO ADDRESS:
The scheme was designed to address growing concerns of western consumers about the link between the use of minerals in electronics such as mobile phones and violence in the Congo region of Africa. Consumers wanted assurance that the minerals used in their electronics were not supporting militia activities in the Congo.
Growing public awareness also led to a range of new due diligence and disclosure requirements for companies including:
- The Dodd-Frank Wall Street Reform and Consumer Protection Act 2010 (United States)
- U.S. Securities and Exchange Commission 2010 Conflict Minerals draft rule
- OECD Due Diligence Guidance for Responsible Supply Chains from Conflict-Afflicted and High-Risk Areas
- UN Resolution 2010 requiring member states to urge their companies not to purchase minerals that might be financing violence in the Congo.

METHOD OF PRODUCT RECOGNITION:
Due the nature of the products, which can be reformed many times along the supply chain, certified products are not marked. Rather a list of compliant smelters and refiners is administered by the Conflict-Free Sourcing Initiative that downstream customers can consult in their due diligence and disclosure processes.

FRAUD PREVENTION MEASURES:
The list of certified smelters and refiners is administered by the Conflict-Free Sourcing Initiative.

EVIDENCE SCHEME SUCCESS:
Armed groups and the Congolese army are no longer present at two thirds of tantalum, tin and tungsten mines in Eastern Congo. Gold remains problematic due to high rates of smuggling.
Initially, there was concerns about unintended consequences of the scheme. Introduction of the scheme, along with international regulations, brought mining to a halt in the Congo, with resulting unemployment. However, the number of conflict-free mines in the Congo has increased from one in 2011 to 16 in 2014.
Over 40% of the world's tantalum, tin, tungsten and gold smelters have now passed third party conflict-free audits.

EVIDENCE OF PREMIUM FOR PRODUCTS:
There is evidence of a premium for products. A two-tier market for tantalum, tin and tungsten from the Congo has formed. Minerals that do not go through conflict-free programmes now sell for 30-60 % less than those that do.

EVIDENCE OF REDUCED COSTS FOR SCHEME PARTICIPANTS:
The scheme provides a method to show compliance with the Dodd-Frank Wall Street Reform and Consumer Protection Act 2010 (United States). Seventy percent of companies surveyed for the Conflict-Free Sourcing Initiative report that they used the Conflict-Free Sourcing Initiative's Conflict Minerals Reporting template to survey their suppliers for filing and compliance purposes.

EVIDENCE OF WIDER BENEFITS EG. MARKET ACCESS, BRAND PROTECTION
See under "Evidence of Scheme Success"

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REFERENCES:
- Conflict-Free Sourcing Initiative website: www.conflictfreesourcing.org
- Conflict-Free Smelter Program (CFSP) Smelter Introductory Training and Instruction Document – 2012 - www.conflictfreesourcing.org/media/docs/CFSI_CFSP_SmelterIntroduction_ENG.pdf
- "What's Wrong with Dodd-Frank 1502? Conflict Minerals, Civilian Livelihoods, and the Unintended Consequences of Western Advocacy" Laura E. Seay, Center for Global Development, Working Paper 284 January 2012
- Schulte Roth & Zabel LLP and Conflict-Free Sourcing Initiative Conflict Minerals Reporting White Paper (September 2014): www.lexology.com/library/detail.aspx?g=8d2ce83b-e430-4016-8a7c-8d2cbfd9a6d3
- The Impact of the Dodd-Frank and Conflict Minerals Reforms on Eastern Congo's Conflict, Fidel Bafilemba, Timo Mueller, and Sasha Lazhnev, Enough Project, June 2014 : http://enoughproject.org/reports/impact-dodd-frank-and-conflict-minerals-reforms-eastern-congo's-war
- Conflict minerals – An evaluation of the Dodd-Frank Act and other resource-related measures, Andres Manhard & Tobias Schleicher, Oeko-Institut e.V. August 2013 : www.oeko.de/oekodoc/1809/2013-483-en.pdf

DAIRY TRACEABILITY WORKING GROUP

LOGO/LABEL/IMAGE: Not yet developed.	**WEBSITE:** www.foodsafety.govt.nz

DESCRIPTION (SCOPE):
The scheme intends to provide electronic, full chain traceability from farm gate to consumer.
The scheme will offer **product**-level traceability and will cover dairy products, dairy produce, ingredients and packaging – but not feed and other farm inputs.
The primary purpose of the scheme is to enable precise tracking of products through the complete product supply chain in order to accurately identify products that may need to be withdrawn.

GEOGRAPHICAL COVERAGE:
New Zealand (mandatory) but recommended for overseas parties in the supply chain.

TYPE OF SCHEME:
Track and trace.

SET UP BY:
The Dairy Traceability Working Group in conjunction with the Ministry for Primary Industries.

OPERATING SINCE:
In development.

ISSUE SCHEME DESIGNED TO ADDRESS:
The whey protein concentrate contamination incident in 2013 highlighted the critical importance of New Zealand having – and being seen to have internationally – a strong food safety culture.
During that incident, tracing potentially affected products took a long time, and threatened New Zealand's reputation as a trusted supplier of safe and suitable food. An investigation found that New Zealand's food safety regulatory model was consistent with international principles and among the best in the world. However there is a desire to strengthen the model further, particularly to take into account international market trends seeking ever-greater confidence in the integrity and safety of food.

METHOD OF PRODUCT RECOGNITION:
Not yet specified but traceability information must be both machine-readable and human-readable.

FRAUD PREVENTION MEASURES:
The prevention of counterfeiting was specifically excluded from the initial objectives of the traceability scheme. The Dairy Traceability Working Group recommended that a separate study be undertaken on how to reduce the risk of counterfeiting and improving confidence in the authenticity of products.

EVIDENCE SCHEME SUCCESS:
Not applicable as not yet operating.

EVIDENCE OF PREMIUM FOR PRODUCTS:
Not applicable as not yet operating.

EVIDENCE OF REDUCED COSTS FOR SCHEME PARTICIPANTS:
Not applicable as not yet operating.

EVIDENCE OF WIDER BENEFITS EG. MARKET ACCESS, BRAND PROTECTION
Not applicable as not yet operating.

Study Report SR365 Electronic traceability of New Zealand construction products: Feasibility and opportunities

CONTACT DETAILS:
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REFERENCES:
• Dairy Traceability Working Group report - http://foodsafety.govt.nz/elibrary/industry/dairy-traceability-working-group-report/index.htm

ETHICAL TEA PARTNERSHIP	
LOGO/LABEL/IMAGE:	**WEBSITE:** www.ethicalteapartnership.org

DESCRIPTION (SCOPE):
The Ethical Tea Partnership monitors members' compliance with the Ethical Tea Partnership standard. The standard applies to all **sites** which produce and process tea leaves bought by Ethical Tea Partnership members.
The standard covers both social, labour and environmental provisions. The social and labour provisions are based on the ethical trading initiative base code, which covers the relevant International Labour Organisation core conventions.
The Ethical Tea Partnership's monitoring and certification programme covers many of the social and environmental elements of third party certification programmes. The Ethical Tea Partnership supports producers to achieve Fair Trade, Rain Forest Alliance and UTZ certification.
In addition to monitoring and certification, the Ethical Tea Partnership's regional offices run a range of local projects including promoting health and safety, climate change adaptation and education for children on tea estates.

GEOGRAPHICAL COVERAGE:
Global.

TYPE OF SCHEME:
Certification – product segregation: bulk commodity.

SET UP BY:
UK-based tea packing companies. Originally called the Tea Sourcing Partnership. The Ethical Tea Partnership now has a global membership.

OPERATING SINCE:
1997

ISSUE SCHEME DESIGNED TO ADDRESS:
The scheme was initially designed as a means for the UK tea packing industry to provide better monitoring and assurance of their own supply chains through working together.

METHOD OF PRODUCT RECOGNITION:
Members display the Ethical Tea Partnership logo on their products.

FRAUD PREVENTION MEASURES:
No details found from initial search.

EVIDENCE SCHEME SUCCESS:
None found.

EVIDENCE OF PREMIUM FOR PRODUCTS:
None found.

EVIDENCE OF REDUCED COSTS FOR SCHEME PARTICIPANTS:
None found.

EVIDENCE OF WIDER BENEFITS EG. MARKET ACCESS, BRAND PROTECTION
The ETP reports raising the core standard of producers that they work with –an 11% improvement in average audit scores was achieved in 2014.
The ETP also reports the benefits of each of their suite of regional partnerships and training programmes. Some of the benefits include:
- Increased productivity and income for producers
- Improved opportunities and representation for female workers
- Planting of trees and installation of water and energy efficiency devices
- Improvement in workers reported social and economic opportunities.

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REFERENCES
The Ethical Tea Partnership website: www.ethicalteapartnership.org
The Ethical Tea Partnership Global Standard, September 2011: www.ethicalteapartnership.org/wp-content/uploads/ETP-Global-Standard.pdf
Pushing Boundaries, Ethical Tea Partnership 2014: www.ethicalteapartnership.org/wp-content/uploads/ETP-Pushing-Boundaries.pdf

FAIRTRADE	71

LOGO/LABEL/IMAGE:	WEBSITE:
	www.fairtrade.net (International)
	www.fairtrade.org.nz (New Zealand)

DESCRIPTION (SCOPE):
Fairtrade International administers a suite of standards. These include both producer and trader standards, as well as product-specific standards. Across all standards a set of common principles relating to social, economic and environmental development, and forced and child labour apply. The standards distinguish between core requirements, which producers must meet to be certified, and development requirements, which encourage producers to continuously improve.
A key feature of all product standards is the Fairtrade minimum prices and premiums, which are set regionally. Minimum prices are intended to cover the average costs of sustainable production and meet a broadly determined living wage in the sector. The price premium is paid by the buyer to the cooperative organisation in addition to the sales price for community development purposes.

GEOGRAPHICAL COVERAGE:
Global

TYPE OF SCHEME:
Certification – product segregation: bulk commodity (dominant) also product segregation: identity preservation and mass balance.

SET UP BY:
The suite of standards are administered by Fairtrade International, an umbrella organisation for Fairtrade organisations worldwide.

OPERATING SINCE:
A common Fairtrade certification mark was launched in 2002. Prior to this, various national labelling initiatives existed.

ISSUE SCHEME DESIGNED TO ADDRESS:
The scheme was designed to improve the living conditions for farmers and workers in developing countries. The main aim was to ensure that growers of crops in low-income countries were provided with sufficient wages to provide a basic livelihood. Other aims included developing longer-term buyer-seller relationships that facilitate access to financing for producers, improved working conditions, the creation and maintenance of producer and worker organisations, and improved environmental outcomes.

METHOD OF PRODUCT RECOGNITION:
Fairtrade mark/logo on products and services.

FRAUD PREVENTION MEASURES:
Independent auditing and certification. FairTrace, an online verification tool that enables its customers to ensure the physical integrity and quality of products through entire supply chains.

EVIDENCE SCHEME SUCCESS:

Market research rates awareness of the Fairtrade mark in New Zealand at 79%, with conversion of recognition to regular purchase at 42%.

Retail sales of Fairtrade products and services in Australia and New Zealand grew by 11% in 2013. Global retail sales grew by 10% between 2013 and 2014, however there is considerable variation between markets. In some mature markets, such as Sweden and Germany Fairtrade purchases are increasing at over 25% per annum, while in others, such as the UK, sales are flat or decreasing. There is significant growth in new and emerging markets such as Canada and Hong Kong.

EVIDENCE OF PREMIUM FOR PRODUCTS:

A review of studies in North America on consumers' willingness to pay for fair trade or ethically certified products concluded that overall consumers value production that occurs to fair trade/ethical standards (i.e they are prepared to pay a price premium and/or buy comparatively more of a product carrying fair trade labelling) and consumers believe that certification conveys credible information. However, this research used a broad definition of "fair trade" and these results do not relate solely to the Fairtrade international mark.

EVIDENCE OF REDUCED COSTS FOR SCHEME PARTICIPANTS:

None found.

EVIDENCE OF WIDER BENEFITS EG. MARKET ACCESS, BRAND PROTECTION

Monitoring and evaluation by Fairtrade and independent organisations finds that Fairtrade brings small producers and works on Fairtrade plantations. The nature and scale of benefits varies, among other things, product and region. While Fairtrade certification does not always lead to direct wage or income benefits, the Fairtrade Premium provides benefits. For small producers this includes direct services to farmers, investment in business infrastructure and farmer dividends. On plantations the benefits include housing, education and healthcare.

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REFERENCES

- Fairtrade Australia New Zealand 2013/14 Annual Report - http://fairtrade.org.nz/sites/default/files/2013-2014%20Fairtrade%20Annual%20Report_online%20version_1.pdf
- Fairtrade International Annual Report 2014-15 - http://annualreport.fairtrade.net/en/
- "The Economics of Fair Trade" Raluca Dragusanu, Daniele Giovannucci, and Nathan Nunn, Journal of Economic Perspectives volume 28, Number 3 – Summer 2014 – Pages 217-236 : http://scholar.harvard.edu/files/rdragusanu/files/jep_firstdraft_sept10_2013.pdf
- FLOCERT Year in review 2014 - www.flocert.net/wp-content/uploads/2015/09/FLOCERT_AR14_WEB.pdf
- Monitoring the scope and benefits of Fairtrade, Seventh Edition, Fair Trade International 2015: www.fairtrade.net/fileadmin/user_upload/content/2009/resources/2015-Fairtrade-Monitoring-Scope-Benefits_web.pdf

FOREST STEWARDSHIP COUNCIL (FSC)

LOGO/LABEL/IMAGE:	**WEBSITE:**
	www.nz.fsc.org (New Zealand) www.ic.fsc.org (International)

DESCRIPTION (SCOPE):

The scheme offers a range of certificates for wood and other forest products. The scheme certifies both **products** and **sites.** The certificates are**:**

- forest management – confirms a specific forest area is being managed in line with the Forest Stewardship Council (FSC) principles and criteria
- forest management/chain of custody – applies to operations with forest management certification that sell material to customers
- chain of custody – for manufacturers, processors and traders – verified that FSC-certified material is identified or kept segregated from non-certified or non-controlled material throughout the production process
- controlled wood – shows that wood used does not include wood considered unacceptable to FSC and can be mixed with certified wood in the FSC Mix products.

The scheme also offers four claims or product labels that can be used in the marketplace:

- FSC 100% - all wood or other forest products the product contains come from FSC-certified forests
- FSC Mix – products contain at least 70% FSC-certified virgin or post-consumer content
- FSC Recycled – products contain at least 85% post-consumer material
- FSC Controlled Wood – wood is not certified, but comes from controlled sources that can be mixed with FSC-certified wood in products with the FSC Mix label.

Independent certification bodies carry out the certification assessments. Certification is valid for five years and includes an annual check.

GEOGRAPHICAL COVERAGE:

Global

TYPE OF SCHEME:

Certification – product segregation: bulk commodity (dominant), also product segregation: identity preservation and mass balance.

SET UP BY:

The scheme was set up by the Forest Stewardship Council, a group of timber users, traders and representatives of environmental and human rights organisations.

OPERATING SINCE:

1993

ISSUE SCHEME DESIGNED TO ADDRESS:

The scheme was designed to address concerns about accelerating deforestation, environmental degradation and social exclusion.

The scheme evolved from the Forest Principles (non-binding) at the Earth Summit in 1992.

It was thought that certification would be driven by direct price premiums for certified wood.

METHOD OF PRODUCT RECOGNITION:
Producers, manufacturers and suppliers include the claim on the product invoice.
There are also a suite of consumer labels for products at point-of-sale.

FRAUD PREVENTION MEASURES:
Independent certification bodies are checked regularly to ensure they comply with FSC rules. Annual office and field audits are conducted to ensure that certification bodies comply with FSC rules and procedures.
The FSC has a Supply Chain Integrity Program underway. One of the programme's focus areas is to identify and address inaccurate claims in the FSC system. It has five projects underway to achieve this, including:
- revising the chain of custody standard to include specific criteria addressing volume fraud
- improving the system for input and control of information in the FSC certificate database
- creating an online claims platform
- utilising fibre testing to reduce substitution fraud
- a specific China integrity plan.

EVIDENCE SCHEME SUCCESS:
There is evidence of FSC certification achieving social benefits for people who own and rely on forests for their livelihoods, as well as benefits for local communities. These include:
- improvements in internal community structures
- improvements in external relations
- community development and poverty alleviation
- enabling communities to assert their customary rights over land managed by others
- enhanced professional status and esteem.

EVIDENCE OF PREMIUM FOR PRODUCTS:
The FSC Global Market Survey found that 81.5% of respondents agreed that the FSC label adds value to products. While some manufacturers receive higher prices for sales, most say that price benefits have been limited. Where end products have increased in value, a flow through of higher prices being paid to landowners for producing wood is uncommon.

EVIDENCE OF REDUCED COSTS FOR SCHEME PARTICIPANTS:
FSC certification can provide a recognised guarantee that forests are being responsibly managed, therefore helping smallholders and communities to access external grants or development support.
In the US, forests with FSC-certified plans are eligible for federal cost-sharing incentives.

EVIDENCE OF WIDER BENEFITS EG. MARKET ACCESS, BRAND PROTECTION:
Market access is seen to be a valuable indirect benefit of FSC certification and a popular strategy for differentiating products in an increasingly globalised market.
At a business-to-business level, FSC certification is seen to be highly advantageous. For example, among North American manufacturers, FSC chain-of-custody certification is the most popular certification by 4:1 – creating demand for FSC-certified supplies.
There is anecdotal evidence of non-FSC-certified suppliers having to offer price concessions of 5 – 25%.

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REFERENCES

- Forest Stewardship Council International website - https://ic.fsc.org/en
- FSC Global Market Survey Report 2014 - https://ic.fsc.org/en/resources/market-information/gms
- FSC Supply Chain Integrity Program, 2013 - https://ic.fsc.org/preview.supply-chain-integrity-program-delivering-a-stronger-and-more-simple-coc-system.a-5036.pdf
- Costs and Benefits of Forest Certification, FactSheet, Forest Stewardship Council US
- Why get certified? Forest Certification for Ecosystem Services

GS1 GLOBAL TRACEABILITY STANDARD	
LOGO/LABEL/IMAGE:	**WEBSITE:** www.gs1nz.org

DESCRIPTION (SCOPE):
The GS1 Global Traceability Standard describes the generic minimum requirements for a system that can track forward and trace back (one step up, one step down as a minimum) at any point along a supply chain.
The standard establishes a common way to describe the traceability process, independently from the choice of enabling technologies, and irrespective of differences such as the role in the supply chain, industry sector and regulatory environment.
The GS1 Global Traceability Standard draws on GS1's suite of supply chain standards, which cover unique identification of items, record keeping and communication between trading partners.

GEOGRAPHICAL COVERAGE:
Global

TYPE OF SCHEME:
Track and trace

SET UP BY:
GS1

OPERATING SINCE:
2007, latest version 1.3.0 2012.

ISSUE SCHEME DESIGNED TO ADDRESS:
The scheme is designed to provide:
- a common approach and understanding of key principles by users globally
- interoperability between traceability systems across the full supply chain, while accommodating specific business, sector or regulatory requirements
- a foundation standard that sectors and countries can use as a starting point to build their own specific traceability scheme
- a means for organisations to demonstrate that they meet the requirements of corporate responsibility.

METHOD OF PRODUCT RECOGNITION:
None specified.

FRAUD PREVENTION MEASURES:
None specified.

EVIDENCE SCHEME SUCCESS:
None found.

EVIDENCE OF PREMIUM FOR PRODUCTS:
None found.

EVIDENCE OF REDUCED COSTS FOR SCHEME PARTICIPANTS:
None found.

EVIDENCE OF WIDER BENEFITS EG. MARKET ACCESS, BRAND PROTECTION
None found.

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REFERENCES
- GS1 Global website – www.gs1.org/
- GS1 New Zealand website – www.gs1nz.org
- GS1 Standards Document – Business Process and Systems Requirements for Full Supply Chain Traceability – GS1 Global Traceability Standard – Issue 1.3.0, November 2012 - www.gs1.org/docs/traceability/Global_Traceability_Standard.pdf

LEATHER WORKING GROUP	
LOGO/LABEL/IMAGE:	**WEBSITE:** www.leatherworkinggroup.com

DESCRIPTION (SCOPE):

The scheme assesses the compliance and environmental stewardship practices of leather manufacturers. It is a **site** level scheme. Certification is granted based on a scoring system that covers operating permits, environmental management system, restricted substances, energy consumption, water consumption, effluent management and tannery and other processes. Bronze, silver and gold level awards (certification) are available under the scheme.

The scheme rates a leather manufacturer's ability to trace their material on a scale from A to F, depending on the percentage of traceable product used and the method of traceability. There are additional requirements for leather sourced from Brazil.

GEOGRAPHICAL COVERAGE:

Global

TYPE OF SCHEME:

Certification – product segregation: identity preservation

SET UP BY:

The Leather Working Group is made up of representatives from across the leather supply chain, including brands, tanners and technical experts.

OPERATING SINCE:

2005**,** traceability was added as a component of the scheme in 2010.

ISSUE SCHEME DESIGNED TO ADDRESS:

The Leather Working Group was set up to improve environmental standards in the leather industry. The leather industry had traditionally been associated with odour and pollution problems.

In the 2000s, NGOs raised awareness of the links between major leather brands and ranches implicated in illegal deforestation in the Brazilian Amazon.

Understanding where the leather in shoes and other products came from became a consumer issue. Leather retailers and brands were unable to determine whether or not their supplies were connected with deforestation as there was no traceability system in place.

METHOD OF PRODUCT RECOGNITION:

Physical stamping of hides/material with a code identifying the facility where the animals were slaughtered. The date of slaughter is also a requirement for material sourced from Brazil.

FRAUD PREVENTION MEASURES:

GPS mapping of Brazilian farms is used to verify that ranches are not illegally encroaching forest areas.

EVIDENCE SCHEME SUCCESS:
Tanneries participating in the Leather Working Group project have reduced water and energy use by an average of 15–20% (2011).

EVIDENCE OF PREMIUM FOR PRODUCTS:
None found – leather is the identifier of value for the consumer (as opposed to other materials e.g. leather shoes, leather car upholstery).

EVIDENCE OF REDUCED COSTS FOR SCHEME PARTICIPANTS:
None found.

EVIDENCE OF WIDER BENEFITS EG. MARKET ACCESS, BRAND PROTECTION
None found.

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REFERENCES:
- Leather Working Group website: www.leatherworkinggroup.com
- FROM Major Driver of Deforestation and Greenhouse Gas Emissions to Forest Guardians? New Developments in Brazil's Amazon Cattle Industry, National Wildlife Federation, 2010 - www.nwf.org/Global-Warming/Policy-Solutions/~/media/4878226C49BF48EB9EB54C1B7C616327.ashx
- Leather, a sustainability obstacle or the ultimate sustainable material? Dr Dietrich Tegtmeyer, September 2012 - http://lanxess.cn/uploads/tx_lxsmatrix/120906_MD4_Tegtmeyer_en_presented_4-3.pdf
- How Timberland, Levi's Use Teamwork to Advance Sustainability, Mindy S. Lubber, GreenBiz 2011 - www.greenbiz.com/blog/2011/05/09/how-companies-court-stakeholders-accelerate-sustainability

NATIONAL ANIMAL IDENTIFICATION AND TRACING (NAIT)	
LOGO/LABEL/IMAGE:	**WEBSITE:** www.nait.co.nz

DESCRIPTION (SCOPE):
The scheme is a mandatory identification and tracing system for cattle and deer. Persons in charge of animals register themselves and their location with NAIT. Cattle and deer are tagged with NAIT-approved radio-frequency identification (RFID) ear tags. Tagged animals are registered in the NAIT system, that then records the animal's movements. The person in charge of animals must record and confirm both animals sent and animals received.

GEOGRAPHICAL COVERAGE:
New Zealand proprietary

TYPE OF SCHEME:
Track and trace

SET UP BY:
The scheme was set up by the New Zealand Government, in conjunction with industry groups. The scheme is currently administered by OSPRI (a not-for-profit company).

OPERATING SINCE:
2012 for cattle, 2013 for deer, with a transition period for the first three years.

ISSUE SCHEME DESIGNED TO ADDRESS:
The main driver for NAIT was the need to improve the efficiency and timeliness of establishing the animal health status of New Zealand livestock.
A central repository of animal identification and tracing data could considerably reduce the costs to farmers and the industry when faced with an exotic disease incursion.
The scheme was also seen to be necessary to keep up with international trends in food traceability and to protect both market access and consumer confidence in New Zealand products.

METHOD OF PRODUCT RECOGNITION:
RFID tags on animals.

FRAUD PREVENTION MEASURES:
Persons in charge of animals must confirm both the sending and receiving of animals.

EVIDENCE SCHEME SUCCESS:
The Ministry for Primary Industries calculates NAIT would limit the impact of a foot-and-mouth disease outbreak by 4–10%.
Prior to the introduction of the scheme, an analysis in 2009 showed a benefit of $141 million over 20 years to the New Zealand economy from implementing the NAIT scheme.
The number of animals registered as a percentage of the estimated national herd is 65% in 2013/14 – within the transition period.

EVIDENCE OF PREMIUM FOR PRODUCTS:
Prior to introduction of the system, Meat & Wool New Zealand estimated that there is potential for price premiums of up to 25% on specific cuts of New Zealand traceable beef in the European Union, North-American and North-Asian markets.

EVIDENCE OF REDUCED COSTS FOR SCHEME PARTICIPANTS:
None found. A NAIT slaughter levy was introduced to cover the costs of administering the scheme. Initially set at $1.00 per carcass, this was reduced to $0.50 in 2014.

EVIDENCE OF WIDER BENEFITS EG. MARKET ACCESS, BRAND PROTECTION:
No direct evidence found. The scheme was developed on the basis that market access is underpinned by New Zealand's uniquely high livestock health status, and the assurances that can be provided based on the maintenance and improvement of the country's veterinary disease surveillance and control infrastructure. There is evidence in developed nations worldwide that individual animal identification and tracing systems significantly contribute to these assurances.

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REFERENCES:
- NAIT website - www.nait.co.nz/
- OSPRI Annual Report 2013/14 - http://nait.co.nz/assets/Annual-reports/Annual-Report-2014.pdf
- Stage Two Business Case - http://nait.co.nz/assets/Scheme-background/NAIT-stage-2-business-case.pdf
- Tracing our cattle and deer, NZ Official Yearbook 2012, Statistics New Zealand - www.stats.govt.nz/browse_for_stats/snapshots-of-nz/yearbook/environment/agriculture/nait.aspx

NEW ZEALAND MERINO

LOGO/LABEL/IMAGE:	WEBSITE:
	www.nzmerino.co.nz

DESCRIPTION (SCOPE):
The New Zealand Merino Company Limited (NZM) is an integrated sales, marketing and innovation company focused on transforming New Zealand's merino sheep industry. NZM was formed and is owned by New Zealand merino growers.
NZM set up merino fibre sales through long-term supply contracts to brand partners, rather than via commodity auction.
NZM sells its merino fibre under a number of brands. Fibre sold under the ZQ brand is sourced from growers certified under NZM's ZQ Merino programme. The programme covers product quality, animal welfare and health, environmental, economic and social values. ZQ Merino growers are independently assessed and audited every three to five years.

GEOGRAPHICAL COVERAGE:
New Zealand

TYPE OF SCHEME:
Certification – product segregation: identity preservation

SET UP BY:
NZM was formed and is owned by New Zealand merino growers.

OPERATING SINCE:
NZM formed in 1995. The ZQ Merino brand and programme were introduced later.

ISSUE SCHEME DESIGNED TO ADDRESS:
When NZM was formed wool commodity prices were highly volatile, with the demand for and price of coarse wool in decline. New Zealand merino growers wanted a way to distinguish their product in the market to obtain a premium price, as well as avoid the fluctuations of wool commodity prices. Reputational attacks have caused luxury brands (NZM's customers) to increasingly measure their suppliers on factors other than just price and quality. The ZQ brand and programme was established to provide NZM's customers with certainty around animal welfare and health, environmental, economic and social values.

METHOD OF PRODUCT RECOGNITION:
NZM's ZQ certified merino is sold under the ZQ brand.

FRAUD PREVENTION MEASURES:
The NZM purchasing system involves direct relationships between growers and their customers – there are no intermediary traders.

EVIDENCE SCHEME SUCCESS:
NZM transacts approximately 85% of merino wool grown in New Zealand.

EVIDENCE OF PREMIUM FOR PRODUCTS:
NZM reports securing premiums for its products but contract prices are not publicly disclosed.

EVIDENCE OF REDUCED COSTS FOR SCHEME PARTICIPANTS:
None found. Wool traders traditionally charge 4% commission – in comparison, NZM costs for growers are around 8%.

EVIDENCE OF WIDER BENEFITS EG. MARKET ACCESS, BRAND PROTECTION:
None found.

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REFERENCES:
- NZ Merino website – www.nzmerino.co.nz
- Case study – Stanford Graduate School of Business – www.nzmerino.co.nz/casestudy/company.php
- New Zealand Merino Annual Report 2015 – www.nzmerino.co.nz/assets/Investor-Relations/2015-NZM-Annual-Report.pdf
- ZQ Merino fibre – www.zqmerino.com/home/zq-merino/

PEFC (PROGRAMME FOR ENDORSEMENT OF FOREST CERTIFICATION)

LOGO/LABEL/IMAGE:	WEBSITE: www.pefc.org

DESCRIPTION (SCOPE):

PEFC is the world's largest forest certification scheme. The scheme overs environmental aspects (biodiversity, hazardous substances, forest conversions) as well as social and labour aspects (workers' rights and welfare, indigenous rights, health and safety, property rights).

PEFC is an umbrella organisation for national forest certification schemes. National forest certification schemes are independently assessed against PEFC's Sustainability Benchmarks to ensure consistency with international requirements.

The scheme offers both **product** and **site** certifications, including:

- sustainable forest management certification
- chain of custody certification – all entities along the supply chain must possess a PEFC chain of custody certificate
- project chain of custody certification – not all parties involved in specific projects are certified, even though forest-based material used for the project is covered by chain of custody certification.

GEOGRAPHICAL COVERAGE:

Global

TYPE OF SCHEME:

Certification – mass balance (dominant), also product segregation: identity preservation and product segregation: bulk commodity.

SET UP BY:

PEFC is an international non-profit organisation. It is an Umbrella organisation that endorses national forest certification schemes.

OPERATING SINCE:

1999, first national scheme recognised in 2000. New Zealand joined in 2015.

ISSUE SCHEME DESIGNED TO ADDRESS:

PEFC certification was founded in response to the:

- specific requirements of small and family forest owners
- need for a mechanism to enable the independent development of national standards tailored to the political, economic, social, environmental and cultural context of individual countries, while ensuring global recognition and compliance with internationally-accepted requirements.

METHOD OF PRODUCT RECOGNITION:

There are three standard labels used directly on products or for product marketing:

- PEFC Certified
- PEFC Recycled
- Promoting Sustainable Forest Management (SFM)

FRAUD PREVENTION MEASURES:
Only companies and forest owners that have achieved PEFC certification and obtained a logo usage license can use the PEFC logo and label on products and marketing and access the PEFC label generator.

EVIDENCE SCHEME SUCCESS:
The 2014 PEFC Global Consumer Survey found that certification labels, such as the PEFC label, are the most trusted means of giving confidence to consumers that wood-based products are from sustainable sources – ahead of country of origin and brand.

EVIDENCE OF PREMIUM FOR PRODUCTS:
PEFC states that brands and manufacturers that choose to use certified wood-based fibres should not necessarily have to pay a price premium for those fibres.

EVIDENCE OF REDUCED COSTS FOR SCHEME PARTICIPANTS:
None found.

EVIDENCE OF WIDER BENEFITS EG. MARKET ACCESS, BRAND PROTECTION:
The PEFC chain of custody standard was updated in 2013 so that it fully aligns with the European Timber Regulation which prohibits the placing of illegally harvested timber and timber products on the European market and requires companies to implement a due diligence system.
New Zealand Forest Certification Association reports that most countries New Zealand exports forest and wood products to are PEFC members and recognise PEFC certification as meeting their import requirements.

OTHER:
PEFC has been criticised for a lack of robust systems to protect social and ecological values, and has been deemed a weaker system than Forest Stewardship Council by international environmental NGOs.

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REFERENCES:
- PEFC website – www.pefc.org/
- PEFC Annual Review 2014 – Towards the Tipping Point - www.scribd.com/fullscreen/265159299?access_key=key-irXAqyV4K7jWT1l8yrr5&allow_share=true&escape=false&show_recommendations=false&view_mode=scroll
- New Zealand Forest Certification Association Incorporated – www.nzffa.org.nz/article-archive/new-zealand-forest-certification-association-incorporated/
- Weaker Certification Schemes – http://m.greenpeace.org/international/en/mid/campaigns/forests/solutions/alternatives-to-forest-destruc/Weaker-Certification-Schemes/
- An Advisory Note for brands and manufacturers, PEFC – www.pefc.co.uk/system/resources/W1siZiIsIjIwMTUvMDMvMTcvNmdlNmRuemp0dV9QRUZDX0JSQU5EX09XTkVSVX1NfRkFDVFNIRUVUX3Rpc3N1ZV8ucGRmIl1d/PEFC%20BRAND%20OWNER%27S%20FACTSHEET%20%28tissue%29.pdf

PRODUCE TRACEABILITY INITIATIVE	
LOGO/LABEL/IMAGE: No logo or label.	**WEBSITE:** www.producetraceability.org

DESCRIPTION (SCOPE):
The scheme is a voluntary initiative that provides a common framework and nomenclature for product identification by the United States and Canadian produce industry.
Scheme participants track two common pieces of information on every case of produce as it moves through the supply chain – global trade item number (identifies the manufacturer and type of product) and lot number.
There is no centralised database, however each member can track the two fields in their individual databases.

GEOGRAPHICAL COVERAGE:
United States and Canada

TYPE OF SCHEME:
Track and trace

SET UP BY:
The scheme is a collaboration between the Canadian Produce Marketing Association, GS1 US, Produce Marketing Association and United Fresh Produce Association.

OPERATING SINCE:
Established in 2007, phased in through to 2012.

ISSUE SCHEME DESIGNED TO ADDRESS:
The scheme was designed to aid traceback investigations and recalls in the event of a foodborne illness outbreak, as well as isolate food-safety problems before they occur.
Technology and communications advances had aided the detection of outbreaks, but there was still considerable difficulty in investigating and tracing foodborne illness outbreaks back to the sources of the problem. Following the "one up, one down" (one step upstream and one step downstream) paper trail required under the US Bioterrorism Act often meant following the financial flow of products (via invoices) rather than the physical flow.
It was also hoped that improved traceability systems would minimise the impact of a recall by narrowing the scope of the product that is implicated.

METHOD OF PRODUCT RECOGNITION:
Each case is marked with global trade item number and lot number in both human-readable form and a machine-readable GS1 barcode.

FRAUD PREVENTION MEASURES:
No details found.

EVIDENCE SCHEME SUCCESS:
None found.

EVIDENCE OF PREMIUM FOR PRODUCTS:
None found.

EVIDENCE OF REDUCED COSTS FOR SCHEME PARTICIPANTS:
Industry support of the scheme has been described as mixed at best. The cost of implementation has been a major hurdle for both suppliers and distributors of fresh produce due to the additional technological and labour expenses involved in adding a lot-specific barcode to each box and then reading and storing that data.

EVIDENCE OF WIDER BENEFITS EG. MARKET ACCESS, BRAND PROTECTION:
None found.

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REFERENCES:
- Produce Traceability Initiative website **–** www.producetraceability.org
- Frequently Asked Questions – www.producetraceability.org/documents/faqs%202011%20062011%20final.pdf

The U.S Produce Traceability Initiative: Analysis, Evaluation, and Recommendations Porter, Baker & Agrawal / International Food and Agribusiness Management Review / Volume 14, Issue 3, 2011 – www.ifama.org/files/20110032_Formatted.pdf

RESPONSIBLE JEWELLERY COUNCIL	
LOGO/LABEL/IMAGE:	**WEBSITE:** www.responsiblejewellery.com

DESCRIPTION (SCOPE):

The scheme covers diamonds, gold and platinum group metals. Certification is granted to the member company as a whole, not individual facilities or products. Companies have two years from joining the council in which to gain member certification. Certification requires substantive conformance with the Responsible Jewellery Council's standard codes of practice as verified by third-party auditors.

The codes of practice cover:

- responsible supply chains and human rights
- labour rights and working conditions
- health, safety and environment
- gold, diamond and platinum group metal products (specifics)
- responsible mining

Any member that makes provenance claims may have these audited as part of their certification. There is also a voluntary chain of custody certification.

GEOGRAPHICAL COVERAGE:

Global

TYPE OF SCHEME:

Certification – product segregation – bulk commodity (for chain-of-custody certification)

SET UP BY:

The Responsible Jewellery Council was formed by a group of mining companies, jewellery retailers and trade associations.

OPERATING SINCE:

The Responsible Jewellery Council was established in 2005. Certification commenced in 2009, with chain of custody certification introduced in 2012.

ISSUE SCHEME DESIGNED TO ADDRESS:

The scheme was designed to reinforce consumer confidence in the jewellery industry.

Consumers were increasingly concerned about the integrity of jewellery products. A number of high profile campaigns against conflict minerals and dirty gold raised awareness of the issues amongst consumers.

Jewellery purchases are highly discretionary and have a strong emotional connection.

METHOD OF PRODUCT RECOGNITION:

Members use the Responsible Jewellery Council logo on their websites.

FRAUD PREVENTION MEASURES: None found.
EVIDENCE SCHEME SUCCESS: The scheme has grown from 14 founding members to 640 members.
EVIDENCE OF PREMIUM FOR PRODUCTS: None found.
EVIDENCE OF REDUCED COSTS FOR SCHEME PARTICIPANTS: Chain of custody certification can assist companies to conform with the OECD Due Diligence Guidance, London Bullion Market Association Responsible Gold Guidance and the Electronic Industry Citizenship Coalition Smelter/Refiner Validation Program and to comply with the provisions of the US Dodd-Frank Act. The Responsible Jewellery Council, the London Bullion Market Association, the Electronic Industry Citizenship Coalition-GeSI Conflict Free Smelter program and the Dubai Multi Commodity Centre have agreed to cross-recognise audits of gold refinery due diligence.
EVIDENCE OF WIDER BENEFITS EG. MARKET ACCESS, BRAND PROTECTION: None found.
OTHER: The Responsible Jewellery Council has been strongly criticised for being more concerned with improving the industry's image than improving standards of operation. Criticisms include: • industry controlled governance that excludes non-industry members from participation in decision making • failing to place concrete targets or limits on key environmental factors e.g. water use, energy use, mercury emissions, mining in protected areas • weak protection of labour and human rights • loopholes that enable companies with known irresponsible operations to gain company-wide certification.
CONTACT DETAILS: Andrew Bone Executive Director Responsible Jewellery Council info@responsiblejewellery.com + 44 (0)207 321 0992
REFERENCES: • Responsible Jewellery Council website - www.responsiblejewellery.com/ • More Shine Than Substance – How RJC certification fails to create responsible jewellery – May 2013 - www.earthworksaction.org/files/publications/More-Shine-Than-Substance-FINAL.pdf • Is the Responsible Jewellery Council an imitation ethical standards body? - www.theguardian.com/sustainable-business/responsible-jewellery-council-ethical-standards

RESPONSIBLE STEEL	
LOGO/LABEL/IMAGE:	**WEBSITE:** www.steelstewardship.com

DESCRIPTION (SCOPE):
The scheme is intended to work across the entire steel life cycle from mining through to manufacturing, processing, product fabrication, use and re-use and recycling. The first phase of the scheme will target mining and steel manufacturing.
The scheme will certify entities (company, part of a company or site) rather than products. Once there is sufficient participation, a chain of custody scheme will also be developed to certify products or groups of products.

GEOGRAPHICAL COVERAGE:
Australia

TYPE OF SCHEME:
To be developed.

SET UP BY:
Steel Stewardship Forum, Australia.

OPERATING SINCE:
In development.
The Steel Stewardship Forum was established in 2008.

ISSUE SCHEME DESIGNED TO ADDRESS:
There was no mechanism across the entire steel supply chain to consistently and comprehensively capture, measure, benchmark and communicate efforts on climate change, environmental programmes and other sustainability indicators. This was restricting steel producers' abilities to report on and improve their credentials in the market and with regulators.
The Steel Stewardship Forum was established around the time of policy initiatives such as the Australian Energy Efficiency Opportunities Act 2006 (since repealed), which required large energy-using businesses to assess and report on energy efficiency.
A key driver in developing the scheme is the perception by key stakeholders that steel products are as much part of the environmental problem as part of the solution.

METHOD OF PRODUCT RECOGNITION:
To be developed.

FRAUD PREVENTION MEASURES:
To be developed.

EVIDENCE SCHEME SUCCESS:
Not applicable as scheme not yet operating.

EVIDENCE OF PREMIUM FOR PRODUCTS:
Not applicable as scheme not yet operating.

EVIDENCE OF REDUCED COSTS FOR SCHEME PARTICIPANTS:
 Not applicable as scheme not yet operating.

EVIDENCE OF WIDER BENEFITS EG. MARKET ACCESS, BRAND PROTECTION:
Market research conducted by the Steel Stewardship Forum in conjunction with the Australian Centre For Corporate Social Responsibility found stakeholders agree that Responsible Steel will deliver:
- competitive advantage – reputational benefits, product differentiation and risk management
- a structure for good business – screen suppliers, simplify purchasing and reduce marketing to provide confidence to buyers.

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REFERENCES:
- Responsible Steel website - http://steelstewardship.com/projects/responsible-steel/
- Market Research Executive Summary - http://steelstewardship.com/steel-stewardship-forum-update/
- Benn, S., Giuro, D., Brown, P.J., Agarwal, R. (2014) Resources, 3, 275-290 www.mdpi.com/2079-9276/3/1/275/htm

ENGINEERED WOOD PRODUCTS ASSOCIATION OF AUSTRALASIA

LOGO/LABEL/IMAGE:	WEBSITE: www.ewp.asn.au

DESCRIPTION (SCOPE):
The Engineered Wood Products Association administers a suite of certification schemes covering:
- plantation timber
- chain of custody (Australia only, in association with PEFC and the Australian Forestry Standard)
- plywood and LVL
- particleboard and MDF
- wood packaging (to meet international standards).

Certification involves independent verification that facilities, and the products they produce, consistently meet the requirements of the specified Australian/New Zealand Standards.
Certification is mostly offered at the mill level, with both auditing of mill processes and testing of end products.

GEOGRAPHICAL COVERAGE:
Australia and New Zealand

TYPE OF SCHEME:
Certification – product segregation: identify preservation; Certification – mass balance for chain of custody standard.

SET UP BY:
Engineered Wood Products Association of Australasia (EWPAA)

OPERATING SINCE:
1996

ISSUE SCHEME DESIGNED TO ADDRESS:
The EWPAA's market development programme seeks to differentiate plywood as engineered wood panels, with structural applications. Therefore, requirements for product predictability, reliability and durability became more important. The certification schemes were developed to provide quality control and demonstrate quality to purchasers and regulatory authorities.

METHOD OF PRODUCT RECOGNITION:
The PAA Engineered Wood logo is used on products.

FRAUD PREVENTION MEASURES:
EWPAA auditors randomly select products from merchant yards or stores to test that they meet the certification requirements. Each certified mill has some of their product randomly tested this way at least annually.

EVIDENCE SCHEME SUCCESS:
None found.

EVIDENCE OF PREMIUM FOR PRODUCTS: None found.
EVIDENCE OF REDUCED COSTS FOR SCHEME PARTICIPANTS: None found.
EVIDENCE OF WIDER BENEFITS EG. MARKET ACCESS, BRAND PROTECTION: Products certified under the schemes are automatically deemed to satisfy the product certification requirements of the Building Code of Australia. Certification also satisfies the acceptance requirements of Australian state and Commonwealth government purchasing authorities.
CONTACT DETAILS: Dave Gover CEO Engineered Wood Products Association of Australasia inbox@ewp.asn.au +61 7 3250 3700
REFERENCES: • Engineered Wood Products Association website – www.ewp.asn.au • EWPPA Role and Activities, 2012 – www.ewp.asn.au/library/downloads/ewpaa_roles_and_activities.pdf

CONCRETE SUSTAINABILITY COUNCIL

LOGO/LABEL/IMAGE:	WEBSITE:
	www.concretesustainabilitycouncil.org

DESCRIPTION (SCOPE):

The scheme, currently in the final stages of development, is intended to cover ready-mix concrete, precast, hollow core, block, pavers and all masonry-based construction products.

The scheme offers **product** level certification – certifying either full plants or specific products from a plant. There are two mandatory prerequisites – legal compliance and human rights. Certification is assessed on a points basis over four categories – management, environment, social and economics. There are also four possible levels of certification– bronze (baseline/pass), silver, gold or platinum. The scheme will have regional certification, with variation (points weighting, additional topics, etc.) allowed between regional scheme operators within minimum standards.

GEOGRAPHICAL COVERAGE:

Global

TYPE OF SCHEME:

Certification – product segregation: bulk commodity

SET UP BY:

The Cement Sustainability Initiative, part of the World Business Council for Sustainable Development.

OPERATING SINCE:

Not yet operating, currently in the pilot phase with operation expected to commence in 2016.

ISSUE SCHEME DESIGNED TO ADDRESS:

The primary objectives in designing the scheme were to:

- promote sustainable practices and incentivise continuous improvement in the concrete sector
- make concrete sector sustainability initiatives more visible and allow organisations to demonstrate leadership
- enable responsibly sourced concrete to be recognised in green building rating systems such as LEED, BREEAM, DGNB, GreenStar, and HQE
- improve the public opinion of concrete products and the concrete sector
- improve the business case of sustainable and responsibly sourced concrete.

METHOD OF PRODUCT RECOGNITION:

Concrete Sustainability Council logo along with the relevant certification number, in a different colour denoting the level of performance achieved (silver, gold, etc.).

FRAUD PREVENTION MEASURES:

Independent, third-party audit.

EVIDENCE SCHEME SUCCESS:
Not yet operating.

EVIDENCE OF PREMIUM FOR PRODUCTS:
Not yet operating.

EVIDENCE OF REDUCED COSTS FOR SCHEME PARTICIPANTS:
The scheme has been designed to align with BES 6001, with about 60 points needed to be gained under the scheme to gain BES 6001 certification.

EVIDENCE OF WIDER BENEFITS EG. MARKET ACCESS, BRAND PROTECTION:
Not yet operating.

CONTACT DETAILS:
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REFERENCES:
- Concrete Sustainability Council website –
  www.concretesustainabilitycouncil.org/index.php?pagina=home
- The Concrete Responsible Sourcing Scheme wiki –
  www.concretesustainabilitycouncil.org/wiki/index.php?title=Main_Page
- "Sourcing concrete with confidence" A Global Responsible Sourcing Certification System for the Concrete and Cement Industry –
  www.concretesustainabilitycouncil.org/index.php?popupdoen=download&p=concrete_sustainability_council_sept4.pptx

Appendix B: Traceability survey questions

Construction industry stakeholder survey questions

This section provides a summary of the questions in the BRANZ traceability survey carried out in 2015 using SurveyMonkey. Depending on the response, one or more of the following questions may have been skipped (as they were not relevant given the respondent's answer). This question logic is not reproduced here.

The results of the survey are presented in section 4.

Question 1

If implemented, what should a traceability system for construction products look like?

- "Chain of custody", in which a product can be tracked through the supply chain and information about the product can be easily retrieved using a suite of common global data standards
- "Authentication based", per "chain of custody" plus information accessible about the product is independently certified by a third party, as being true and accurate
- A combination of both of the above in which lower risk products may have a "chain of custody" system and higher risk products may have an "authentication based" system.
- Don't think we need a traceability system.
- Don't know.

Question 2

In a "chain of custody" system, what information about construction products should be available? You can select one or more options.

- Test results for Building Code compliance
- Relevant 'other' product related standards compliance certification
- Amounts and types of constituent materials in the product, including materials that are classed as hazardous under the HSNO Act
- Provenance (place of origin)
- Safe disposal information, including opportunity for re-use, recycling or recovery
- Health & safety policies and record of health & safety amongst companies in the supply chain
- Ethical policies and record of ethical behaviour amongst companies in the supply chain
- Environmental policies and record of environmental management amongst companies in the supply chain
- Environmental information about the product
- Other (please specify)

Question 3

In an "authentication based" system, what information should be certified? (Respondents given the choice between essential, nice to have, less important or not importaunt)

- Test results for Building code compliance
- Relevant 'other' product related standards compliance certification

- Amounts and types of constituent materials in the product, including materials that are classed as hazardous under the HSNO Act
- Provenance (place of origin)
- Safe disposal information, including opportunity for re-use, recycling or recovery
- Health & safety policies and record of health & safety amongst companies in the supply chain
- Ethical policies and record of ethical behaviour amongst companies in the supply chain
- Environmental policies and record of environmental management amongst companies in the supply chain
- Environmental information about the product
- Other (please specify)

Question 4

What do you think are or could provide the drivers for traceability of construction products in New Zealand? (Respondents given the choice between strong driver, weak driver, not a driver)

- Demand from customers
- Product recall requirements from retailers, merchants and regulators
- Risk of product on the market which is not "fit for purpose"
- Risk to exports through inability to meet overseas legislation that requires a system of traceability
- Risk to exports through inability to compete with overseas competitors that can already demonstrate traceability systems in place
- Opportunity to assist procurement and supplier decisions through provision of better information
- Opportunity to make the building consent process quicker and easier
- Substitution of specified products
- Compliance with building environmental tools e.g. Green Star
- Other (please specify)

Question 5

If a traceability system for construction products was available in New Zealand, who do you think should be leading development?

- Individual companies for their own products
- Sector bodies/trade associations on behalf of their members
- Local authorities/councils
- The Government
- Other (please specify)

Question 6

What do you see as providing potential barriers to establishing a traceability system for construction products in New Zealand construction? (Respondents given the choice between very important, somewhat important and not important)

- Lack of understanding
- Lack of resources and support making it difficult to know what to do
- Extra cost or perception of extra cost
- Administrative burden

- Perception of no value now or likely in the future
- Apathy
- Other (please specify)

Question 7

In your experience, how often is alternative product substituted on construction jobs?

- Often (on more than half of jobs)
- Rarely (on less than half of jobs)
- Never

Question 8

When product is substituted, what is the main reason?

- More convenient alternative
- Better product
- Problems with supply of specified product
- Other (please specify)

New House Owners' Satisfaction Survey - traceability

Below is the question that was included in the BRANZ New House Owners' Satisfaction Survey in 2015:

Building code compliance was covered in your new house, but would you pay extra for assurance that the materials were produced ethically, safely and sustainably?

- No, I understand this goes beyond current legislation but I would not be prepared to pay a premium for it.
- Yes, I would pay up to 2% more.
- Yes, I would pay 2 - 4% more.
- Yes, I would pay 4 - 10% more.
- Don't know.