Self-certification in construction industry trades

Report to Ministry of Business Innovation and Employment

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Summary and report conclusions

This review of self-certification was undertaken as an input to the statutory review of the Plumbers, Gasfitters, and Drainlayers Act 2006. The objective of the review is to report on:

- key features of self-certification in regulated occupations and critical factors that make it successful
- relevant lessons from the current systems of self-certification practiced by gasfitters and electrical workers
- the opportunity for plumbers and drainlayers to transition to self-certification.

We recommend that MBIE considers the findings of this report, noting in particular that there is no common consensus among stakeholders, that the current data set does not provide useful insight, but that the literature does set out certain prerequisites. Below, we set out our recommendations and then summarise our findings.

Underpinning our recommendations, is the finding that the current regulatory system for plumbing and drainlaying is not working well. The current system relies on consents and inspections by Building Consent Authorities (BCAs). We found that:

- the quality of installations by plumbers and drainlayers is inconsistent
- inspections vary in reliability and timeliness
- there is a lack of useable information about inspection outcomes
- the level of record keeping of installations is variable and stakeholders do not have a uniform view about the value of records
- there appears to be a technical issue about the consistency of the Building Act and other regulations.

Recommendations

Change is needed to the regulatory system for plumbing and drainlaying

Stakeholders are divided on whether a self-certification regime with peer review of high-risk installations, a comprehensive BCA inspection regime, or a hybrid approach is appropriate in the plumbing and drainlaying sector, or for wider building trades. In this context, we recommend that MBIE:

1. Note that irrespective of the regulatory approach, improvements to the system are needed to ensure that quality outcomes are achieved in an efficient manner.

Self-certification could be adopted in an improved regulatory regime for plumbing and drainlaying. However, self-certification does not offer a quick win in terms of efficiency gains due to underlying problems with consistency of skill, variability in record-keeping, lack of information suitable for policy making purposes, and some technical problems with the regulation.

These elements will take time to solve. In the next section we describe our recommendations for establishing the pre-requisites for self-certification. In our view, these elements should be resolved irrespective of the decision to introduce self-certification.

Pre-requisites to self-certification

The four key elements to a successful self-certification regime are: clear rules setting out responsibilities and requirements for tradespeople; a robust training and licensing system; a credible auditing regime and an enforceable obligation to remediate quality issues. These elements underpin our recommendations that MBIE:

2. Determine a risk-based categorisation of plumbing and drainlaying installations based on factors including building type, whether the installation is a standardised design and the level of risk to public health.

3. Investigate further the consistency and quality of training of plumbers and drainlayers, including ongoing training, to determine whether training levels support dependable self-certification.

4. Use the findings of this report to establish the record keeping that is necessary to support risk-based auditing of self-certification of construction trades.

5. Investigate the process by which occupational regulatory bodies address work quality issues and the extent to which this needs to be strengthened to support dependable self-certification.

6. Investigate the extent to which consumers have access to remedies for poor quality work and whether this needs to be strengthened or mandated for successful self-certification.

Separate certification from testing and verification

We recommend that MBIE :

7. Consider a compliance approach for some plumbing and drainlaying installations that separates the certification by the BCA from the testing and verification step. Testing and verification would be completed by the installer.

Self-certification transfers responsibility for the decision about compliance from the BCA to the installer (or third-party certifier). The approach of separating certification from testing would mitigate risk associated with certifying non-compliant installations and could be considered as a pilot to test the readiness of plumbers and drainlayers to self-certify. It could also be considered as an ongoing quality assurance method for higher risk installations.

As an interim step, we recommend MBIE:

8. Consider whether the existing legislation allows, or could be modified to allow, the use of photos and video as evidence of compliance with a consent to reduce the need for on-site inspection. This could improve timeliness of inspection in the short to medium term.

Other system improvements

In addition to these recommendations, to support MBIE's ongoing regulatory stewardship and improve compliance in the plumbing and drainlaying sector we recommend that MBIE:

9. Collect additional data from BCAs in a consistent way that enables MBIE to monitor outcomes to inform the evaluation of building compliance approaches and as an input to cost-benefit analysis of alternative approaches to quality assurance.

10. Identify where the Building Code and ANZ Standards regulatory frameworks for plumbing and drainlaying are out of alignment and provide clear guidance to the industry in order to remove this inconsistency as a source of non-compliance.

Summary of findings

Self-certification focuses on the regulatory compliance of an output

Testing and certification focus on the regulation of output; this contrasts with occupational licensing and registration which focus on the regulation of the (labour) input. Work can be certified based on compliance with a functional or performance expectation, or based on compliance with a standard design or method of installation. Compliance with a standard implies that the installation will perform in the required manner. As examples:

- Energy work is regulated based on compliance with prescribed designs and specifications.
- The NZ Building Code is performance-based regulation, specifying the outcome required but not the method by which it must be achieved.

Testing and certification are separable tasks, which can be performed by the same person. If testing is performed separately, evidence including test results, may be provided to another party which completes the certification task, for example:

- A government organisation, for example a building consent authority, may have responsibility for certification, which it may contract out to a third party.
- The alternative, commonly called self-certification, which is an umbrella term that includes certification by the designer, installer, or an independent third party. The third party may be contracted to the installer or directly to the owner of the works. The latter arrangement may provide stronger incentives on the independent certifier to act independently of the installer but is likely to incur higher transaction costs.

Occupational regulation can also control entry to a trade or profession by licensing or registering the individual. The terms are not used in a consistent way across jurisdictions and industries. We adopt the nomenclature described by the NZ Cabinet Office:

- *Disclosure* of information about the service or service provider; financial advisers are required to disclose certain information to potential customers.
- Public *registration* of practitioners: registration is not a signal of competence or quality, rather it is a way of collecting information about who is practicing in an occupational field.
- *Certification* of a practitioner confers a right to use a restricted title. A non-certified person can compete with a certified practitioner but must use a different title.

- *Licensing* is the most restrictive form of occupational regulation. Only licensed practitioners are able to carry out particular tasks or offer a specific service. Licensing may involve ongoing reviews of competence, via recording hours of training or successful completion of a test. (Cabinet Office, 1999)

In construction, licensing is required where competence cannot easily be tested by the consumer and there is a risk of disproportionate harm from lack of competence. Certification of work outputs relies on licensing; that is those certifying work must be competent.

Some industry bodies have an accreditation system. Accredited providers may have to prove a specific competence to the industry body to be accredited, or it may simply be a membership organisation. These schemes are usually intended to signal to consumers some skill or competence, but do not convey exclusive legal rights to do certain types of work.

Self-certification requires four key elements

The most common reason internationally for adopting self-certification in construction trades was to reduce delay and cost in the building process. Often the delays arose from a shortage of government inspectors.

The key elements of a self-certification regime are:

1. **Clear rules setting out responsibilities** and requirements of tradespeople, that are understood by consumers (and potential consumers).

2. **A training and registration regime** that ensures tradespeople are competent and up to date with current practices and regulations, and that certifiers have skills relating to inspecting and verifying another person's work.

3. **A credible auditing regime.**

4. **An enforceable obligation** on the certifier to remediate over a suitable period.

Tradespeople and consumers need to understand the responsibilities and requirements conferred under the certification regime. Clarity about their responsibility (and certainty that they will be held to account) give tradespeople the incentive to take care. Where there is lack of clarity or consumers are not able to require remediation of faulty work this incentive is diluted.

The ability of consumers to require remediation requires both a process that is not unduly costly or burdensome to invoke and an assurance that the tradesperson will have sufficient liquidity to remediate problems as required. There are two other features of remediation:

- The building owner will not necessarily have a direct contractual relationship with all sub-trades on a project. This means that if contractual provisions are relied on for the remediation process then the contractual system must reflect this – not just the head contract between the owner and builder.
- A disadvantage of relying on the contractual system for remediation is ensuring the obligations are maintained when buildings change hands or when building companies are

liquidated. For this latter reason, the obligation to remediate may be tied to the individual tradesperson rather than the firm.

In some jurisdictions it is a registration requirement for tradespeople to maintain insurance in order to be able to meet their obligations to remediate. This approach has the additional benefit for the registering board of identifying low quality tradespeople as the insurer will undertake a risk assessment including recording repeated failures and may refuse insurance.

It is important that certifiers expect poor quality work to be discovered – or more precisely that the cost of certifying non-compliant work, which includes reputational damage or loss of ability to trade, and the cost of remediation, is greater than the cost of ensuring work is compliant, which may include inspection and re-inspection costs. This requires a credible audit regime that ensures a sufficiently high probability of discovering inappropriate certification.

Finally, and as already mentioned, the registration regime is a core component of self-certification. Registered tradespeople must have up-to-date knowledge of technical best practices and regulations; these expectations must be consistent across all tradespeople irrespective of how long they have been registered. Where certification is undertaken by a third party, i.e. not the installer, then the registration system is used to ensure certifiers have skills relating to review or audit of another person's work; these skills are different and complementary to technical building skills.

Energy work is self-certified to prescribed standards

Energy work in New Zealand operates a self-certification scheme that covers electrical and gasfitting work. For electrical installations, general and high-risk work is certified as complying with the relevant parts of the Electricity (Safety) Regulations 2010. High risk work is also subject to inspection by an independent third party. This may not be the person who carried out the work, supervised the work or issued the certificate of compliance for the work. This person must hold the requisite registration for an electrical inspector. For gasfitting, there is no work that is specified as high risk.

A risk engine that determines the risk category of different installations underpins the energy work scheme, although the electrical component is acknowledged to be more sophisticated than the gasfitting component. Energy work is highly standardised and the standards that must be met for specific installations are described in the relevant rules and must be attested to by the certifying tradesperson.

How is it going?

- The system is thought to be relatively well understood, although no data was available that could confirm the extent (if any) to which certificates are not provided or risk is mis-classified by tradespeople. Some stakeholders lamented the loss of the database of work certificates that was held centrally under an earlier iteration of the scheme.
- There is limited auditing, presumably in part because of the lack of information about installations. This means that the monitoring of the system relies on complaints from customers, other tradespeople and BCAs, and the frequency of accidents. The regulator considered the system worked relatively well on this basis.

Consent data does not provide useful information…

The administrative data collected by BCAs in relation to inspections does not provide information that can be used to determine the number of plumbing inspections or consented works that fail due to non-compliance. Nor can the rate of failure be determined as data on total inspections were not supplied. Each consent is subject to multiple inspections and a single visit can also give rise to multiple records.

We analysed the notes fields of the database, but these were often ambiguous, or incomplete. The materiality of non-compliance is unknown and the data are not reliable or informative for policy-making purposes.

…and stakeholders views appear to conflict (although there are underlying similarities)

While stakeholders were often passionate in their views, the lack of data and the conflicting perspectives mean objective conclusions are difficult to draw.

Unease was expressed by a range of stakeholders about the prospect of self-certification being extended to plumbers and drainlayers. The key concerns were:

- **The extent to which designs are non-standard.** A variety of concerns were raised about the design process including that not all designs were practical to install. While we understand that there are standards for plumbing there may be some confusion with the inappropriate application of Building Code requirements in combination with the standards. Standardised installations are more amenable to certification by the installer. Inspection by a suitably qualified third party plumber or plumbing inspector may be required for non-standard designs.
- **The extent to which installations vary from designs.** Plumbing and drainage was cited as being the reason for the majority of building consent variations. The reasons given for this were either practical (from tradespeople's perspective) or arose from a lack of technical understanding of design issues (from BCAs). While plumbers are not designers, they are often skilled at laying out pipework and some examples were given where changes to consented pipe drawings were required. We are not able to confirm the extent to which inappropriate product substitutions are made or other real quality variations arise. Concerns were raised by some stakeholders that variations from design could have adverse effects on other aspects of a building.
- **The competence of the various parties.** There is a varied level of skill amongst both tradespeople and inspectors. Some stakeholders considered this was a training issue, either with the initial apprenticeship scheme, or ongoing training. Others considered that a perceived lack of responsibility among tradespeople led to sloppy practices. A robust training and ongoing continuing professional development scheme is a key component of a self-certification regime.
- **The prospect of losing the centralised recording of information**. Again, there were varied views on how valuable centralised records are. It was noted that not all plumbing is currently consented and recorded. The certification system could be designed in a way that

critical information, such as connections to the three waters system, is still recorded. Technology may provide opportunities for low cost records to be collected. It will be important to ensure consistency across BCAs to limit transaction costs.

- Finally, **the ability to hold plumbers and drainlayers to account to remediate faults.** While the system may not be in place to allow this at the moment, there do not appear to be insurmountable barriers. Providing an enduring remedy is a key element of a successful self-certification regime.

There is an opportunity to streamline the certification of some installation work

Despite the variety of views, there did seem to be general agreement that the process for certification of plumbing and drainlaying could be streamlined. The two areas of agreement between stakeholders were:

- some low risk work does not need independent inspection
- it may be possible to gather evidence for some 'inspections' without a site visit.

This streamlining would require a technical review of plumbing and drainlaying standards and risks. It may be possible to use a similar engine to the energy work system to determine the key risks. We have not reviewed the specifics of this model. One difference is that risk to public health is likely to be a critical driver, for example where water systems are being connected to the network. If the recording of pipe drawings is connected with the approach to certification, then the value of a central record could be included as an element of the risk assessment.

There seems to be an opportunity to align requirements between BCAs

It is not clear whether there is a gap in the current regulatory system or in the understanding by BCAs and others of the regulatory system as it is currently designed. Some BCAs have replaced physical inspections with other evidence including photographs and producer statements from installers. A consistent approach across BCAs would lower costs to the plumbing industry and may improve the usability of data for monitoring

Some issues require additional consideration:

- **We were not able to reach a conclusion about whether changes to the system would reduce or increase costs.** One BCA noted that they did not recover the full cost of consents and inspections through the fees. Replicating the system outside the BCA would simply move the location of the costs. However, it appears likely that some costs, such as physical inspection costs would reduce. While other costs such as auditing costs would increase. One cost that it was generally agreed would be reduced by self-certification was delay costs. There was no consensus over the average length of delays experienced as a result of inspection requirements, but delays of some duration were noted by almost all stakeholders.

- **Remediation is critical to the success of the certification scheme.** Councils and other state organisations are long-lived and, as such, are attractive parties for long-lived liabilities. If the responsibility for certification is moved to the installer or tradesperson inspector, then access to remediation is required. This may include compulsory insurance or another guarantee for at least the period over which installation faults are likely to be discovered. The scope of this issue depends on the scale of works that can be self-certified.
- **Training repeatedly arose as an issue,** exploring this in detail was outside the scope of this project and further investigation may be warranted to determine the extent of any underlying problem.

There was disagreement between stakeholders about the extent to which plumbing was more interconnected with other building components than electrical or gasfitting works are. This is a technical issue but is important in terms of resolving the way in which a building site or project is overseen and the correct interaction of components of a project are assured.

To the extent possible, it would be useful to address the apparent inconsistencies or incompatibilities between the Building Code and the standards relating to plumbing.

1. Introduction and review questions

This analysis was commissioned by MBIE to inform its statutory review of the Plumbers, Gasfitters and Drainlayers Act 2006. The objective was to review the effectiveness of self-certification models before considering similar approaches for plumbers and drainlayers. MBIE sought to answer the following questions:

1. What is a self-certification system intended to achieve (purpose and goal), and how does this differ from other forms of occupational regulation? Note that since self-certification is a form of regulation, the comparison needs to be with other forms of occupational regulation.

2. What are the key features or characteristics of any self-certification system?

3. What are the critical factors in any self-certification system that would make it a success?

4. What cost and time efficiencies, if any, could be generated through adopting a self-certification system where the necessary success factors are present?

5. What lessons can be learned from the current systems of self-certification by gasfitters and electrical workers that could be applied to self-certification in construction trades?

6. What is the evidence that the plumbing and drain laying occupational trades currently meet criteria identified in the literature review as necessary to transition to self-certification?

7. What changes to the current building regulatory system, e.g. record keeping or audit functions, would be required if plumbers and drainlayers were allowed to self-certify work?

8. What would it take to make the self-certification of plumbers and drainlayers a success?

9. To what extent might self-certification be applicable to building and construction industry occupations in addition to plumbing and drainlaying?

There were four elements to our approach to this work:

1. Literature review focusing on the use of self-certification in construction industry trades in other jurisdictions.

2. Interviews with Australian plumbing regulators to explore their approach to certification of installations, specifically the Department for Energy and Mining in South Australia, the Department of Housing and Public Works in Queensland and the Department of Justice in Tasmania.

3. Interviews with a broad range of New Zealand stakeholders including government technical advisors, WorkSafe, construction sector licensing board members, master tradesman organisations, tradespeople, Building Consent Authorities (BCAs), building inspectors, BCITO and HOBANZ. A list of interviewees is contained in the appendix.

4. Analysis of administrative data records relating to inspections in seven BCAs.

The effort of my colleagues Ben Barton, Tammy Hambling, David Moore, Jo Prince, Linda Tran, Daniel Watt and Michael Young in the preparation of this report is gratefully acknowledged.

2. What the literature tells us

We were asked to undertake a literature review to look at self-certification systems for construction industry trades around the world to address the following questions.

1. What is a self-certification system intended to achieve (purpose and goal), and how does this differ from other forms of occupational regulation?

2. What are the key features or characteristics of any self-certification system?

3. What are the critical factors in any self-certification system that would make it a success?

4. What cost and time efficiencies, if any, could be generated through adopting a self-certification system where the necessary success factors are present?

We have structured the literature review as follows:

1. We briefly discuss occupational regulation as an overarching input control for managing who can enter certain occupations.

2. We then describe what self-certification is, in the context of construction industry trades, and what current self-certifications systems look like in different countries. Self-certification is different to occupational regulation in that it is a regulatory system where the output is being certified. Therefore, a self-certification system relies on occupational regulation as an element that makes the system successful.

2.1 Occupational regulation (input regulation)

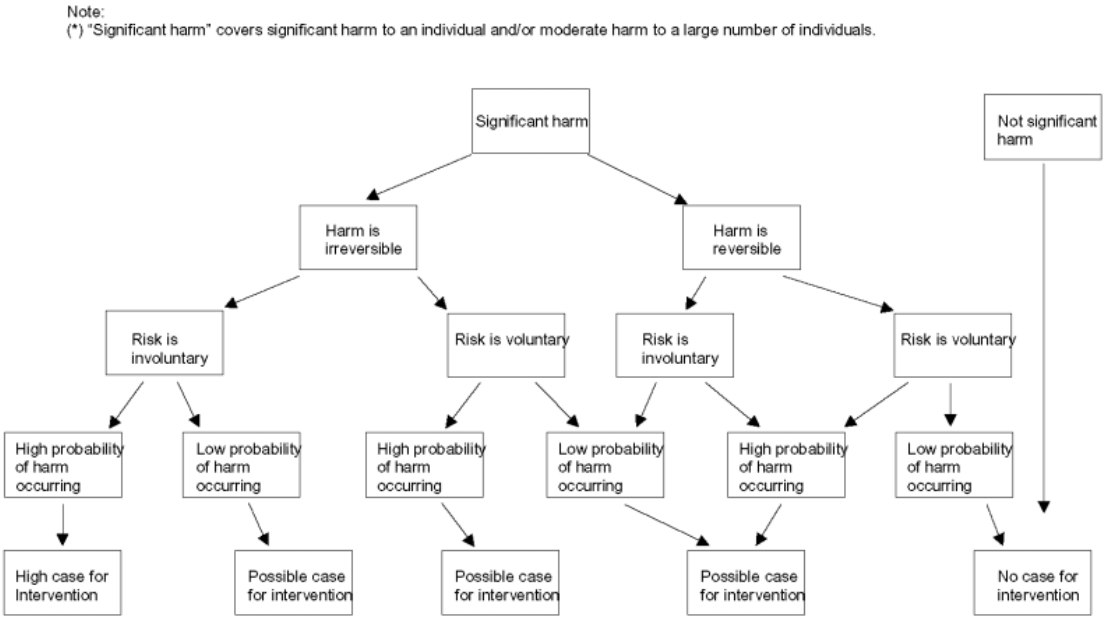
Occupational regulation is an overarching input control, focussed on managing entry into an occupation. Occupational regulation aims to protect the public from harm by ensuring services are performed with reasonable care and skill. Occupational regulation should ensure that regulation is proportionate to the risk to public safety, practitioners who are registered or licensed are appropriately skilled and productive and are held to account for carrying out substandard work (Ministry of Business Innovation & Employment, 2019). Figure 1 illustrates the relationship between harm and the nature of risk and the case for involvement in regulating an occupation.

This distinguishes voluntary and involuntary risks: voluntary risks are those that the public could be expected to know about and therefore avoid or control. It illustrates the high level principles, but notes that the terms cannot be defined with precision and the particular circumstances of the occupation being regulated need to be considered.

> There is a possible case for intervention where there is a risk of significant harm, the harm is irreversible and the risk involuntary but there is a low probability of the harm occurring. Similarly there is a possible case where the harm is reversible but the probability is high. There is also a possible case where the harm is reversible and the probability of harm occurring is low but the risk is an involuntary one. There is a possible case for intervention when the risk of significant harm is highly probable, whether the risk is voluntary or involuntary and

> whether the harm is reversible or irreversible. (Cabinet Office, 1999, p. 6)

Figure 1 Flow diagram of the case for intervention in an occupation



Source: Cabinet Office (1999)

Occupations can self-regulate. Typically this would involve an industry body establishing either:

- A code of practice: this could cover matters like regulation of behaviour in the workplace, standards of training, and processes for dealing with complaints; or
- A voluntary accreditation system: businesses could seek accreditation, but non-accredited practitioners would not be prevented from operating. This system is intended to give the public information about the quality of a business or practitioner without restricting entry to the occupation. Master Builders is an example of a voluntary accreditation system: accredited builders are more likely to be high quality. The customer also receives assurance that complaints will be dealt with independently and a financial guarantee is in place.

Government regulation of an occupation can take a number of forms (Forth, Bryson, Humphris, Koumenta, & Kliener, 2011; Cabinet Office, 1999). We adopt the nomenclature described by the NZ Cabinet Office:

- *Disclosure* of information about the service or service provider; financial advisers are required to disclose certain information to potential customers.
- Public *registration* of practitioners: registration is not a signal of competence or quality, rather it is a way of collecting information about who is practicing in an occupational field. It is an administrative approach which enables provision of information to practitioners or collection of information. Registration is often confused with licensing.
- *Certification* of a practitioner confers a right to use a restricted title. A non-certified person can compete with a certified practitioner but must use a different title. Registered psychologist, and chartered accountant are examples of certified titles.

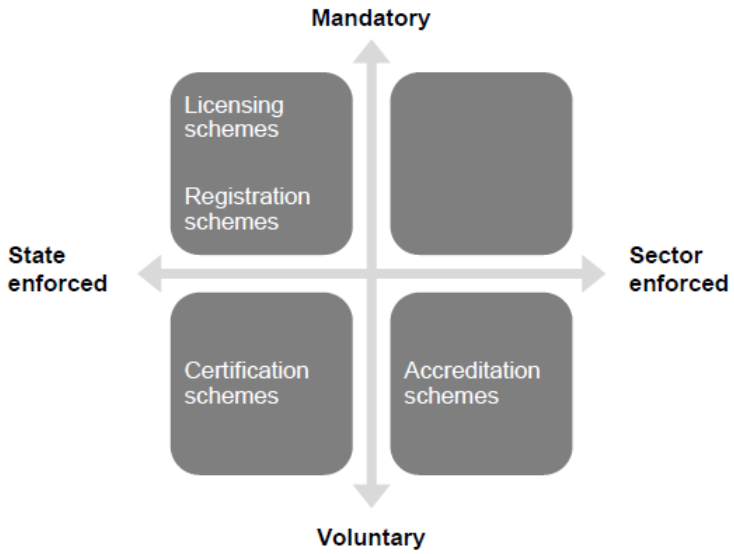
- *Licensing* is the most restrictive form of occupational regulation. Only licensed practitioners are able to carry out particular tasks or offer a specific service. While a distinction may be drawn between licensing tasks and licensing an occupation, it appears to typically be the case that a licensed occupation is specified as one that undertakes particular tasks. The distinction relates to how restrictive the controls are and perhaps the way that they are set out in legislation: licensed building practitioners have certain tasks reserved to them, in contrast licensed electrical workers are required for all electrical work with specified exceptions.

From these distinctions we conclude that there are three facets of occupational regulation:

- Sector based self-regulation or government (state) regulation.
- Voluntary or mandatory participation by practitioners.
- Requirements relate to disclosure of information by practitioners or assessment of competence of practitioners. In the first case the consumer is expected to be able to assess competence from the information disclosed, the second is more restrictive in terms of competition within an occupation but reduces search costs and limits risk for consumers.

Figure 2 provides an overview of where some forms of occupational regulation sit on the continuum between mandatory and voluntary participation and state or sector enforced. The third feature distinguishes licensing and registration, the first is practice based, whereas the second has an administrative or information focus.

Figure 2 A typology of occupational regulation



Source: Forth et al. (2011)

Occupational regulation is only one component of industry regulation. However, it is an important part, particularly as many professional services are intermediate inputs to other productive processes (Parker, Comley, & Beri, 1997).

2.2 Occupational regulatory regimes for construction occupations in New Zealand

In New Zealand there are currently six regulated occupations in the building process: electrical workers, licensed building practitioners, plumbers, gasfitters and drainlayers, architects, engineers, and engineer associates. The type of occupational regulation is different for each occupation and in some instances both registration and licensing is required (Ministry of Business Innovation & Employment, 2019), we briefly describe our understanding of the requirements for each below.

- **Electrical workers** are required to be licensed and registered. Prescribed electrical work can only be carried out by a licensed electrical worker. There are different licences for different types of work. The term for different licences is "class of registration". Electrical worker registration and licensing entitles the practitioner to carry out prescribed electrical work according to the class of registration. Every two years electrical workers must renew their licence by completing a competence programme to refresh knowledge and assess competence.
- **Licensed Building Practitioners** (LBPs) are licensed to carry out or supervise Restricted Building Work (RBW), which includes important and critical residential building work (including design work) relating to structure or weathertightness. It is an offence (with a fine of up to $20,000) for an unlicensed building practitioner to carry out RBW unless they or someone supervising their work is appropriately licensed. LBPs may hold a recognised qualification, for example all architects are LBPs or become licensed based on an assessment of their experience and competence.
- **Plumbers, gasfitters and drainlayers** must be registered with the PGD Board, and are licensed to carry out sanitary plumbing, gasfitting or drainlaying. While an individual practitioner may hold a licence in more than one of these areas, they are separate licences.
- **Architect** is a certified profession under the Registered Architects Act 2005. Architects are required to register and have a five-yearly review of competence. A code of ethical standards for architects is given in the Registered Architects Rules 2006. Under the Building Act certain tasks are licensed and can only be undertaken by registered architects (or LBP – Design, a separate occupational class).
- **Chartered Professional Engineer** is a certified profession under the Chartered Professional Engineers of New Zealand Act 2002.
- **Engineering Associate** is a registered profession under the Engineering Associates Act 1961.

2.3 Output regulation – performance or standards based

Over the last 20–30 years building regulations in many countries have become less prescriptive and more performance oriented. These changes were primarily intended to increase flexibility in design and reduce regulatory burden. In some cases, there has also been an increased reliance on self-certification by design and other trade practitioners (Meacham, 2010).

In a performance-based system, such as the New Zealand Building Code, the emphasis is on enabling innovation and alternative solutions. This tends to put increased pressure on the competence of practitioners and certifiers to assess complex designs. There is greater scope for interpretation of the

Code. It is also necessary to take a whole of building approach to design, to ensure that the inter-related components work together. This contrasts with the building function-based approach seen in more prescriptive systems. A performance-based system enables dynamic efficiency in the building sector, but requires greater investment in training and a strong focus on responsibility and accountability:

> Prescriptive-based regulatory regimes aim to achieve accountability by mandating adherence to the rules and are biased towards monitoring adherence to rules that are easy to observe. By contrast, performance-based regimes often seek accountability for results. However, this can be a problem if jurisdictions are not willing to invest the necessary resources to train staff and third-party certifiers and to review adequately alternative building products, systems and methods of design and construction.
>
> At the same time, industry must be willing to raise the bar in terms of responsibility and accountability, working even harder to promote their ethical mandate of protecting the public by demonstrating suitability of their designs over a range of conditions, even if it means undertaking more assessment and testing than is needed in a prescriptive system, and becoming subjected to higher proportion of liability over the life of the building in the event of errors or omissions associated with the design. (Meacham, 2010, pp. 692-693)

2.4 Self-certification

Self-certification is a mechanism for regulating output quality. This contrasts with occupational regulation, as described in Section 2.1, which focuses on putting restrictions on the input or entry into an occupation (i.e. providing evidence that certain standards are met).

An installation or design can be certified:

1. By a state organisation. In New Zealand, the BCA certifies ("consents") that a plan or design complies with the performance requirements in the Building Code. It may conduct site inspections or receive other evidence to satisfy it that the work as installed is consistent with the consented plan. In some jurisdictions, building control authorities may choose to contract a specialist to undertake the necessary inspection and verification. This would then comprise part of the evidence that the installation can be certified.

2. By the installer or designer.

3. By an independent third-party inspector, contracted to the building owner.

These latter two options are commonly called "self-certification".

A self-certification system requires that occupational regulation is already in place (i.e. a standard for entry into the occupation is met) and the focus is a low level of regulating the outputs produced by the individual practitioner in that they can then self-certify their work as meeting a stipulated standard.

Self-certification may be more difficult to implement in a performance-based system if there is room for alternative interpretations of what is required (Kubes, 2006). Interpreting and implementing regulations requires expertise and the ability to understand the relevance of the requirements to the context (Buckley, 2015). This emphasises the importance of appropriate training and definition of acceptable solutions.

> The abstract formulation [of the system of performance requirements of the Dutch Building Decree] however, requires good explanation and simple guidelines of how to interpret the requirements for standard solutions. (Visscher, Meijer, & Sheridan, 2003, p. 4)

For construction industry trades, a self-certification system is prescribed in regulations, and allows registered and licensed practitioners to sign off their own work as meeting a stipulated standard (e.g. the Gas (Safety and Measurement) Regulations 2010) eliminating the requirement that all work be inspected by state authorities. Currently in New Zealand gasfitters and electrical workers are two occupations within the construction industry trades that can self-certify.

In this section we look to the literature on self-certification systems for construction industry trades around the world to identify their purpose, efficiencies, and key characteristics. We also look briefly at examples of third-party certification schemes that have been adopted in the UK and Canada.

2.4.1 The purpose of self-certification

The purpose of a self-certification system is to allow a registered or licensed practitioner to sign off their own work as meeting a stipulated standard.

> The rationale behind self-certification is straightforward. Entities who can be professionals or builders are presumably competent in their field so they are empowered to self-certify that their works comply with the prevailing statutory requirements with regard to building design and construction without the need to involve the local authority. (Yau, 2009, p. 224)

From the literature we identified some variation between trades and countries for what can be self-certified. For example, in England self-certification by professionals for some minor work is possible, whereas in Sweden the builder may be fully responsible for self-inspection under the control plan agreed between them, the building owner and building consent authority. In Vancouver architects and engineers can take on a role in the building consent and inspection process through the Certified Professionals scheme (Sturm & Marriage, 2012).

Consistent with the principle that the regulatory intrusion should be proportionate to the risk, in Australia's state of Victoria, gasfitters are only permitted to certify a specific set of work which includes type A appliance installations in residential areas and type A appliance installation in commercial areas (Gas Safety Act 1997; Building Act 1993). In New Zealand, gasfitters can certify high risk, general and low risk gas fitting work with specified definitions and inspection requirements for each. There are almost no self-certification systems where professionals are given the right to certify a broad field of

work (i.e. all building work). Self-certification can be used to improve compliance for low risk installations by reducing the cost of certification (Yau, 2010).

2.4.2 Benefits include cost and time efficiencies

Self-certification has been seen as a way to increase efficiency. In a number of countries, the decision to move to self-certification was primarily based on an expected reduction in costs associated with time delays due to regulatory authorities being overwhelmed with inspection requests (Visscher & Meijer, 2002). Below we provide some examples:

- In the early 2000s, delays in plan review and permitting in the US were estimated to have cost the domestic construction industry US$15 billion per year in costs of financing, lost opportunities and delay. In New York City, prior to the introduction of self-certification for permits, plumbing inspections required a 16 week wait due to the level of inspections being requested (Kubes, 2006).
- In the UK, a major factor motivating the shift to self-certification was local authorities being unable to cope with growth in the volume of inspections following changes to the building code (Department for Communities and Local Government, 2009). A subsequent review of their self-certification system noted that without the burden for installers and customers of notifying work to the building control body and having it checked when completed there was a time and money saving of £60–£180 (Department of Communities and Local Government, 2014). The review also noted that building control for most notifiable building work (around 3.4 million jobs per year) is now through self-certification by members of Competent Person Schemes.
- In Norway and Sweden, the push to private self-regulation was largely a result of local authorities being unable to cope with the administrative burden of the inspection regime (Visscher & Meijer, 2002).
- In Hong Kong changes to streamline the statutory approval process were driven by criticism of "excessive red-tape and the delays thereby caused in processing applications" (Yau, 2009, p. 225).

However, self-certification is not necessarily less costly.

It depends on the overall compliance system. Reynolds (2015) describes the additional costs associated with the system of "privatised self-certification building control" in force in Ireland at that time. He cites World Bank data that showed it was €119,344 cheaper to build a warehouse in the UK as opposed to Ireland. There are nuances in both systems which have some privatised elements. The UK remained predominantly a government- controlled system (3,000 employees of local authorities and 600 private licensed approved inspectors). There appeared to be significantly greater number of processes and separate parties involved in certifying in Ireland than in the UK.

Large companies may be able to introduce new ways of work that improve efficiency (Visscher, Meijer, & Sheridan, 2003). Conversely, the costs of establishing and maintaining registration, including training costs, can be a burden for small contractors carrying out relatively low-cost jobs (House of Commons: Communities and Local Government Committee, 2012). This may reduce their ability to compete with larger companies.

The cost of self-certification also depends on whether third party certification is required, and if it is the sufficient number of qualified certifiers. If there are insufficient people with appropriate qualifications then self-certification may simply shift the problem from government to a quasi-monopoly private scheme (Yau, 2010).

The cost of monitoring the system, including licensing, record keeping, auditing and disciplinary functions must also be considered.

> Monitoring the service quality of the private certifiers (i.e. the qualified technical personnel), and audit checking are not costless, and thus the costs to maintain a high-quality building control system could continue to be very high. (Yau, 2009, p. 230)

The way in which the system is funded is important for the incentives created to revoke the licence of an unsafe installer. In particular, if the installers fund the approval authorities; this is a conflict of interest (House of Commons: Communities and Local Government Committee, 2012).

2.4.3 Risks include a lack of public awareness of requirements and potential for misconduct

A key risk in a self-certification system is a lack of public awareness about the existence of self-certification systems and concerns that it can be difficult for a customer to identify who is able to carry out and self-certify their work. As with any system there is potential for misconduct and breaches of the regulations. For example, the UK's self-certification system requires that installers obtain a self-certification credential before they can self-certify their work. A review of this system found that many consumers were unaware who was credentialled, and in some cases mistakenly contracted professionals that were not (Department of Communities and Local Government, 2014).

This lack of clarity and awareness about self-certification schemes has the potential to make it easier for practitioners to intentionally mislead consumers into believing they are able to self-certify.

> The responsibility for Building Regulation compliance rests with the property owner but many property owners will take advice from practising businesses as to the requirement to comply with legislation. The risk in relation to compliance will depend on the knowledge and business ethics of the practising business and does not ensure the completion of an installation that meets the required standards. (House of Commons: Communities and Local Government Committee, 2012, p. 40)

A registration system is often used to mitigate this by providing consumers with a searchable database to confirm a certain practitioner is credentialled to self-certify. Consistent branding and language are also important as terms can mean different things to different people (Department of Communities and Local Government, 2014).

If there is a tiered system of risk, whereby there are different requirements for different types of installations this can exacerbate the lack of clarity. This lack of clarity can extend to tradespeople.

> However, some of these bodies have suggested that the definition of minor works within the new system could be more clearly defined as there is currently a lack of guidance as to what kinds of building works should be classified in this way. (Yau, 2009, p. 227)

Some of the literature warns of the disruption caused by rapid or abrupt change to a self-certification regime. For example in Norway and Sweden there was a lack of uniformity across the sector, and the ability to self-control was decided on a case-by-case basis. This caused "chaos…[but] the development of quality assurance systems in many companies" (Visscher, Meijer, & Sheridan, 2003, p. 8).

Similar views are seen in Australia, "we raced to the self-certification model too quickly. We were not mature enough" (Tan, 2019, quoting Lynda Kypriadakis of Australian Building Management Accreditation).

2.4.4 Some countries allow all licensed practitioners to self-certify, others require additional credentialing and third-party schemes

Controls on who can self-certify vary by country, scheme and level of work that can be undertaken. Low risk work can be self-certified by the licensed installer their work. Australia's Northern Territory scheme allows a person to be approved as a 'self-certifier' for work in relation to Class 10 building (i.e. fences, garden sheds, carports, etc.) as long as the following elements are met: the product or system has to have been approved for installation by a self-certifier; the self-certifier must be approved by the Director of Building Control; and they must comply with Terms of Self-Certification. On completion of the work the self-certifier must issue a Certificate of Self-Certification confirming these three elements were met (Department of Lands, Planning and the Environment, 2016).

Work with a higher risk level may be associated with additional qualifications or experience. In some schemes a third-party is accredited as a scheme operator (e.g. the Competent Person Schemes in the UK or the Certified Professional Program in British Columbia, Canada which are described below).

Some schemes combine requirements where the self-certification system for minor building work allows approved persons to install approved products and/or systems with the need to engage a building certifier for full certification for more complex installations.

2.4.4.1 Competent Person Scheme (United Kingdom)

The UK Government introduced Competent Person Schemes as an alternative to submitting a building notice or using an approved inspector. The Scheme allows individuals and enterprises to self-certify that certain types of work (e.g. electrical work, plumbing and water supply systems and some building work) comply with the Building Regulations. A Competent Person must be registered with a scheme that has been approved by the Ministry of Housing, Communities & Local Government to ensure a consistent standard and that the scheme operator rules are meet. For an individual to be registered with a Competent Person Scheme they need to demonstrate they meet relevant minimum technical competence requirements. (Competent Persons Register, n.d.; Competent person schemes, n.d.)

For an organisation to run a Competent Person Scheme, it must demonstrate that it:

- has the administrative and managerial capacity
- sets a competence standard for members that would achieve compliance with relevant Parts of the Building Regulations
- is capable of testing potential members to that standard
- has in place appropriate measures to guard against non-compliance and
- mechanisms to have instances of non-compliance put right
- is able to issue certificates of compliance to customers and relay information on installations to local authorities. (House of Commons: Communities and Local Government Committee, 2012)

The Competent Person Scheme competes with the local authority system and some studies have concluded that it had a positive effect on quality and efficiency of building control (Visscher, Meijer, & Sheridan, 2003).

2.4.4.2 Certified Professional Program (British Columbia, Canada)

The Certified Professional Program is an alternative permit process to the conventional Authority Having Jurisdiction process for building permitting and monitoring of construction (Certified Professional Program, n.d.). As part of this alternative process the Certified Professional provides their professional assurance to the Authority Having Jurisdiction that they will take all appropriate steps to ascertain that the design will substantially comply and the construction of the project will substantially conform in all material respects with the fire and life safety, and accessibility aspects of the building code, other applicable safety enactments, and the related development permit. The Chief Building Official of an Authority Having Jurisdiction relies upon the Certified Professional's assurances in issuing Building Permits and Occupancy Permits for a project constructed under the Certified Professional Program. The Certified Professional Manual is intended to be used as a guide in executing the Certified Professional Program in the Province of British Columbia where local governments have adopted the Certified Professional Program.

The Certified Professional Program is administered jointly by Engineers and Geoscientists BC and the Architectural Institute of British Columbia (AIBC). An architect registered with AIBC or a professional engineer registered with Engineers and Geoscientists BC can qualify as a Certified Professional. The Certified Professional Program course covers advanced code knowledge and the detailed application of Division A, Division B Parts 1 and 3, and Division C of the BC Building Code and the Vancouver Building By-law. It also covers the requirements and demonstrations on sample projects on how Certified Professionals practice in the cities of Vancouver, Surrey, and other participating municipalities. The AIBC and Engineers and Geoscientists BC run the Certified Professional Course and maintain a list of those who have successfully completed the Certified Professional Course and upgrade requirements.

For a Certified Professional Program to operate successfully, the Certified Professional must demonstrate competence in code knowledge and must be familiar with procedures as outlined in the Certified Professional Manual. The Authority Having Jurisdiction places a high level of expectation on the Certified Professional, as a result, Certified Professional projects are given significantly less oversight than conventional projects by local government staff.

2.4.5 Legal responsibility and remedies

The importance of ensuring that the liability for remedying faults remains with the installer is emphasised (for example Meacham, 2010). Reynolds (2015) notes that "[i]t is not consistent with human nature that a person who can devolve his responsibility for his work onto a third party will do his work better in consequence" (p.12).

There are some indications that quality may improve as the responsibility of the tradesperson for the installation is clearer (Visscher, Meijer, & Sheridan, 2003).

The responsibility for ensuring compliance with the regulations that require inspection or certification may lie elsewhere, for example with the building owner (Sturm & Marriage, 2012). In Vancouver architects and engineers can take on a role in the building consent and inspection process through the Certified Professionals scheme. This is, however, complemented by the apportionment of legal accountability through Letters of Assurance (this system covers most buildings except residential houses):

> They are legal accountability documents in which registered design professionals state their responsibility for the design of a building, have carried out the required inspections and determined that the building work in their area of responsibility 'substantially complies' with code requirements. The owner is required to engage a coordinating registered professional to coordinate the design work, ensure other professionals complete inspections and their respective letters of assurance, and ensure the design 'substantially complies' with the code. The owner and coordinating registered professional must both sign a letter of assurance confirming this (Building and Safety Standards Branch, 2010). The VBBL states that both the Chief Building Official and the City of Vancouver do not have any duty of care to any other party, or that issuing a building permit guarantees that a building will comply with the By-Law and that compliance is the responsibility of the building owner. The owner must notify the Office of the Chief Building Official of the builder, designer and any inspection or testing agency involved in the project. They must also ensure the correct letters of assurance are submitted. The owner and builder are jointly and severally liable for the work (Office of the Chief Building Official, 2009). (Sturm & Marriage, 2012, pp. 5-6)

Other variations are documented below:

- The Seattle Building code states that compliance is the responsibility of the building owner and specifically absolves the City of Seattle of any liability and states minimum requirements for some professionals (Sturm & Marriage, 2012).
- Documents for the self-certification scheme in Oklahoma explain that "self-certification does not state or imply a guarantee or warranty of code compliance but is rather a statement of professional opinion" (Development Services Department, 2019).
- "Self-Certifiers are expected to perform professionally and ethically at all times. Self-Certifiers are subject to the scrutiny of the Director of Building Control for both administrative procedures and compliance with approved plans. The Director of Building Control may monitor the work of a Self-Certifier, and their compliance with the terms and conditions of self-certification at any time. Should monitoring identify an area of non-

compliance, the Self-Certifier will be held responsible and will be liable to correct the non-compliance at his/her own cost. Failure to comply with the requirements of the Director of Building Control may result in the revocation of the self-certification exemption." (Department of Lands, Planning and the Environment, 2016).

- In Illinois when applying for Self-Certification Registration in addition to professional requirements "all applicants must include a valid Certificate of Liability Insurance with limits greater than $500,000 per claim and $1,000,000 in aggregate for all claims with their enrolment application" (Chwedyk, 2017).
- In the UK "The current criterion is: Adequate consumer protection through the offer of an insurance-backed warranty, professional indemnity insurance or bond. The Department has never specified in detail how the schemes should comply with this criterion in part because schemes must individually negotiate with insurance providers on the provision of suitable policies" (Department for Communities and Local Government, 2009).

Although in most situations the legal responsibility sits with the self-certifier being liable to fix any faulty or non-compliant work or pay any damages, there is a risk that the installer or their business may no longer be operating at a later date. The UK's Competent Person Scheme mitigates this risk by requiring private Competent Person Scheme operators to cover the liability of their self-certifiers. By doing this, the UK system explicitly places this burden on Competent Person Scheme operators and requires them to hold insurance to cover the liability costs. In addition, a Competent Person Scheme operator is required to show they are financially viable as they are expected to be long-term organisations. (Department for Communities and Local Government, 2009).

2.4.6 Risk of loss of ongoing development of tradespeople

In the absence of external inspections, there need to be other methods for practitioners to learn about new practices and regulations.

Local Authority Building Control, an organisation representing all building control authorities in England and Wales, notes that building control surveyors, who stay regularly informed with the latest developments in building regulation, can pass on their expertise to workers on site when they carry out inspections (Local Authority Building Control, n.d.). Some inspectors facilitate the sharing and utilisation of regulatory information which promotes regulatory compliance (Buckley, 2015). This study found that inspectors in the food processing industry often provided advice in their inspections which particularly helped small businesses improve their operations. This depends on the specific motivation or attitude of the inspector, and their expertise.

Hence, the value inspectors provide may not just be regulatory, inspectors could be important intermediaries of new best practices and regulatory information along with helpful industry advice for small businesses (i.e. advice around better building materials or processes that the inspector knows work best from experience). If a self-certification system is implemented and inspections are reduced to infrequent audits, there is a risk that the level of regulatory compliance and quality of work will fall, as the industry could be slower to adapt to new changes in best practices and regulation. Smaller businesses may also lose a useful source industry information negatively impacting their development and productivity.

The UK Competent Person Scheme addresses part of this concern by requiring Competent Person Scheme operators to provide mandatory training for all members when there are changes to building regulations or BS standards (which define best practices in the industry).

2.4.7 Frequent auditing that increases with risk

Some system of auditing self-certified work is required, by the sector regulator or another government certification body, such as the local authority if it retains some certification expertise and responsibility. In the UK private Competent Person Scheme operators are responsible for doing audits. Regardless, audits create the incentive to only self-certify work that is to code, as it could be inspected at any time.

One of the risks with any building regime is that work is completed illegally without the required certification. This risk can occur with self-certification or local government inspection. In the UK, the Gas Safe Register notification records identified that approximately 50% of boilers sold were not notified to the Local Authority Building Control. "Over 46% of heat producing appliances sold for new build properties are not notified in a manner that identifies that appliances are being installed by competent Gas Safe registered engineers" (House of Commons: Communities and Local Government Committee, 2012, p. 40). Reasons for non-notification were thought to be:

- lack of knowledge and understanding of requirements by consumers
- lack of knowledge and understanding of requirements for practicing businesses
- the cost implication re time and administration
- failure to apply knowledge and understanding
- no enforcement for non-compliance
- multiple registration to other Competent Person Schemes.

Reducing the quantity of "unauthorised building works" was a key driver for the introduction of the minor works regime in Hong Kong, where the expectation was that a more streamlined, cheaper system would encourage compliance (Yau, 2009)

A concern with the inability to audit work that had not been notified was noted in the Office of the Auditor General's report into the PGD Board. (Office of the Auditor General, 2010)

> Usually a small proportion of plumbing installations are audited, with no process in place for auditing installations that do not return a compliance certificate, this current system only checks plumbing installations (and plumbers) who try to do the right thing (Master Plumbers and Mechanical Services Association of Australia, 2007, p. 4)

2.4.8 What are the consequences of inappropriate certification and who decides?

Self-certification means that by design the certifying party works for the property owner, possibly as a sub-contractor to the installer. This means that they have a competing profit motive and ethical motive. Refusing to certify an installation can delay a project and cost money to remedy. These costs are born by the property owner, who is also the employer of the certifier.

> What is the certifier going to do? Not obey the requirements of its employer? At the handover of buildings, there are deadlines, cashflow issues…it is a race to finish the building and bump everyone in. Ensuring everything is done perfectly is not top of the list. (Tan, 2019, quoting Lynda Kypriadakis of Australian Building Management Accreditation)

This means it is important to hold the certifier to account for inappropriate certification to strengthen their professional ethics. "The independent review is not an opportunity to buy a second favourable opinion." (Kubes, 2006, p. 8).

In New York 20% of plans submitted under the self-certification scheme were audited to check compliance. If the plans failed to meet the relevant code then the certifier lost the right to self-certify (Kubes, 2006). In 2006, it was discovered that one architect had misrepresented whole floors as mezzanines in order to avoid height restrictions and work was halted on around 60 of his buildings due to safety concerns. A subsequent Department of Building "audit found that 57% of self-certified new building plans in 2006 failed to comply with codes." (Davis, 2007, p. 2). The New York State Education Department, which is responsible for licensing architects, opposed the removal of self-certification privileges on the basis that it was responsible for professional discipline. Having one body responsible for discipline ensures that a consistent standard of care is applied, and that the same action is not disciplined multiple times (Davis, 2008).

An apparent flaw in the Competent Persons regime in the UK is that there is not requirement for applicants to become scheme operators, nor potential members of schemes to disclose their full trading history, including any complaints or county court judgements (Department of Communities and Local Government, 2014).

3. Self-certification of plumbing in Australia

We spoke with representatives from three states involved in the review, development, and implementation of occupational regulation for the plumbing industry that involved aspects of self-certification. These contacts provided documentation on the regulation in their jurisdiction and directed us to sources of documentation for other Australian states.

In Australia, plumbing inspection is independent of building inspections with few exceptions such as isolated areas with limited resources.

3.1 Summary

Australia has adopted a tiered risk-based approach to regulating plumbing work that allows for some self-certification. The specifics differ from state to state, with some states deciding drainlaying or is too difficult to inspect/audit and correct ex-poste so must be at least made available for inspection before backfilling. Some consider just the threat of inspection sufficient, while others still attempt to inspect 100% of work deemed high-risk. The Western Australia approaches uses camera to inspect what others have deemed too difficult.

The funding of auditing systems and the whole shift to limited self-certification can be done in a cost neutral way. Using a levy on water utilities may avoid undesirable incentives associated with fees and general revenue-based funding.

Confidence in the competence of both the plumbers and inspectors is crucial with continuing professional development seen as a critical part of maintaining a competent workforce.

3.2 There has been a shift to risk-based categorisation of work

Approaches differ across jurisdictions but generally Australia has adopted a tiered risk-based approach. This allows simple tasks to go ahead as unregulated work, standard work to be performed by appropriately qualified plumbers, self-certification of notifiable work (where some work is inspected or audited) and permitted work that is all inspected.

- Unregulated work exempts very simple tasks, meaning homeowners can change a tap washer or unblock a drain.
- Minor or standard work distinction are not completely consistent other than it does not require self-certification or inspection. An example would be changing a plumbing fixture.
- Notifiable work (self-certifiable work) could be extension to an existing property (i.e. putting in a second bathroom). This involves submitting forms to the state or local government who select some jobs to audit (5% is often mandated).

- Permit work is generally new developments, which can be 100% inspected the whole way through or booked for inspections that only some occur based on daily prioritisation scheduling.[1]

3.2.1 We hear the shift is generally going well with a few exceptions

The feedback from interviewees is that this shift to risk-based categorisation is going well with some emerging issues.

Some issues are material and structural, such as the difficulty of inspecting some completed works. There is also a risk that inspection and audit activity focuses on work that is more likely to be compliant. This arises if inspections are funded on a per site basis, non-compliant work is more costly to attend to with no additional fee.

Other issues are more transitional such as confusion around when forms should be submitted. Legislation can require submitting a form when a job is invoiced or when the work is operational. The rule exists for circumstance where there are multiple plumbers on a job, the obligation that a plumber submits a form after invoicing enables another plumber to take over. However, in practice when an invoice is issued there may still be work to come back and finish. So, the case can arise where multiple invoices are issued that require multiple notifiable work notices and duplication of fees payable on one job.

3.3 The auditing or inspection system remains critical

Inspection and auditing are terms used almost interchangeably with the key difference being the rate of inspection which can decrease with a legislative shift to allow self-certification of certain types of work. For some jurisdictions this has meant a reduction from 100% inspections to auditing systems where only a small percentage (often mandated at 5%) of work is inspected.

3.3.1 Alignment across local consenting authorities is challenging

As there can be many local governments inspecting work there can be difficulties in getting process alignment. Regular engagement with local governments has reportedly helped clarify what changes in regulations mean and is thought to improve the consistency of inspections. A tangible result from self-certification systems is an increase in the material made available on websites, such as guides for consumers and plumbers to follow and aides for understanding requirements.

3.3.2 Funding mechanisms can create perverse incentives

There are several approaches to funding auditing systems, these include fees charged to the plumbers submitting work, general revenue and a utilities levy. The fees and general revenue-based systems appear more likely to result in undesirable incentives.

[1] Depending on the job type the plumber is notified as little as an hour before the inspection is due whether inspection will occur.

When fees are charged directly to a plumber, such as for lodging a Code of Compliance form. The plumber may look to minimise this cost and find ways to avoid the form and fees.

Local governments with tight budget constraints might be incentivised to inspect jobs where there are more likely to find compliance. Since if they inspect a job that requires a follow up, they could incur further costs but don't receive any extra funds.

Utilities levy funding shares costs across a large consumer base so it may be absorbed or unseen. This funding method means there is no need to charge for the Code of Compliance form submission which encourages plumbers to submit a Code of Compliance for all work.

3.3.3 The type of work determines the ability to inspect/audit

Water heaters are easy to audit whereas drain laying jobs are very inconvenient post installation.

The tiered approach to inspection/ audit can alleviate some of this challenge. State approaches differ, with some mandating that all below-ground work is inspected (permitted work) and others feeling the threat of inspection (self-certification) is a sufficient deterrent.

In Western Australia cameras are being used to inspect drainlaying work, this is reportedly working well as the high cost of having to fix faulty installations provides enough incentive to ensure installations are compliant.

3.3.4 Determining which jobs to audit can be computer generated or involve human elements

Computerised risk-based calculation are only as good as the data inputs. Where data quality is good algorithms can target audits based on historical experience such as high fail rates. However often data quality is mixed, with some smaller inspecting authorities reportedly still paper based.

When there is a large number of local governments inspecting, there is not a quality centralised source of data. Whereas when there are few auditors or large populations are audited under one regime data improves.

A human based approach allows inspecting authorities to use a risk matrix to produce a score that decides which jobs to inspect. The inspectors make a judgement call based on the complexity of a job, the work history, experience of the plumber and other domain expertise.

3.3.5 Auditing systems can be simple or complex, with differing investment and maintenance requirements

While the submission of forms required in self-certification systems could be managed in an analogue manner it is almost certainly more efficient with online elements. Simple cheaper content management systems are less automated which may improve flexibility. The main trade off with complex fully automated systems is they cost a lot more to build and maintain.

3.3.6 There is a training element to auditing and inspection

The educational side of audit process goes beyond the need to engage with industry, so they understand regulation. We are told a key aspect is to be part of solution, to continually engage with industry, and strive for constant improvement. Failing installations can be a critical part of training, especially if the penalties encourage improved outcomes. The stick could to be wielded lightly for first time offences or honest mistakes, and punishments increase for deliberate or repeat offences.

> Plumbers need to be allowed to make mistakes so that they learn, if it affects a plumber's pocket they'll learn.

3.3.7 Actual inspection rate can be higher than mandated levels

While mandated levels of inspections can be only 5% the result can still be 20% of work inspected through the audit process. Determining the appropriate amount of inspections is likely best left to knowledgeable inspectors that desire the best outcomes for society. It is a delicate balance of reducing costs and regulatory burden while ensuring installations are complaint. The key is that it should enable the highest risk jobs to get inspected and provide a high enough probability that a plumber's work will be looked at.

> If it's going to be looked at it should be a good job.

Councils maintaining the ability to inspect anytime any work is suggested as a key part of auditing systems.

3.4 Quality training of plumbers and inspectors provides confidence in self-certification systems

Part of self-certification is provision of the right tools and knowledge to the appropriate parties. There was no consensus on what was required from stakeholders, only personal suggestions.

Some stakeholders advocated for the need strong trade apprenticeships; others were concerned the incentives of private training institutions did not align with the requirements for self-certification or even competent plumbers.

In some regulations there is a requirement to be a plumbing inspector you need to have plumbing license with some exceptions allowed for small councils. A state institute of plumbing inspectors was highlighted as a good method for inspectors to share ideas and talk about common issues.

3.4.1 Continuing Professional Development desirable for plumbers and inspectors

Continuing professional development for both plumbers and inspectors, is widely recognised a key part of the regulatory system. Enabling and ensuring broad knowledge of all relevant legislative requirements, adopted codes, and awareness of any changes to the applicable administrative or technical requirements is essential.

Those with continuing professional development requirements spoke proudly of how the system is being replicated across Australia. The continuing professional development aspect for maintaining a plumber licence requires a pre-set value of continuing professional development each year or in a three-year window. The licenced plumber must be able to prove they have undertaken the training upon request.

The only issues with continuing professional development raised was it is largely being driven by associations that also have training businesses and would be costly for the industry.

3.4.2 Training can be required as plumbers relocate or change employer

It is observed that plumbers tend to specialise, and the required skills and knowledge differ depending on climate and job type. So inexperienced plumbers may struggle when changing employer or relocating. We are told NSW and Queensland are setting up a test to confirm plumbers are actually competent in areas they claim to be competent in.

3.5 Warranty periods are inconsistent

The system of self-certification allows approved persons to install approved products and/or systems without the need to engage a building certifier for full certification. In Western Australia this means that licensed plumbing contractors are responsible for all plumbing work they perform for a period of six years from the time the work is completed.

In other states the warranty period can be up to ten years for below ground aspects but in other states it is not great.

> No one knows how long; general consensus is about 12 months.

The Watermark guarantee is spoken of highly, with some concerned that the product certification could be watered down. This is seen as a key protection for both plumber and consumer.

> If you install a product without Watermark in Queensland it's an offense. And now selling a non-water marked product is an offense. So now if a consumer asks the plumber to install a non-Watermarked product a plumber can prosecute them.

The Queensland Building Commission recently passed nonconforming building legislation which places responsibility on the whole supply chain. This shares the liability and protects the installer from customer pressure to install cheap non-accredited fittings.

3.6 Liability and enforcement methods are wide ranging

Generally, for self-certified work, should monitoring identify an area of non-compliance, the Self-Certifier is responsible and liable to correct the non-compliance at their cost. There is then an escalation process such as, issue an action notice, and if the work is not made compliant within a

required time frame a penalty notice can be issued. Then problems can move to court and prosecution.

An enforcement issue identified is that the local government could issue a penalty for the first offense, but then a plumber could go to a different local government and get issued a second "first offense". A system or register for lodging and tracking offenses easily closes this loophole.

Another issue is the size of the penalties. If fines are too small, unlicensed or unscrupulous plumbers could budget the risk of having to pay a penalty into their work. An escalating penalty system depending on number of breaches is suggested as a simple solution.

3.6.1 Insurance requirements can play an enforcement role

In most of Australia insurance is not part of licencing plumbers. However, in Victoria plumbers must hold public liability (AU$5 million) and consumer protection (AU$50,000) insurance as a condition of their license.

Insurance requirements can help protect plumbers and the public. When licensed plumbers must carry insurance protection there is a market-based mechanism that incentivises compliant work. As insurance premiums would increase for plumbers whose work history required pay-outs on claims. A plumber with repeat issues could quickly find themselves uninsurable and unable to be licenced.

4. Inspection data does not provide relevant information

We recommend the data we analysed is not used for policy making.

Self-certification records the work done by the tradesperson, the testing and verification that has been completed and the standards used for the work. The work is certified as complete and safe. The consent data we analysed does not record the extent to which plumbing work is left incomplete or unsafe. The materiality of non-compliance is therefore unknown. This is consistent with findings of other studies of consent inspection data (Jane Cuming (Build Insight Ltd), 2019; Taylor, 2016).

Data is critical in a performance-based regulation system and pass/fail information is not particularly helpful, as is demonstrated here. A system that consistently records information about consents and installations would provide valuable information for monitoring and decision-making.

4.1 The number and rate of failures is unknown…

MBIE supplied anonymised inspection data for seven BCAs who used the GoGet suite to record their inspection data between January 2009 to December 2018. There were 75,927 entries for plumbing and drainage of which 45% were recorded as "fail". Unfortunately, this figure is essentially meaningless:

- It is common for there to be multiple entries per consent and often multiple entries for a single inspection visit.
- Plumbers report that a number of BCAs routinely fail inspections of compliant work until the final inspection: This would increase absolute numbers of failures and potentially skew the reasons noted.
- Not all passes are recorded and since 2016, none were recorded

This means that neither the number of failures nor the rate of failure can be measured.

4.2 …and the reasons are ambiguous

The notes fields from the inspection data were analysed in *R* using direct and partial string matching (55%) and manual matching (45%) of key words. The notes were often ambiguous. The categories we used were defined by MBIE and we sought input from a building inspector to attempt to clarify the meaning of some of the notes.

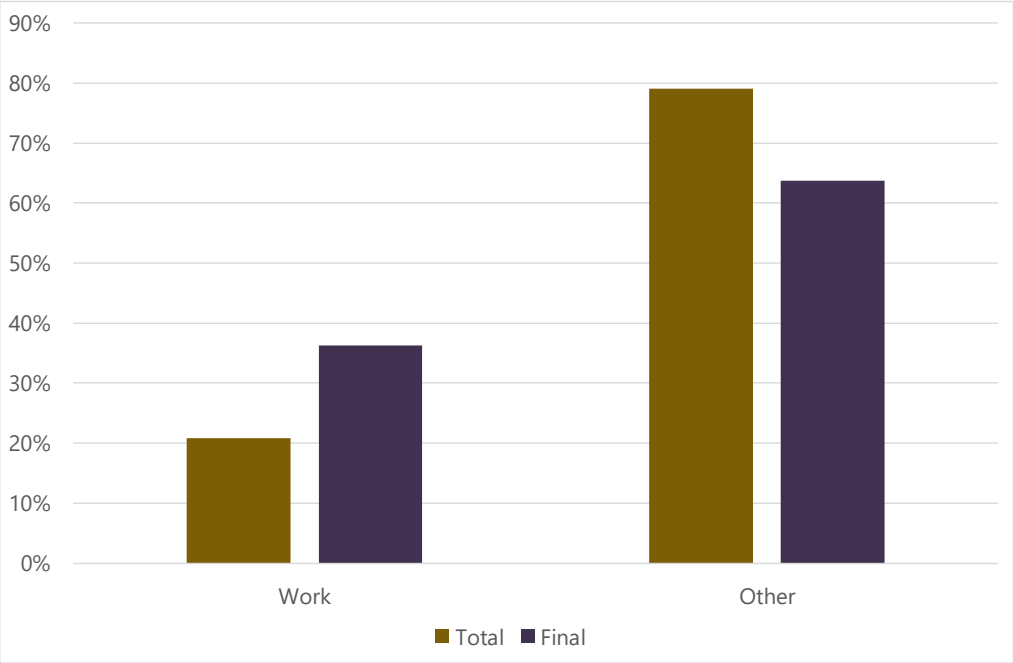
No reason or note is recorded for 39% of failed inspections. For the remainder, we attempted to group the reasons for failure that may be related to the plumbing work on the installation:

- Building Code compliance
- poor work
- not to plan (ambiguous).

Figure 3 shows the percentage of failures that were coded as one of the three reasons related to plumbing work ('work') and the percentage that were coded as relating to something else ('other'). As

we are aware that some BCAs routinely fail work until the final inspection, we also analysed final inspections separately.

Figure 3 Reason for failure (per cent)



This data suggests that more than 30% of final inspections that fail, are for reasons related to plumbing work. However, this figure does not inform the actual extent of quality or compliance issues:

- Fundamentally, as we do not know what proportion of consents fail at the final inspection, we are not able to judge whether 30% of failures is a material proportion of consented plumbing works.
- Rather than being due to higher levels of poor workmanship at final inspection stage, the higher proportion might be due to lower levels of failures due to administrative issues.
- It is not possible to determine from the qualitative notes if the cause of failures are material enough to impact the functionality of plumbing work or whether these issues are superficial in nature.
- Many notes are ambiguous in meaning. For example, "not to plan" may reflect adjustments made to pipework configurations for practical reasons (a benign or positive outcome), or be a deviation from the consent which does not comply with the Code.

Conclusions cannot be drawn from the data made available to us. For the purposes of monitoring the building control system, we recommend investigating improving the quality of data collected.

5. Stakeholders' views are not aligned

We interviewed a range of stakeholders to obtain their views on the current regulatory regime for building work and energy work and the possible advantages and risks of enabling self-certification for a broader scope of construction tasks. Interviewees are listed in the appendix and included representatives of:

- MBIE's technical advisors
- WorkSafe
- Licensing Boards
- Master Plumbers
- Master Builders
- BCAs
- Building inspectors
- BCITO
- HOBANZ

Many stakeholders held strong views, which were not always aligned; for example, a range of faults were perceived with the current system. The data do not inform us about the relative weight to give to these views. For example, while BCAs are concerned about non-compliant installations, we cannot measure the proportion of installations that are non-compliant, or even the number of non-compliant installations with any confidence. We were able to test some contrary views in interviews as we became aware of them. We offer some observations on what may be driving the views based on our research.

The critical difference between the two approaches is who *decides* whether the installation complies with the Building Code. In the current system, the BCA decides; in a self-certification system the tradesperson would decide.

5.1 A tiered approach was generally considered appropriate

The construction process can be separated into four components: design, installation, testing and certification. The approach to regulating each of these four components of the process is interdependent. For example reduced installation inspection may be required for standardised designs.

A tiered approach is already in place informally. Master Plumbers report that in Auckland less than 50% of consented plumbing work is physically inspected. Rather the BCA relies on PS3 producer statements that work has been completed to plan. This approach was also mentioned by the PGDB and is recorded on the Council's website. We were advised by Master Plumbers and their lawyer that PS3s have no legal status. We also note that BRANZ is developing an app called 'Artisan' that allows tradespeople to photograph their work avoiding the need for physical inspection. This is being trialled in Auckland and Tauranga.

An MBIE advisor noted that a lot of plumbing/drainage installations do not require a consent (and therefore inspection). His view was that these requirements are not well understood by plumbers. He

also noted that there is no specified inspection requirement in the Act. We understand the inspection requirements are generally specified as conditions on the consent. It was noted that BCAs use a range of approaches but "if the council does not inspect then they don't know whether the 'as built' complies with the Code". This issue again refers to unapproved differences between the consent and what is installed. The advisor estimated that "90% of the time the plumber changes the plans or specifications". If the BCA has not inspected then they would rely on the plumber or drainlayer explaining what they had done, and as laid plans are not always provided. Despite this sometimes Code Compliance Certificates are issued by BCAs.

Different approaches are used for different types of buildings. In a multi-level building, the BCA might check only every third floor; someone might provide videos of work on other parts of the building. The BCA makes a decision on the basis of photographs and videos. A hydraulic engineer might design the pipework in a multi-level building, provide a PS1 and a PS4 when complete. The BCA then might rely on the expertise of the engineer or they may have an expert who can look at it.

BCAs are making a judgement about the relative riskiness of installations and choosing which to physically inspect given limited resources. It is preferable to make such a process more transparent. We suggest that legal review of the available approaches to establishing compliance with the Building Code may be valuable as there appears to be some lack of clarity.

Examples of risk that were raised by stakeholders included the number of levels of a building and whether the installation related to a new building or additions to an existing building where new connections to the three waters systems are not required.

Some stakeholders raised the possibility that different builders or tradespeople could be treated in different ways. For example, a volume builder (such as GJ Gardner) that is replicating a design, or a large commercial builder that has internal quality assurance processes may pose less risk than a more bespoke building. The relevance of this to self-certification is in the auditing process: risk-based auditing would be expected to select these less risky buildings less frequently. If the system were focused rather on the type and extent of evidence required for the BCA to decide the installation complies then this could be targeted based on the type of builder or building (as appears currently to be the case).

5.2 The energy work regime is prescriptive of the approach to installation

The self-certification regime that applies to electrical and gas installation works is a risk-based regime. There are four categories of risk for electrical work:

- Work that is outside the regime – the certification regime only applies to 'prescribed' electrical work.
- Low risk installations – require a certificate stating who has completed the work, generally applies to replacement or replications of existing work. The certificate is given to the building owner and retained for a period of seven years by the installer.
- General risk installations – which require the installer to certify a greater level of detail.

- High risk work – for electrical work an independent tradesperson inspects the work. The inspector has an additional qualification that includes training on how to evaluate the work of another person. Certificates for high risk work are lodged with WorkSafe.

For high risk work, there is explicit separation of two stages: the electrician installing the work certifies that the work has been completed in accordance with relevant standards and that they have tested it during the installation process, and the inspector certifies that it is safe to connect.

In the gas safety regime there is no work that is independently inspected – a certifying class of registration specifies the requirements for certification of higher risk work, but certifying gasfitters can sign off work they installed or supervised.

The electrical work regime evolved from the previous inspection regime in which a Power Board inspector checked that electrical works were safe to connect prior to connecting the building. When Power Boards were deregulated in the early 1990s, the regime was established to certify that the installation was safe prior to connecting it. Safety critical aspects of electrical installations, such as testing the polarity of supply, were specified in the previous regime.

'Electrical inspector' is a specific class of registration and the role of electrical inspectors is to certify high risk work. The inspector is independent of the network company (the successor to the Power Boards) and of the installing electrician. **Officials expressed the view that the system generally works quite well and is relatively well understood.**

The consistency of the regime across time, despite changes in the employment of the electrical inspector, is likely to be a key factor in this clarity. It was noted that part of the success of the regime relies on teaching customers to expect a certificate. Sometimes people contact WorkSafe because they did not receive a certificate; this is "mostly [a problem with] communication and not compliance". In the view of the officials we spoke to, there is limited non-compliance in terms of missing paperwork. While WorkSafe undertakes some auditing, confidence in the system appeared to be underpinned by the limited number of accidents that have occurred. It was also noted that there is a confidential reporting facility run by the Electrical Workers Registration Board to 'report a cowboy' which is considered an important component of the system.

Overall, the officials considered that the system works well and "possibly better" than the previous system (that was based in the electricity distribution sector). There has been no increase in incidents reported and some incidents relate to poor product rather than installation. In their view, many tradespeople believed that inspectors were previously checking their work and these tradespeople have either improved their ways of work or left the industry. This observation is consistent with the economic principle of moral hazard, which recognises that a person will typically take less care if they are in some way protected from the impact of their actions.

One key difference between the electrical work regime and the Building Code appears to be the level of standardisation. The electrical work regime is prescriptive and standards-based: the way in which an installation is completed is described in the Electrical Wiring Rules. We were advised that the Rules make very clear the way that work is prescribed to be carried out safely – the particular cable, its length and the way it is installed is specified and the particular machine used to certify and the answer required are also specified. In contrast, the Building Code sets out the functional requirements of an installation and does not prescribe the way in which the installation must comply with the Code. The

gas regime is similar to the electrical work regime, but "not as sophisticated" according to officials. It was also noted that the gas regime was never completed: high risk installations are not subject to third party inspection and there is no extra qualification level for gas inspectors.

At the core of the energy work regimes are a risk engine which is a "simple mathematical model [in a] big spreadsheet". This is used to evaluate the risk level based on factors including how difficult the installation is to complete, whether specialist skills are required and the extent to which previous installations have been problematic. Officials described the risk engine as fairly unique internationally, but noted that it is peer reviewed and verified by the UN.

The regime makes the individual who certifies the work responsible, rather than the company. This is intended to limit the ability of individuals to avoid responsibility through the structure of their business affairs. Consistent with this principle of responsibility lying with the person who did the work, certificates can be 'nested' whereby stages of work can be signed off by different practitioners.

Two principles appear to be at the core of the energy work regime:

- interventions should be proportional to the risk being addressed
- the person who creates the risk is held responsible for the risk

5.3 Quality and consistency of training was a common concern

There was a common concern about the approach to training articulated by a range of stakeholders including BCAs, inspectors and tradespeople. Risk of error is a combination of the complexity of the task and the skill of the tradesperson, which implies that a robust training programme is needed.

The industry training organisation develops the qualifications.[2] The employer is the teacher, through the apprenticeship system and providers such as institutes of technology and polytechs (ITPs) assess the competence of the trainee. This system relies heavily on the ability of the employer to teach, their technical skill and how up-to-date they are with current practice as well as the range of work that the employer undertakes. Polytechs provide some off the job training in the form of block courses and night classes, but the impression we gained from a number of stakeholders was that this was primarily to test knowledge rather than a training opportunity.

The prevailing view is that this training system is not working well. Whereas the apprentice was previously taught at the ITP then practiced on the job and was therefore able to pass information to their employer this no longer occurs. One plumber explained that in the last 10 years he has had 10 or 11 apprentices "only two [of whom] were on the same scheme". He said that often "certifying plumbers don't want to be bothered with the apprenticeship scheme". While we have not examined the specifics of the training scheme as this was outside the scope of the project, a concern was raised that most certifying plumbers trained under an earlier apprenticeship scheme and there may be a "looming" problem (for self-certification) with the ageing of these plumbers.

[2] The ITO for plumbing and drainlaying, The Skills Organisation, declined our invitation for an interview.

One BCA said, "if people who were registered [plumbers and drainlayers] were competent then local government would add little value…[but] evidence suggests this is not the case". Conversely, tradespeople described a variation in the skill of inspectors with respect to plumbing and drainlaying that meant at times plumbers had to explain the work and the inspectors were not always providing "correct advice".

Consumers expressed the view that an understanding of the responsibility of plumbers and the impact on the building owner of getting it wrong "has to be instilled in the baby plumber – it has to be part of training". Their view was that it was hard to change an attitude in an apprenticeship system.

There was a common view that the skills needed to certify work were different or complementary to the technical skills required for installation. "Just because you are technically competent at being a builder doesn't mean you are competent to review or audit [work]" (training organisation). It was noted that LBPs have to meet additional requirements including health and safety knowledge.

Maintaining skills appears to be a risk, largely because of questions about the supply of suitable trainers. A training organisation noted that everyone should be held to the same standard, meaning that continuing professional development ought to "fill the gap" for those with licences to meet the current standards (and not higher). The Plumbers Gasfitters and Drainlayers Board specifies the continuing professional development topics and as such the specification of requirements does not seem an insurmountable hurdle. However, an issue noted by a licensing body was that it was not always practical for a tradesperson to be instructed to undertake further training for disciplinary reasons, because suitable training may not be available. The method of delivery continuing professional development requires further investigation.

5.4 Regulate "as little as possible, as much as necessary"

At a surface level there was strong opposition to self-certification by a number of stakeholders including BCAs and consumers. However, beneath this reaction there was almost unanimously a recognition that there are likely to be elements of plumbing and other construction work that could be self-certified to reduce cost (particularly delay) at low risk.

The key then is to unbundle or disaggregate the elements of work sufficiently to be able to regulate in a way commensurate with the degree of risk and significance of harm. A training organisation noted that it would be important to consult the sector to foster understanding. This is consistent with the observations of officials about the importance of industry and public knowledge of the system to its success.

The driver for intervention is to ensure public health in an environment where consumers make infrequent purchases and therefore have limited skill in being able to ascertain quality of the tradesperson before or the work after it is completed. If regulation is too restrictive, prices are driven up due to shortages of labour and there is limited benefit in terms of reduction in risk to the public. It is critical to identify in sufficient detail the aspects of work that are high risk, where the potential harm is disproportionate to the value of the work and the consumer is not in a position to make a judgement. For example, a training organisation identified that for building work more generally, the foundations, structural work and the exterior water envelope of a building are the risky elements: if it

is possible to isolate these elements, then it is only necessary to license builders to undertake these tasks.

A secondary consideration may be protection of the consumer in terms of individual wealth destruction associated with poor quality building. However, independent inspection is not a complete solution to this secondary consideration, and, as consumers noted, inspection may not be a solution at all, citing the weathertightness issues. This is a financial issue and there are contractual solutions available, possibly with mandatory guarantees or insurance depending on the quantum at risk. It is critical to isolate the problem.

5.5 Isolating the elements of a building could be hard

An issue that was raised by both a training organisation and a BCA is that there are interconnections between building elements and it may be difficult to isolate aspects of a building to be clear about sign off responsibility.

While it is clear that a building comprises many parts, and a whole of building approach is needed from a system perspective, this does not logically lead to the conclusion that plumbing and drainage cannot be self-certified. In some jurisdictions, including Hong Kong and Sweden, there is a requirement to appoint a supervising person to monitor the contractors (Sturm & Marriage, 2012). In Hong Kong a structural engineer is also required in some circumstances (Yau, 2010).

One BCA gave examples of building sites where the slab and the framing did not fit, but the framing was still erected because the two elements were the responsibility of different sub-contractors. This illustrates that the system of certification must be clear, including the link between design and installation, the use of prescribed standards and the sequencing or nesting of certification.

- **The issue is contributed to by the system of contracting** whereby the framer is probably paid for erecting the framing (rather than on the basis of the time required) and therefore wants to complete the task in the shortest possible time. The framer perceives the problem is not theirs to solve, and they are not paid if they delay. Coordination of trades and site supervision is a separate issue from the risk relating to specific installations. Nonetheless the view from a BCA was that the "only person who provides QA across the overall work is the inspector". This person is focused only on quality, and has the ability to look more widely at the building as a whole.
- **Supervision of works by less qualified tradespeople is a potential risk.** A BCA suggested that in the early period after self-certification was introduced, there were instances of tradespeople allowing their 'mates' to use their number to 'self-certify'.
- Another issue that was raised by BCAs was where the actions of one tradesperson creates problems for the building structure as a whole, for example where a hole is drilled through a floor joist for pipework. The consequences of such can be "quite dire…you can't always observe it's not right until something very bad happens." These comments go to the issue of tiering the regulation of activity to the risk of harm and ensuring a suitable approach to site supervision. We also note that energy works are part of the building structure and this issue was not raised in respect of these. It is not clear from our interviews why not.
- BCAs also raised as a consistent problem, which was verified by plumbers, that there was often a mismatch between the consented plan and the work actually done. There was not

close agreement about the reasons or consequences of this. BCAs considered this evidence that plumbers were installing improper or non-compliant works, whereas tradespeople considered they were improving the pipework layout or substituting something equally suitable and the need to amend consents was an unnecessary cost. It seems likely that the truth lies in the middle, that is sometimes the changes are suitable and compliant, and sometimes they are not. It is not possible to know, given the data, which occurs more often. We did hear that plumbing changes are a major cause (one BCA said the "top" cause) of variations to building consents (although presumably part of those variations would relate to changes in the layout of bathrooms for example). One issue that arises is that there are two different approaches under the standards and the Building Code (e.g. ANZS3500 and G13) and while either is acceptable, they are not compatible, that is aspects of them cannot be combined. To the extent that it can be resolved, there is likely to be benefit in making the inter-relationship of standards and Code consistent.

Clarity about the boundaries of the certification being given are important to ensure that the appropriate, qualified person is made responsible for certifying that the work has been completed (to the design). Officials noted that the energy certificate of compliance acted as a form of checklist for the energy worker as it records the work done, testing, verification and standards used for that work – this reminds the worker of their obligations.

5.6 Records can be useful, but there are costs to keeping them

Record keeping can be an element of monitoring a system or used to minimise the cost of knowing what happened (or what is built) at a later date. There was general agreement among stakeholders that records can be useful, but less agreement about what specific records are of value. For example,

- The move away from the central recording of all work to only high-risk work was considered by some inspectors and tradespeople to be a problem in terms of future amendments.
- Some officials conversely expressed the view that the cost of retaining all records exceeded the benefit.

There were differing views about the best person or organisation to hold the records, with some stakeholders reflecting on the relative cost of centrally collecting these compared to holding by the tradesperson or building owner. Some factors that arose:

- The purpose of the record: is it intended to monitor the work of the individual (as part of the licensing system) or the effectiveness of the overall regulatory framework (the certification system)?
- How likely is it that the records will be required later: for example, because problems are slow to develop or to inform later building additions or changes?
- The potential cost if the records are lost: how would the information be replicated?

A licensing body raised the point that as there is no central register of work completed it cannot be determined whether work is being incorrectly specified as general or low risk when it is actually high-

risk work. Where energy work is part of consented works then the BCA relies on the certificate of self-certification. Problems are not likely to be picked up by the BCA unless the inspector had particular expertise. In fact, officials indicated concern that some BCAs were inspecting energy work when that is not their role.

5.7 Sufficient auditing provides a meaningful deterrent

Tradespeople and licensing bodies suggested figures in the range of 10% to 15% would be a suitable target for auditing.

A BCA said that unlike electrical work, where it is possible to test the whole system after it is installed this is not possible with plumbing work. This may mean that auditing may have to occur as inspections of work-in-progress. This raises issues around how work is identified if a consent is not required (as is the case for energy work).

5.8 Dispute resolution to provide specific remedy and link to licensing

There appears to be some disagreement or lack of clarity regarding liability under the building consent regime when errors occur. Tradespeople indicated that it would depend on the nature of the issue: the BCA, the designer and the builder are all potentially responsible. If a plumber were a sub-contractor to the builder then Master Builders' guarantee would cover plumbing works and it was suggested that self-certification could increase risk under this scheme.

This confusion over responsibility and liability suggests that moral hazard is likely to be a real phenomenon. Moral hazard describes a situation where a party, in this case the plumber, takes less care than they otherwise would because they believe that they are in some way protected from the consequences of their actions. In this case, protection from having to remedy an issue or compensate the building owner (whether actual or perceived protection) reduces the effort taken to avoid the issue occurring.

It is therefore likely that increasing clarity and imposing responsibility on the party best able to mitigate the risk (the relevant tradesperson) would increase the effort to avoid errors. That is quality would improve. BCAs are required to be indemnified for 20 years to be accredited. A self-certification regime may need to mirror this.

The process of complaining about a tradesperson currently seems somewhat onerous. BCAs noted that they do not have the resources to pursue a complaint through the PGDB. In contrast, it was noted that not providing records of design and work is a strict liability for LBPs; withholding these attracts an automatic fine. A balance needs to be struck between simplifying the process sufficiently that harm can be identified, and not allowing frivolous complaints. The LBP Board has a sub-committee that sorts complaints into those that are:

- Trivial, vexatious or where the Board has no jurisdiction; these do not proceed.
- Those where a quick decision is possible, such as when a record of work has not been provided.

- Those that require a hearing. This is an inquisitorial process and the LBP Board acts as a disciplinary tribunal.

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Appendix A: Interviewees

Interviewee	Organisation	Role
MBIE Subject Matter Experts		
Ross Wakefield	MBIE	Senior Advisor Plumbing and Hydraulic Services
Mike Reedy		Senior Advisor Compliance and Assurance Consent System Capability
Vincent Kneebone		Technical and Licensing Team Leader, Occupational Licensing
Central Government Regulator (outside BSP and BSA)		
Paul Stannard	WorkSafe NZ	Technical Officer - Energy Safety, High Hazards, Energy and Public Safety
Peter Morfee		Principal Technical Advisor Energy Safety
Anthony Christenhusz		Technical Officer - Energy Safety, High Hazards, Energy and Public Safety
New Zealand Local Government Regulators		
Garry Cruickshank	Auckland Council	Senior Specialist - (Plumbing & Drainage) Targeted Initiatives Team Licencing and Regulatory Compliance
Ian McCormick	Auckland Council	Building Control Manager
Peter Laurenson		Manager Project Assessment South
Katharine Wheeler	Kāpiti Coast District Council	Building Team Manager
Jon Moser	Kāpiti Coast District Council	Plumbing and Drainage Inspections Officer
Ross McCarthy	Wellington City Council	Strategic & Engagement Manager, Go Shift – BCA consent data national
International Government Regulators and Trade Bodies		
Robert Beard	Department for Energy and Mining, South Australian Government	Office of the Technical Regulator Plumbing
Russell Martin	Department of Housing and Public Works, Queensland Government	Building Legislation and Policy

Richard Harris	Department of Justice, Tasmanian Government	Consumer Building and Occupational Services
Occupational Licensing Bodies (New Zealand)		
Martin Sawyers	Plumbers, Gasfitters and Drainlayers Board	Chief Executive Officer
Roger Woods	Engineering Associates Registration Board	Registrar
Chris Preston	Licensed Building Practitioners Board	Chair
Marc Woodbury	NZ Registered Architects Board	Deputy Chair
Building Peak Bodies		
Greg Wallace	Master Plumbers NZ	Chief Executive Officer
Nick Crang	Duncan Cotterill	Partner, legal advisor to Master Plumbers
Rod Miller	Master Plumbers NZ	National President
Wal Gordon	Gasfitters and Drainlayers Federation, Wal Gordon Plumbing Ltd.	
David Kelly	Chair (Construction Industry Council), CE (Master Builders)	Construction Industry Council, Master Builders
Industry Training Organisations		
Warwick Quinn	BCITO	Chief Executive
Property Owners / Consumers		
John Gray	Home Owners and Buyers Association of NZ (HOBANZ)	President and Co-founder

Appendix B: Inspection data

Data were provided by MBIE. The data were collected from seven building consent authorities (BCAs) that use the GoGet suite to record inspection data. Data covers the time period January 2009 to December 2018. The dataset contains information on building inspections carried out by inspectors.

Data were for plumbing related inspections:[3]

- Plumbing
- Drainage
- Pre-line Plumbing
- Final Residential Plumbing
- Final Commercial Plumbing.

The dataset contained 75,027 rows. Of these rows, there were:

- 33,867 Passes
- 34,083 Fails
- 7,077 NAs

Not all passes are recorded, and no pass data is recorded after 2016. There were no notes for passed inspections. Fails or NAs may or may not have notes attached that detailed the reasons for failure.

Limitations of the data

The data is collected for the purposes of recording building inspection results. As with many administrative data sets, any results of analysis must be treated with caution when attempting to use the data for purposes outside of those intended.

A key limitation of the data was the ambiguity of the notes made be the inspector. The variation in the notes suggests that there is not a common language amongst inspectors. This meant that it was difficult to determine whether work was non-compliant, compliant but inconsistent with the consent, or simply not yet complete. It was not possible to determine, without detailed scrutiny of the comments (which was outside our scope), how serious the failures due to poor plumbing activities were in terms of compliance with the Code. Even undertaking this exercise would not produce a complete picture as almost 40% of the data were missing the specific reason for failure.

In addition, there many other issues identified with the data. Below are some of the identified issues.

- In some BCA areas inspections are recorded as fails until the final inspection is complete (and passed).
- Alarms and moisture checks are included in plumbing inspections although they do not relate to plumbing work. They comprise less than 1% of the records. As there are other serious limitations to the reliability of the data, we have not attempted to exclude these.

[3] For empty inspection categories, MBIE provided a list of items that were considered plumbing-related inspections.

- The data were also only for seven of nearly seventy BCAs, and so, without further analysis it is unknown if the data are representative of New Zealand.
- Passed inspections were not consistently recorded, and not supplied at all after 2016. This means that we cannot determine the failure rate as a proportion of all inspections, and the ratio of failures to passes within the data is not meaningful.

The number of failures is likely to overstate the number of true quality concerns

As discussed above, there is a myriad of issues that have been raised by all parties that suggest the data is not robust enough to be relied on to determine policies regarding the readiness of plumbers to self-certify. In addition to specific data issues, we also caution the interpretation of the results in relation to the level of poor workmanship that might occur under a self-certification scheme.

For instance, it is unknown if an issue that caused failure would have been rectified without an inspection process. Also, while it is likely that all consented works will eventually receive a pass, it is possible for the same work to receive multiple failures at different inspections for the same issue (which is yet to be rectified). This would lead to double counting of failures for a single issue.

Inspections can also be failed for work not completed to the consented plans. In some cases, this is an issue with quality. In other cases, the plans may not have been appropriate for the real-world circumstances, or the best solution. If the plumber changed the work for these reasons, inspections may be failed until updated plans are consented. These changes would inflate the number of failures, despite a safe and quality solution.

Some installation types may be more prone to quality issues

The purpose of our data analysis was to attempt to isolate the failures that relate to workmanship or compliance issues based on what is presented in the GoGet system. We assessed the failures related to plumbing work (RPW), as a proportion of all plumbing inspection failures. We note that, while we categorise failed inspections into those RPW, this does not mean that all failed plumbing work described as RPW was of poor quality, for the reasons provided above. However, this RPW categorisation could give some insight into the reasons for plumbing inspection failures.

Based on the analysis, we found the failed inspections RPW accounted for 21% of total failed inspections. The proportion of RPW failures for commercial buildings was 31%, while it was almost 40% for high-risk jobs. This may indicate that some job types are systematically more prone to quality issues.

Failed inspection categorisation

Table 1 shows the categories that failed inspections were coded to.

Table 1 Failed inspection categories

Reason	Description
No answer (NA)	Left as blank or has comments such as "?", ".", "Unknown". We are unsure why these are failures.
Admin (ADMIN)	Producer statements (PS3, PS4), ground checks, engineer confirmations, surveyor confirmations, required documentation. This also includes minor variations. Any comments that mention a name or business is included in this category as it implies administration is required from these entities.
Building compliance (BC)	Work that may not comply with the Building Code. Note from MBIE: the work may not comply with the acceptable solution but does not mean it doesn't comply with the Building Code. As the notes are unclear, failures in this category may mean: • Building consent does not comply with the Building Code • Amended building work does not comply with the Building Code (but is the acceptable solution) MBIE notes there is no way of telling; the builder either works off the consent which may not meet the Code, or the amended work does not comply with the Code.
Engineer (ENG)	Work requiring an engineer to come in and assess (excludes engineer confirmations).
Cancellation (CANCEL)	This includes cancellations from plumbers not being on site, hot/cold water not being connected yet, power not connected yet or cancellations due to bad weather.
Not to plan (NTP)	Notes that say, "does not follow plan" (such as being installed in a different location) or requires an amendment to the plan. There is some overlap between this category and BC as things built not to plan are unlikely to comply with the Building Code and vice versa. However, comments categorised in here specifically mention being not to plan or design.
Poor work (PW)	Poor work may overlap with building compliance as, if it complies with the Building Code, it is likely to be good work. This includes comments on low quality work. For instance, "I have put seals in here as a shower leaking" implies poor work.
To be completed (TBC)	This includes incomplete work at the time of inspection or things are yet to be installed.

Source: Categories and descriptions provided by MBIE with additional descriptions from Sapere analysis

Inspection failure could be due to workmanship or administrative issues

Due to the data quality and limitations, we analysed the reasons for failed inspections only. Failures could be due to compliance or workmanship issues that reflect the quality of plumbers' work. These may be failures relating to plumbers not using the right materials or not following the plan. These failures may indicate the need for a more cautious approach to self-certification as they may indicate that the plumber has installed work incorrectly or it does not comply with the acceptable solution. The consequences of these failures could mean damage and harm to property and people if they do not comply with the Building Code.

Other reasons for failures may be administrative or simply because the work was not completed at the time of inspection. These do not reflect the quality of plumbers' work. For example, there are failures relating to hot water that is not yet running or where a producer statement is requested. The plumber may have installed everything correctly, but it cannot be verified at the time of inspection. This is recorded as a fail but reflects a lack of the ability to verify, rather than the absence of plumbing quality. These failures may be easily remedied, or their consequences are of low impact.

Failures due to compliance or poor workmanship might be less easily remedied, and the consequences of non-compliance or poor workmanship can have high impacts. We therefore focus our analysis on the proportion of failures that relate to these causes.

We therefore group the categories shown in Table 1 into two subsets:

- Related to plumbing work (RPW). This includes
    - **Building Compliance** as plumbers have not complied with the Code
    - **Poor Work** as workmanship is subpar
    - **Not to plan** as plumbers have not complied with the consented plan and the work may not comply with the Code
- Not related to plumbing work (NRPW)
    - **Admin** as it reflects deficiency in administrative tasks, rather than in plumbing workmanship
    - **Cancellation** as these circumstances may be out of their circumstances or do not accurately reflect plumbing workmanship
    - **To be completed** as the work is not yet completed to accurately judge workmanship
    - **Engineer** as these are typically related to a technical issue which the plumber must seek advice for. This does not reflect plumbing workmanship.
- **No answer** as we cannot ascertain the true reason for failure

String and manual matching used to categorise failures

String matching was initially used to match keywords and phrases provided by MBIE. We used direct and partial string matching packages in R. This assigned 55% of the rows to the failure categories. The remaining 45% were matched manually. To guide the process, we used word/keyword frequency packages in R that produced commonly used terms to narrow our efforts.

Manual matching was guided by input and documentation by MBIE, discussions with building inspectors, and existing string matches. For example, "no test gauge" may appear in the initial string matches but mean the same thing as "not on test" or "to be tested" which may not appear in the string matches.

Summary statistics and results

Almost 99% of the non-pass data to a category. Less than 2% of the data is double coded to two categories. "Poor work" and "building compliance" are separate categories, but are likely to overlap, as mentioned above.

We provide statistics for failures grouped by:

- All inspections
- Inspection type
- By BCA (anonymised)
- Residential/Commercial split
- Risk 3 (high risk), Risk 1 and 2 (low risk)
- New construction (this is not a perfect measure but gives an indication)

Percentages are presented as a proportion of each row, rather than the overall table. Failures are grouped into those related to plumbing work (RPW) or not related to plumbing work (NRPW).

A fifth of plumbing inspection failures are due to plumbing work

The largest inspection failure category is NA; approximately two-fifths of failures have no recorded reason for failure. The next largest category is 'work to be completed' which accounts for 19% of the data. Total RPW failures make up 21% of the failures.

Table 2 Reasons for inspection failure

	Related to plumbing work			Not related to plumbing work				NA
	BC	PW	NTP	ADMIN	CANCEL	ENG	TBC	NA
n	4,572	3,233	907	7,126	1,578	139	7,983	16,210
%	11%	8%	2%	17%	4%	0.3%	19%	39%

Source: GoGet data, Sapere analysis

Failed final plumbing inspections are more likely to be related to plumbing work

RPW failures during the final residential, and commercial, plumbing inspection are responsible for more than 30% of failures in these categories. This is higher than other plumbing inspection types. Rather than being due to higher levels of poor plumber workmanship at this stage, this might be due to lower levels of failures from due to administrative issues.

For all plumbing inspection types (apart from NA), NA makes up the largest proportion of the failures. For pre-line plumbing inspections, TBC was the next largest reason for failure. This may be because incomplete plumbing may be sighted at subsequent inspections. This is also the case for drainage inspections. For plumbing inspections, NRPW failures were the cause of 41% of the failures, while 19% of failures were RPW.

Table 3 Reasons for inspection failure by inspection type

	Related to plumbing work			Not related to plumbing work				NA
	BC	PW	NTP	ADMIN	CANCEL	ENG	TBC	NA
NA	312 3%	633 6%	300 3%	4633 43%	302 3%	38 0.4%	1289 12%	3360 31%
Pre-line Plumbing	733 11%	422 7%	107 2%	555 9%	260 4%	12 0.2%	1921 30%	2444 38%
Drainage	457 6%	201 3%	188 3%	768 10%	280 4%	28 0.4%	1865 25%	3624 49%
Plumbing	185 7%	126 5%	164 6%	474 19%	299 12%	55 2%	210 8%	1013 40%
Final Residential	2157 19%	1460 13%	116 1%	491 4%	317 3%	6 0.05%	2110 19%	4632 41%
Final Commercial	728 23%	391 12%	32 1%	205 6%	120 4%	0 0%	588 18%	1137 36%

Source: GoGet data, Sapere analysis

Most BCAs analysed have similar plumbing work failure proportions

NA and TBC seem to be the most common reasons for failure between BCAs. BCAs 1-6 have RPW failure proportions between 7% and 17%. However, BCA 7 has a much larger proportion, approximately 40%. This could be due to many different reasons, some of which we outline below.

1. BCA 7 has more stringent inspection thresholds than other BCAs
2. The other BCAs are not picking up potential failures
3. The quality of plumbers differs by BCAs
4. The data is reported differently
5. Lower levels of NRPW failures (increasing the relative proportion of RPW failures)

If BCA 7 has more stringent inspections, this could suggest that plumbers are being failed for inspections that may otherwise achieve a pass. If the other BCAs are missing potential failures, this

could suggest that inspectors are passing plumbing in inspections that do not meet the requirements. The quality of plumbers could differ if there are localised effects of plumbing training. For example, all plumbers in BCA 1 may receive the same high-quality training and are therefore good quality plumbers.

It is possible that the data is recorded differently (or in a way that causes our categorisation to code the data differently) between BCAs. For instance, BCA 2 has a relatively high proportion of failures due to administration issues, but also has the lowest level of to be completed failures. Finally, as we are only assessing the failed inspections, lower levels of NRPW fails may result in the higher proportions of RPW fails.

Table 4 Reasons for inspection failure by BCA

	Related to pluming work			Not related to plumbing work				NA
	BC	PW	NTP	ADMIN	CANCEL	ENG	TBC	NA
BCA 1	56 7%	15 2%	30 4%	56 7%	36 5%	2 0.3%	254 33%	318 41%
BCA 2	245 3%	612 6%	274 3%	4523 46%	238 2%	32 0.3%	967 10%	2864 29%
BCA 3	255 4%	123 2%	49 0.9%	483 8%	142 2%	6 0.1%	1685 29%	2985 52%
BCA 4	25 5%	8 2%	9 2%	66 13%	61 12%	0 0%	197 38%	147 29%
BCA 5	1075 8%	954 7%	281 2%	1133 9%	714 6%	75 0.6%	2525 20%	6078 47%
BCA 6	16 5%	2 1%	7 2%	24 8%	21 7%	3 1%	125 41%	109 36%
BCA 7	2900 24%	1519 13%	257 2%	841 7%	366 3%	21 0.2%	2230 19%	3709 31%

Source: GoGet data, Sapere analysis

Commercial plumbing inspections are more likely to fail due to plumbing work than residential inspections

Residential RPW failures are 22% while commercial RPW failures are 31%. This could suggest that, self-certification might be more appropriate for residential plumbing work than commercial work. Alternatively, stricter requirements to become a self-certified plumber could be used to enable commercial work to be self-certified.

Table 5 Reasons for inspection failure by work type – residential/commercial

	Related to plumbing work			Not related to plumbing work				NA
	BC	PW	NTP	ADMIN	CANCEL	ENG	TBC	NA
Res	2962 11%	2164 8%	583 2%	5489 21%	881 3%	93 0.4%	5116 19%	8967 34%
Comm	927	426	130	510	203	18	969	1555

	20%	9%	3%	11%	4%	0.4%	20%	33%

Source: GoGet data, Sapere analysis

Higher proportion of failed inspections due to plumbing work for high-risk construction

High-risk plumbing work is more likely to fail inspection due to plumbing work (38%) than low-risk work (21%). This may indicate that low-risk plumbing work is more likely to be completed correctly and safely. However, high-risk plumbing work fail over one third of inspections which may be commensurate to the level of complexity required. This suggests that self-certification may not be appropriate where the work undertaken is considered high-risk. Alternatively, this may also be due to data reporting differences; low-risk work has a much higher proportion of fails without a known reason compared to high-risk work.

Table 6 Reasons for inspection failure by risk

	Related to plumbing work			Not related to plumbing work				NA
	BC	PW	NTP	ADMIN	CANCEL	ENG	TBC	NA
Low risk	2953 11%	2037 8%	580 2%	5485 21%	900 3%	93 0.4%	4990 19%	9655 36%
High risk	936 22%	553 13%	133 3%	514 12%	184 4%	18 0.4%	1095 25%	867 20%

Source: GoGet data, Sapere analysis

New construction failure reasons are similar to all plumbing work

RPW failures for new construction are approximately 20% of all failures for this construction type.[4] This is consistent with the overall RPW failure proportion. The main difference is that new construction has fewer unknown failure reasons, but more administrative issues.

Table 7 Reasons for inspection failure for new constructions

	Related to plumbing work			Not related to plumbing work				NA
	BC	PW	NTP	ADMIN	CANCEL	ENG	TBC	NA
New	1166 10%	948 8%	278 2%	2958 25%	411 4%	36 0.3%	2394 20%	3551 30%
All	4,572 11%	3,233 8%	907 2%	7,126 17%	1,578 4%	139 0.3%	7,983 19%	16,210 39%

Source: GoGet data, Sapere analysis

[4] We note that there is no 'old' construction as not all new construction as captured in this category. Therefore we have only summarised and analysed the data for those explicitly flagged as 'new'.

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