Chapter 1

Government as a Standard Bearer and Digital Platform Provider:
The Case of New Zealand

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1. Introduction

> Digital technologies have transformed nearly every aspect of daily interactions between households, firms and governments ... The efficiency and effectiveness of interactions with government agencies – from registering a motor vehicle to completing a tax return – have been improved using digital technologies. But 'digital government' remains far from a reality (Australian Productivity Commission and New Zealand Productivity Commission, 2019: 1–3).

The big idea we explore in this chapter is the role of government in promoting the digital economy through the uptake of digital platforms and standards. In the late 20th century, the introduction of barcodes revolutionised logistics, including retail and wholesale trade (Ellickson, 2016), and the impact of standardised containers has been more important for the growth of world trade than successive rounds of tariff reductions since World War II (Levinson, 2006). In the 21st century, will digital platforms and standards play a similar role in enabling economic development in the information age?

The main chapter is structured into five sections. Section 1 provides an introduction, section 2 provides a summary of the case studies, section 3 explores the role of global data standards, section 4 develops the themes that emerged from the research, and section 5 sets out the policy implications and draws out conclusions. The appendixes cover the details of three platform case studies – the New Zealand Business Number, Business Connect, and Beneficial Ownership – as well as exploring the role of global standards, using bar codes and containerisation as examples.

1.1. Research Approach

The research uses three short case studies of new government digital services and the impact of the GS1 data standards architecture to explore the role the government plays through its digital government initiatives in enabling the growth of the digital economy.

Our research has three main phases:
*   A scan of the relevant literature on digital government and the digital economy, focused on New Zealand. We have drawn on the joint Australian and New Zealand Productivity Commission study (2019) of the digital economies of New Zealand and Australia as well as relevant overseas research (OECD, 2019).

- An analysis of three platform case studies[1] – the New Zealand Business Number (NBZN), Business Connect, and ownership authentication for companies and limited partnerships – and GS1[2] as an exemplar of global data standards. The case studies were based on semi-structured interviews and a review of available documents. Interviews were on a non-attribution basis, so material in single quotes reports respondent comments while protecting anonymity.
- Development and testing the insights and conclusions that emerged from the research, culminating in the production of this chapter.

The case studies were selected to explore the potential role of digital platforms and standards in contributing to economic development and greater regional economic integration. We looked to see if digital government initiatives, such as adopting data standards or providing common trusted platforms, enabled network effects (Katz and Shapiro, 1994) that promoted the digital economy. The gains from network effects are far wider than simply improving customer experience and reducing transactions costs – they encourage new uses and draw in new users that benefit from the network.

The null hypothesis is that there were no network effects or transformative impacts. In this case, the impact of digital government is limited to providing digital channels for existing processes and systems. Put simply, this enables 'doing things differently' rather than 'doing different things' (O'Neil, 2009).

Our secondary hypothesis was to explore the proposition that common digital platforms and standards in the 21st century are equivalent to the standardised barcodes and container sizes in the late 20th century.

The policy question we will address is the optimal role for government in the digital platforms and standards space. Is there an equivalent to the Goldilocks zone – neither too hot nor too cold – for digital platforms and standards?

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[1] For details of the NZBN, see New Zealand Intellectual Property Office (n.d.). For Business Connect, see Ministry of Business, Innovation & Employment (n.d.-a). For ownership authentication, see Ministry of Business, Innovation & Employment (n.d.-b) and New Zealand Government (2022a).

[2] See GS1 (n.d.-c).

1.2. Country Context – The Case of New Zealand

New Zealand provides a useful comparator for other countries in the region because, while slightly behind pacesetters like the Republic of Korea (henceforth, Korea), Denmark, and Estonia, it ranks reasonably high in world surveys on digital government and the digital economy.[3] Indeed, one 2017 survey ranked New Zealand's digital economy a 'standout among standouts', meaning a country that it is both highly digitally advanced and exhibiting high momentum but without being in the top group of countries on either dimension.[4]

The box discusses the development of institutional arrangements and strategies to support the development of digital government in New Zealand. It is an open question how much these arrangements contributed to the development of digital government in the country. Arguably, the most important drivers arose from the wide-ranging public management reforms of the 1980s and 1990s, which enabled individual public agencies to adopt information and communication technology (ICT) more readily in their business models.

Chronology of the Main Digital Government Initiatives in New Zealand

2000: e-Government strategy adopted, and a special unit established in the State Services Commission

2005: National Digital Strategy adopted (updated in 2008)

2009–2017: Better Public Services goals include two result areas focused on digital government (updated in 2017):
   (i) Result 9: Business gains value from easy and seamless dealings with government
   (ii) Result 10: People have easy access to public services, which are designed around them, when they need them

2010: Role of Government Chief Information Officer created as the functional leader of the ICT Strategy, based in the Department of Internal Affairs

2013: (i) Government ICT Strategy and Action Plan for New Zealand approved by the government (updated in 2015)
   (ii) New Zealand Data Futures Forum established (phased out 2018)

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[3] The United Nations (UN) survey ranks New Zealand 4th on e-participation and 8th on e-government out of 193 countries (UN, n.d.). The Organisation for Economic Co-operation and Development (OECD) ranks New Zealand 12th out of 37 countries on its Digital Government Index (OECD, 2019).

[4] The 2017 Digital Planet report from Tufts University. See New Zealand Government (2017).

2015: (i) Four functional leads created: Government Chief Digital Officer, Government Chief Data Steward, Government Chief Information Security Officer, and Government Chief Privacy Officer

(ii) Digital Government Partnership established, with stakeholders from government agencies (disestablished in 2019)

2016: ICT Strategy updated, replacing the Action Plan with an integrated work programme

2019: Strategy for a Digital Public Service released

2022: Digital Strategy for Aotearoa released

ICT = information and communication technology.

Source: Author.

A recent joint study of digital government and the digital economy in New Zealand and Australia (Australian Productivity Commission and New Zealand Productivity Commission, 2019) concluded that:

- New Zealand (and Australia) has been an active and rapid adopter of ICT[5] – but as a technology taker, not a technology maker.
- Access to and uptake of rapid broadband is high by international standards (although digital exclusion remains a concern).
- A sequence of e-government and digital strategies have been developed and new roles and institutions have been created (Box).
- ICT has been extensively applied at the individual government organisation level, with examples of transformation changes.[6]

In summary, the Australian Productivity Commission and New Zealand Productivity Commission (2019: 63) concluded:

> Despite the plethora of government policies and bodies in this space, the process of digitalising government services has not kept up with technological developments, nor with firm and consumer use of digital technology... digital government on both sides of the Tasman is something of a patchwork – some government services are highly digitalised, integrated and provide a good user experience, while others are confusing, siloed and still partly paper-based.

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[5] NZTech (2016) estimated that the technology sector (defined as ICT plus high-tech manufacturing) produces NZ$32 billion of goods and services, contributes NZ$16.2 billion or 14.6% of gross domestic product (GDP), employs almost 100,000 people, and generates NZ$6.3 billion or 19% of exports.

[6] Prominent early examples, such as Companies Office online and removing most citizens' obligation to file income tax returns, predate any e-government or digital government strategies. Recent examples include Inland Revenue's payday filing and myIR. See Office of the Auditor-General (2012) for a discussion of the critical success factors for ICT projects in government.

The New Zealand case is something of a paradox. The country's digital economy is thriving ¬— many games producers have become successful, a number of software providers (such as Xero) have gone global, and Trade Me is the only instance (outside China) where eBay has been beaten by a local product. In the public sector, the power of information technology has been successfully harnessed in a number of applications. Despite these developments, it does not seem able to scale up these innovations across the public sector. New Zealand's digital government approaches have not been enduring – changes of government result in new strategies being developed. Furthermore, despite digitisation's obvious 'network' effects and clear association with economies of scale, there was little obvious central leadership, with responsibilities spread across a range of agencies and roles.

As the executive summary of the Australia and New Zealand Productivity Commission study observes, while there have been significant improvements from digital use in a range of public domains, '"digital government" remains far from a reality' in New Zealand and Australia.

2. The Platform Case Studies – What Did We Find?

In this chapter, we focus on the role of the state by using three case studies of newly developed digital platforms to explore the notion of government as a platform (O'Reilly, 2011). The appendixes provide details on the three government digital platforms: the NZBN (a public platform that is open to business) is reviewed in Appendix 1; Business Connect (a government-to-business (G2B) platform to reduce regulatory compliance costs) is discussed in Appendix 2; and Beneficial Ownership (a G2B platform that will be mainly used by enforcement agencies) is covered in Appendix 3.

We found that the openness to the wider public of platforms can be arrayed across a spectrum, as shown in the figure.

Figure 1.1. Continuum of Platform Openness
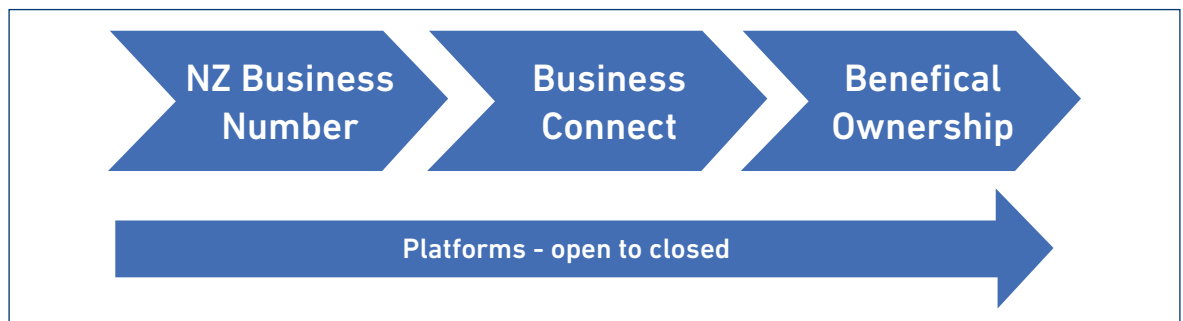
NZ = New Zealand.
Source: Author.

At the open end is the NZBN, an archetypal platform where the government provides trusted curated data in readily available formats, including application programming interfaces (APIs), which enable the private sector to develop value-added processes. In the middle is Business Connect, a G2B platform that takes a user-centric approach – bringing related regulatory processes into one place without making the information in the platform available to the wider public. At the other extreme is the new Beneficial Ownership platform, which will systematically make ownership information available, but the facility will largely be limited to enforcement agencies.

The government has a pivotal role in society. Its monopoly on the exercise of coercive powers makes it uniquely well placed in the digital space to develop platforms based on data sets with universal coverage, but the use of that coercive power is a double-edged sword. There are restrictions on how that information can be used because of other policy objectives, such as privacy and the need to protect against reidentification. Data reidentification or de-anonymisation involves matching anonymised or de-identified data with other data to identify the individual concerned. Reidentification is a problem because government-held data on citizens and business data can be used for unintended purposes, including for criminal use.

O'Reilly (2011) suggested the government has a key role by providing open platforms that anyone can build on. Platforms provide open government data and decision rules for others to use beyond single login/digital identity. This approach appears to assume a degree of routinisation and decision making, without the exercise of discretion, i.e. the exception rather than the rule in the modern state.[7] The case studies highlighted constraints such as privacy concerns and risks of reidentification, which limit the government's role in providing open platforms that anyone can build on.

The cases also show varying degrees of transformative change. The NZBN is transformative by enabling new products and services. The impact of digital government with Business Connect and Beneficial Ownership is more limited, as they provide digital channels for existing processes and systems. Incremental changes that enable dramatic reductions in compliance and transaction costs improve both productivity and living standards. As Krugman (1994: 2) observed in *The Age of Diminished Expectations*, 'Productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker'.

In the next section, we turn to a discussion of standards. New Zealand is largely a technology taker, not a technology maker, and is generally more of an adopter (and adapter) of standards rather than an initiator. The research therefore focuses on global data standards using GS1 as an example. GS1 has already been discussed, as it provided the data architecture on which the NZBN was built.

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[7] See the discussion of discretion in Wilson (1989, Chapter 4).

3. Global Data Standards – The 21st Century Equivalent of Barcodes or Standardised Container Sizes?

3.1. What is a standard?

In this section, we discuss technical standards,[8] by which we mean published documents setting out technical specifications for products, systems, or services that are typically backed by systematic testing. It is important to distinguish standardisation from the broader and vaguer concept of harmonisation, which includes interoperability as well as the adoption of common standards.

Technical standards take four main forms: they can be international or domestic, and they can be public or private.

Public standards developed by intergovernmental organisations can influence national policymaking both directly, when the government adopts standards such as CODEX, and indirectly, through the standards development process. A national standards body either adopts standards developed by international bodies such as the International Organization for Standardization (ISO) or develops domestic standards using a formal process involving explicit communication and negotiation to reach agreement.

Private standards do not have a standard development path, but proprietary standards are generally developed through unilateral action. Some – like Bluetooth – involve a hybrid approach with both communication and unilateral commitment.

It is important to distinguish technical standards from the legal thresholds established by regulations (Table). Standards are generally voluntary unless they are incorporated directly into regulations or indirectly by reference.

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8   The International Organization for Standardization (ISO) definition is: 'A standard is a document that provides requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose'. In the World Trade Organization (WTO) Technical Barriers to Trade (TBT) Agreement (Annex 1.1), standards are defined as a 'document approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for products or related processes and production methods, with which compliance is not mandatory. It may also include or deal exclusively with terminology, symbols, packaging, marking or labelling requirements as they apply to a product, process or production method.'

Table 1.1. Regulations and Standards

Regulation/Standard	Developed by public agencies	Privately developed
Mandatory regulations	Public regulations, e.g. the Building Code	Co-regulation, i.e. legally mandated privately developed rules and standards
Voluntary standards	Public standards developed by national standards bodies or international organisations	Private standards, e.g. Bluetooth or Fair Trade

Source: Author.

3.2. Why are standards important?

Standards can be a double-edged sword. They can be hugely beneficial by reducing switching costs to consumers and enabling producers to achieve economies of scale. As Swann (2010: i) observed:

> Several detailed econometric studies have established a clear connection at a macroeconomic level between standardisation in the economy, productivity growth and overall economic growth… Estimates vary somewhat from study to study, but overall, the growth of the standards catalogue over recent years may account for between one eighth and one quarter of productivity growth over the period.

The benefits of standards extend beyond cost savings and productivity gains to include building competencies, reducing barriers to entry, building network effects, and increasing trust between trading partners (Swann, 2020).

However, standards can have a downside if they are not set well,[9] particularly if they are derived with a specific technology in mind. Standards development is often very path dependent (e.g. VHR vs Betamax videos, Phillips vs Robertson flathead screws). The potential for lock-in is particularly high with the use of proprietary solutions based on one technology or business model.

Private standards, even though they are voluntary, can have similar effects to non-tariff measures introduced by governments in creating non-tariff barriers. Research in the food sector commissioned by the Asia-Pacific Economic Cooperation (APEC) Business Advisory Council (2016: 66–7) discussed how private standards mimic non-tariff measures introduced by regulation. For example, the requirement by some businesses for standardised package sizes for fresh fruit precluded trade in pineapples.

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[9]   Swann's (2010: i) survey of standards concluded that, while standards are often prompted by exports and imports, the exception was for 'standards concerned with Sanitary and Phyto-Sanitary factors (e.g. food safety), however, the pattern is different: here standards are more likely to block imports'.

Becoming compliant with a standard's infrastructure involves costs. These are generally low, but are mainly fixed costs. This can pose a particular barrier to small businesses, as the costs tend to constitute a higher proportion of their budgets than for larger companies.

Recent world economic history provides two examples of transformational change brought about by standardisation: barcodes and container sizes. These are discussed in more detail in Appendix 4.

3.3. Barcodes had significant direct and indirect effects

Since the 1960s, the introduction of barcodes and associated data standards have affected labour productivity in two ways:
- They increased labour productivity by accelerating throughput – an improvement in labour productivity.
- They generated labour cost savings through a combination of automation, eliminating tasks, reducing errors, and removing duplication.

Barcodes' transformational change involved more than cost reductions, as they profoundly affected the supply and logistics sector and enabled the growth of market research through improved visibility of consumer behaviour.

3.4. Containerisation – the long road to international standardised sizes

The use of containers started in the 19th century and developed slowly thereafter, but the breakthrough came in 1956 with the introduction of standardised containers. Containers provided more than just a better means of shipping goods from one port to another – they transformed the whole logistics chain from factory to destination. The growth in containerisation led to dramatic reductions in transport costs, which transformed production through allowing global value chains. Containerisation is one of the major drivers of globalisation, and the impact of international standardised containers was more important for the growth of world trade since World War II than successive rounds of tariff reductions (Levinson, 2006).

3.5. Global Data standards

In the digital space, both public and private standards are important. While New Zealand has a significant high-tech sector (NZTech, 2016), it is largely a technology taker, so the relevant private standards are largely developed offshore. New Zealand has been active in contributing to the development of a number of global public digital standards, but is generally more of an adopter (and adapter) of public standards rather than an initiator.

Public global digital standards are dominated by the International Electrotechnical Commission (IEC), a network of national standards institutes that produces standards for a range of electrical, electronic, and related technologies. The IEC has more than 6,300 published standards-type documents. Amongst the many other public standard setting bodies related to ICT are the ISO,[10] the International Telecommunication Union, the Institute for Electrical and Electronics Engineers, the World Wide Web Consortium, and the Cloud Security Alliance.

Microsoft has more than 100 standards solely related to cloud-based computing, which includes a mix of global, regional, and national standards (Microsoft, n.d.). Shapiro and Varian (1998: 237) observed that 'there are hundreds of official standard setting bodies throughout the world... on top of these we have any number of unofficial groups...such as the thirty six groups operating under the auspices of the Association for Computing Machinery'.

There is also a plethora of competing private standards. ICT development is led from the private sector, and this has produced a wide array of both proprietary and open standards. Bluetooth is a classic example of an open standard. Apple is an example of an ecosystem of proprietary private standards.

The government has an important role to play in supporting the adoption of global data standards that can be readily adapted to a range of applications. In the case of the NZBN, it is based on the GS1 Global Location Number – a globally unique digital identifier that can potentially be linked in global supply chains. In the next section, we discuss the contribution of GS1 to the New Zealand economy.

3.6. GS1 – the contribution of a global digital standard architecture

GS1 is a key part of a global ecosystem of public and private standards, along with domain-specific regimes such as the International Standard Book Number (ISBN), GPS for geospatial data, and SWIFT in international finance.[11]

GS1 provides global data standards that can be applied to the global supply chain by regulators, public border agencies, exporters, logistics providers, wholesalers, retailers, and consumers. The aim is to have standards created by industry for industry, with GS1 acting to facilitate dialogue amongst business and technical experts. These standards are developed through a Global Standards Management Process, which is a community-based forum for businesses to work together and develop standards-based solutions (GS1, n.d.-a).

The New Zealand Institute of Economic Research (NZIER, 2019) identified a number of applications of GS1:

- E-commerce: GS1 data standards support e-commerce through the accurate representation of product characteristics such as specifications, location, and origin. For example, Amazon requires a unique product identifier known as a Global Trade Item Number (GTIN) to create new listings (Amazon, n.d.), while Google adopted the GTIN in 2015 (Google, n.d.).
- e-Invoicing: A joint 2018 study by the Australian Taxation Office and New Zealand Government estimated that e-invoicing using standards could result in cost savings for the Australian economy of A$28 billion over 10 years (Australian Taxation Office and New Zealand Business Number, 2018).
- Product compliance: A scoping study of electronic tracking of construction materials showed a reduction in the incidence and cost of non-compliance, saving the industry NZ$23 million annually (Dowdell, Page, and Curtis, 2017).
- Exporting: Automated information in the export supply chain using GS1 standards reduced manual entry errors, resulting in Australian meat exporters saving an estimated A$14 million each year (GS1, n.d.-c).[12]
- Traceability: GS1 data standards can be used to trace the origins of imported food. Some consumers are willing to pay more for traceable food compared with food that is not traceable. Koreans indicated that they were willing to pay 39% more for traceable imported beef products than for non-traceable products (Lee et al., 2011).

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[10] An example is the joint ISO/IEC 2015 standard on good corporate governance of information technology, which sets out six principles: responsibility, strategy, acquisition, performance, conformance, and human behaviour.

[11] Incoterms or International Commercial Terms, a series of predefined commercial terms published by the International Chamber of Commerce (ICC) relating to international commercial law, is another example of standardisation.

[12] https://www.gs1au.org/download/gs1au-case-study-Traceability-Meat.pdf/file

- Authenticity: standards can also be used to protect against counterfeiting (GS1, n.d.-b).
- Product recall: GS1 standards provide a platform for product recall.[13]

NZIER (2019) undertook a study of the impact of GS1, focusing on the effect of these data standards on labour costs and labour productivity with existing penetration of the wholesale and retail industries (non-traded sector). It found that the impact of the labour productivity gains of using the GS1 data standards had directly increased gross domestic product (GDP) by NZ$417 million or 0.15% annually. These estimates are a conservative indication of the contribution of GS1 to the New Zealand economy because it only focuses on the impacts of labour productivity. Additional contributions include:
- connectivity by making further connections easier
- credibility gains by having one source of truth – the source documents – for all accredited parties in the supply chain
- insights gained by generating more granular data to support better data analytics

While the 2019 study focused on a non-tradeable sector, a more recent NZIER study looked at deploying digital applications in the external trade sector (NZIER, 2020). Specifically, it looked at the costs and benefits of deploying digital trade products and processes based on TradeWindow – a proprietary software solution based on the GS1 digital architecture.

NZIER (2020: iv–v) found that digital trade products:

> have the potential to fundamentally change the supply chain for specific products by providing automated services that make it much easier and faster to trade legitimate products… We estimate that the benefits for all of APEC would be between $9 billion and $18 billion over 10 years. To put this into context, New Zealand's annual export trade is about $61.5 billion. Benefits of this size suggest that pursuing digital trading initiatives should be made a priority.

Other studies cited by NZIER (2019) found significant gains from the application of GS1. GS1 conducted a pilot project to streamline beef exports from Australia to the United States, and the results of this case study showed that the use of GS1 standards led to significant cost savings and greater visibility in the supply chain, from 43% to 93% (GS1 n.d.-c).

Similarly, APEC (2017) found that the GS1 global data standards increased visibility in the supply chain for commodity exporters to 100%. The benefits of improved visibility included:
- cost savings from a reduction in the time searching for information
- a 20%–50% reduction in the time spent approving loading of cargo
- the elimination of delays approving the release of cargo on arrival due to incomplete or inconsistent provision of information
- overall reduction in fruit spoilage due to delays in exporting

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[13] The GS1 classification code GPC is used in the OECD Global Portal on Product Recalls as a mandatory attribute (OECD, n.d.).

- improved compliance
- improved cold supply chain integrity
- improved detection of fraudulent information
- accelerated delivery times

The value of using end-to-end supply visibility technology is highlighted by Elphick-Darling et al. (2017). In that study, pilot projects were conducted on the adoption of GS1 global data standards in Australia to identify and share information on various activities of the supply chain, including freight pick-up, storage and locations, traffic congestion, and other delays. The results of the study showed that the benefits in terms of efficiency, visibility, and innovation to the various actors of the supply chain (manufacturers, producers, and traders) justified the adoption of a strategy to implement these standards more widely.

Several multi-country initiatives are under way to promote the adoption of international standards: the European Union (EU) Strategy on Standardisation (European Commission, 2022) and the International Chamber of Commerce (ICC) Digital Standards Initiative (ICC, n.d.). The ICC Digital Standards Initiative aims to address the fragmentation in current attempts to digitise the global trading system by mapping out what standards already exist (and how they coexist), explore how they can best be leveraged to help drive wider adoption, and create new frameworks to unify digital trade processes.

3.7. Are global standards the next big thing?

Container sizes and barcodes, discussed in Appendix 4, both provide historical examples of how standardisation generated significant, indeed transformational, change. These examples highlight the potential for further transformational change from the widespread adoption of global standards generally. The discussion of GS1 standards highlighted the significant impact on both tradeable and non-tradeable sectors from more widespread adoption of global data standards. Government has a crucial supporting role to play by proactively supporting common standards and not acting alone by developing bespoke stand-alone regimes for public data services or regulations.

History also teaches us that the standardisation process faces considerable obstacles. For example, the discussion in Appendix 4 highlights how standardising container sizes was highly path dependent and how switching costs were a major obstacle. While major network effects and spillover benefits were achieved, these were often dissipated rather than concentrated on the actors that faced the switching costs. The containerisation case also highlights the crucial supporting role that the government must play if the potential of standards is to be realised.

Establishing a single dominant standard is far harder in an established domain, which often has multiple and overlapping standards, and much easier in a greenfield domain such as Bluetooth wireless communication, which starts with a clean slate. Once standards are established, switching costs are higher and vested interests (including accreditation and certification agencies) have an interest in the continuation of competing standards. History provides numerous examples of 'standards wars' in which technically inferior standards end up dominating standards with superior performance – such as QWERTY over Dvorak keyboards, VHS over Betamax video format, and Phillips over Robertson screw heads.

Providing an official public standard is not enough to overturn existing private standards. For example, in the case of organics in New Zealand, there were two competing private standards as well as a government regulatory threshold. The introduction of an official public standard merely resulted in creating a fourth competing standard and essentially had no impact on the continued use of the existing private standards.[14]

Shapiro and Varian's seminal *Information Rules* (Shapiro and Varian, 1998) discussed how, in general, in the face of competing standards, collective switching costs and network effects are critical in determining which standard emerges as the winner from 'standards wars'. Collective switching costs refer to the cost to all players in migrating from one platform and standard to another. Network effects refer to any situation in which the value of a product, service, or platform depends on the number of buyers, sellers, or users who leverage it. These effects are illustrated by Metcalf's law, which states that a network's value is proportional to the square of the number of nodes in the network.

While Shapiro and Varian (1998) focused on private actors, the state has a particularly important role to play in the response to these network effects. The history of regulation is replete with examples of the state's failure in 'picking winners' from competing standards. However, the state has a particularly important role to play as a 'fast follower' or 'standard bearer', where regulatory approvals such as safety checks and customs clearance are an integral part of value chains. The relevant regulatory agencies need to take an active role as members of the network, as such regulatory approvals are an integral part of the trail of trusted documents.

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[14] New Zealand has two private organic standards: BioGro (a home grown standard) and AsureQuality (based on the Ministry of Primary Industry Technical Rules and GLOBALG.A.P.). In addition, the Ministry of Primary Industry has Technical Rules that regulate the export of organics. A public standard (NZS 8410) was developed for organics in New Zealand, but it has failed to displace the competing private standards or gain international acceptance (equivalence).

4. Key Themes – What Can We Conclude?

In advanced economies with high digital uptake, such as New Zealand (and Australia), digital technology is highly dispersed and virtually ubiquitous, so it is hard to distinguish digital government from the rest of government or differentiate the digital economy from the broader economy. The joint Australian and New Zealand Productivity Commission study observed that 'the digital economy is the economy' (Australian Productivity Commission and New Zealand Productivity Commission, 2019: 1), and one respondent commented that 'digital is everything and it is nothing – it is hard to unpack'.

In this chapter, we narrow down our study by using three case studies of newly developed digital platforms to explore the notion of government as a platform (O'Reilly, 2011). The NZBN provides a model example of how the government can play a key role by providing open platforms that anyone can build on. The business case recognises the spillover benefits accruing to all members of the network, which go far beyond the direct benefits to individual members. By requiring all public agencies to adopt the NZBN platform, the government is playing an important role in enabling the uptake of digital approaches. However, the other cases highlight the limitations of platforms where conflicting policy considerations meant that a platform was not freely available to all.

Turning to standards, we explore the role of global data standards. While domestic standards can be used to restrict competition and introduce non-tariff barriers to imports, these risks are lessened with global data standards, so they offer considerable potential. For a small open economy such as New Zealand, global standards are becoming increasingly important.

Studies of the impact of GS1, a global data standards architecture, on both non-tradeables and the trade sector in New Zealand show that while GS1 has yielded significant gains, considerable potential gains have yet to be realised.

GS1 is an interesting case because it is a particular type of public good – a club good that is non-rival but excludable. GS1 provides an excellent example of how a standards architecture has network effects – the more businesses adopt the architecture, the more valuable it is to everyone in the club. Metcalfe's law, which states that gains raise exponentially with increased uptake, highlights the potential opportunity. The state has a particularly important role to play as a standard bearer, where regulatory approvals such as safety checks and customs clearance are an integral part of value chains.

Looking across all the case studies, while the extent of openness to the wider public and transformational change varied across the platforms, three key cross-cutting themes emerged: the importance of bottom–up developments relative to top–down strategies, the impact on small business, and the impact of the coronavirus disease (COVID-19).

The first theme is the role of bottom–up emergent developments and initiatives. The formal top–down government digital strategies and lead institutions in central government played a limited role in driving the cases forward. Interestingly, more impetus came from government public administration reform – the so-called Better Public Services. This provided a kick-start for the bottom–up drive to deliver a range of new digital services. The New Zealand experience suggests that it is possible to achieve high rankings for digital government and the digital economy from bottom–up initiatives without significant contribution from top–down digital strategies.

The limited impact of government strategies is not unique to digital government in New Zealand. Government strategies often have a limited life and do not survive a change in government or even sometimes a change in minister. A review of New Zealand Government strategy documents conducted by the McGuinness Institute (2019) concluded that:
- they often failed to document lessons learnt from past strategies or from the wider public service
- assumptions were not well articulated
- a good structure sometimes masked bad strategy content
- a number of strategies read as though they reflected a decision and were then backfilled

The second cross-cutting theme is the impact on small business. The New Zealand economy is overwhelmingly composed of small businesses, with a limited number of medium-sized enterprises and relatively few large businesses by world standards. The challenges presented by COVID-19 revealed the digital skill and knowledge gaps in small and medium-sized enterprises (SMEs). The original research, which was the impetus for several of the cases, showed that the impact of regulatory compliance costs fell disproportionately on SMEs. However, achieving compliance with the requirement of a standard's infrastructure also involves costs. While these are generally low, they are mainly fixed costs, which poses a particular barrier to small businesses.

The third unexpected theme is the impact of COVID-19 on digital developments.[15] While much of New Zealand was free of COVID-19 for most of 2020–2022, the policy response to COVID-19 had a significant effect. COVID-19 presented an opportunity for business and government to accelerate moving services online and create new digital services. Of the three cases, COVID-19 provided a significant boost to Business Connect and slowed the development of beneficial ownership due to competing policy priorities, while the NZBN was already online when COVID-19 arrived. However, the NZBN provided valuable infrastructure for the provision of COVID-19 identifiers. New Zealand is not unusual in the impetus provided by COVID-19. McKinsey & Company (2020) suggested that the pandemic pushed digital transformation forward by at least 3 years.

5. Policy Implications – What are the Wider Implications and What is to be done?

In this chapter, we have used New Zealand case studies to explore the role of government in promoting the digital economy through the uptake of digital platforms and standards. Is there a sweet spot that is equivalent to the Goldilocks zone – neither too hot nor too cold – for digital platforms and standards?

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[15] For a review of the impact of COVID-19 on the development of digital government, see Lips and Eppel (2021) and New Zealand Government (2021a).

The platform cases suggest that the state can play an important but ultimately limited role in supporting the development of the digital economy. The discussion of standards highlighted the importance of the adoption of global standards rather than acting alone with stand-alone domestic standards. Cross-country standards initiatives – the EU Strategy on Standardisation and the ICC Digital Standards Initiative – provide a window of opportunity to expand the role of standards globally. In addition, the state has a crucial role to play in providing the overall legal framework to support the growth of the digital economy.

The NZBN provides an interesting case study of the use of government-mandated adoption of a platform, based on GS1's global data standards across the public sector. This is an interesting precedent for the wider adoption within the New Zealand Government of global data standards. For example, studies have suggested significant (15%–45%) cost savings from moving to paperless cross-border trading.[16] Achieving the potential benefits of moving to paperless cross-border trade will require full participation by all relevant public agencies, as regulatory approvals are a key part of the trail of trusted documents. It is important to emphasise that the government's main roles are to establish the overall legal framework and then to be a fast follower and standard bearer, contributing to the lead that others have taken rather than acting alone. This involves acting as a regulatory steward to ensure that a fit-for-purpose legal regime is in place.

Industry sources expressed frustration at government agencies for acting alone. Rather than seeking to build on existing standards architecture, government agencies tend to start from scratch on the assumption that relevant standards do not exist. Leveraging existing digital infrastructure enables network effects to be realised and locked in. In addition, New Zealand is largely a technology taker and standard adopter, not a technology maker and standard initiator. Therefore, rather than acting alone, it needs to use international standards where possible to increase potential network effects.

The government has the power to pick winners, and this gives it influence over outcomes associated with digital government. However, just because the government can select a particular platform or standard does not automatically mean that the government will be good at comparing options and understanding market trends. Historical examples of the difficulty of picking winners include the New Zealand Government's failed attempt to apply the New Zealand E-government Interoperability Framework (NZ e-GIF 2008), which had a short 2-year shelf life, and the failure of the government interoperability standard (GOSIP)[17] when the private sector was rapidly innovating with new desktop software such as email, spreadsheets, and word processing.

In response, governments interested in the potential of digital government can equip themselves with two sources of sectoral knowledge. Firstly, governments need a quality trusting relationship with business leaders at the forefront of standards and platforms so that they have access to the latest trends and emerging themes. This access to emerging areas of interest is particularly important in the high-tech sector, where new platforms or technologies can disrupt and displace others.

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[16] Estimates range from 15% to 45%, depending on the implementation stage a country has reached (UNESCAP, 2014; UNCTAD, 2020; WTO, 2015).

[17]   The Government Open Systems Interconnection Profile was a technical standard for open networking products used by governments in the late 1980s and early 1990s. In practice, it went out of use, apart from the odd specialised security application, with the arrival of the internet.

Secondly, access to private sector knowledge needs to be balanced by having the capability within the bureaucracy to act as an independent and impartial interpreter. Currently, that capability is spread across a number of different agencies with four distinct roles: the Government Chief Digital Officer, Government Chief Data Steward, Government Chief Information Security Officer, and Government Chief Privacy Officer.

The New Zealand experience also emphasises the importance of bottom–up initiatives in securing potential gains from adopting digital technologies. That is not to say that top–down initiatives are not important. Digital strategies are useful for lending legitimacy and support to digital government initiatives through general direction setting and articulating a shared narrative. More importantly, top–down initiatives can be required to provide some of the prerequisites needed to achieve the full potential of digital technology. These initiatives need to focus where there are significant network effects and credible private solutions are not readily available. Electronic Identity (E-ID) is a good example of such a prerequisite, as there are significant network effects but the market for identity solutions is fragmented, with many competing technologies being used. The NZBN provides an example of a platform that meets that prerequisite by providing a single accepted form of standardised digital identity for corporate entities.

This research has focused on platforms and standards. That is not to say that the government is limited to a supporting role in the wider digital space. The joint Productivity Commissions' 2019 report highlighted a wide range of policy issues where the government must take a lead, including consumer protection, competition policy, taxation, and cybersecurity. Digital exclusion – lacking the capability, opportunity, and motivation to use the internet to realise meaningful benefits – also needs to be addressed.

To achieve the potential offered by digital approaches for enhanced international integration, many public policy issues need to be resolved. Small countries cannot afford to act alone, as any domestic requirements need to be nested in wider international agreements. The Digital Economy Partnership Agreement is a new type of trade agreement with a series of modules open to all countries. It is intended to assist in the development of an international architecture for digital trade.[18] The agreement includes Singapore, New Zealand, and Chile, while several other countries (including Korea, Canada, and most recently China) have also asked to join.

A number of features of the digital domain make designing robust public interventions difficult, including the speed of technological development, the presence of competing and often proprietary standards, privacy (including data disaggregation), and competing data realms (the United States, the EU, and great firewall of China) (Aaronson and Leblond, 2018). Digital developments are not unambiguously positive, as victims of cybercrime and cyberbullying can attest. Appendix 3 discusses how the success of the New Zealand Companies Office in harnessing information technology to transform the company registration process made New Zealand an attractive destination for money from criminal and other illicit sources. As Holt (2017) commented in the context of big data, 'embrace it but proceed with caution'. Working in the digital space is particularly challenging for government, which tends to be slower, less agile, and more risk-averse that private sector ICT companies in the industry.

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[18] See Asian Trade Centre (2020).

Looking at digital government more broadly, the state still has an important role to play through general policy settings (Australian Productivity Commission and New Zealand Productivity Commission, 2019: 29). Specific digital interventions include:

- enabling – providing regulatory regimes to support the growth of the digital economy, such as the EU's Data Act
- fostering – open government and the use of global data standards
- leading by example – using procurement and regulatory process to encourage the adoption of global standards
- aligning – international standards and conformance infrastructure and consumer protection rules
- including – reducing the digital divide by promoting digital access, affordability, and ability
- building capability – encouraging ongoing skill acquisition and supporting life-long learning
- protecting – data privacy (including right to forget)
- securing – promoting a resilient infrastructure
- learning – funding research and communities of practice
- clarifying – demystifying by countering mis- and dis-information[19]

In undertaking these roles, careful policy scrutiny will be required to ensure that the proposed public policy intervention addresses a genuine public policy problem – a market failure, externality, or public good problem – not merely imposing a public policy intervention that displaces private initiatives. In a domain as dynamic as digital economy, the risk of government failure is as real as market failure risk.

6. Conclusion

This chapter has explored the role of the New Zealand Government in promoting the digital economy through the uptake of digital platforms and standards. It used three short case studies of new government digital services along with an analysis of the impact of GS1 global data standards. The cases studies highlight the important role that bottom–up emergent developments and digital initiatives can play in attaining high levels of digital government performance. However, achieving the full potential of digital technology requires complimentary top–down initiatives, such as a single accepted form of standardised digital identity.

The analysis suggests that, while the government's role is constrained in the platforms and standards space, the state has a crucial supporting role if the potential of the digital economy is to be realised. The discussion of standards brings out the importance of not acting alone or picking winners, but the government proactively adopting and promoting the use of global data standards backed by a regulatory regime to support the growth of the digital economy. The government has adopted this general fast follower approach in the case of cloud computing, with its 'cloud first' policy (New Zealand Government, 2016).

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[19] In New Zealand's case, this includes funding public interest journalism (NZ On Air, n.d.).

The New Zealand Government does not appear to have a sustained focus on the potential role of global data standards and global standards more generally. The approach to digital government has focused on technical standards such as web access to support the Government Enterprise Architecture (part of the Government Chief Digital Officer's mandate) rather than the digital transformation of New Zealand (for which the mandate lies with the Ministry of Business, Innovation & Employment (MBIE)). Global data standards could fall under the Digital Strategy for Aotearoa. The final strategy has no sustained discussion of data standards and one passing mention of ISO standards (New Zealand Government, 2022b). While the issue of global data standards and standards generally is on the radar of the MBIE officials involved, no substantive policy analysis or work is under way (in 2022) to address the issue and move it forward.

COVID-19 had a mixed impact on digital developments, slowing one case down and speeding up another, but the digital platforms in place proved very useful in responding to COVID-19 and have accelerated interest in paperless trading based on global data standards.

While much has been achieved from applying digital technologies to government services in New Zealand, these improvements have been patchy and often incremental rather than transformative. In the platforms and standards space, the government's main role has been as a fast follower, not a leader. This approach requires actively tracking and building on the lead that others have taken rather than acting alone or proactively picking winners. An active supportive role will be critical in achieving network effects and accelerating important initiatives such as paperless cross-border trade.

This chapter has explored the proposition that the role of global data standards in the 21st century is similar to the role that standardised barcodes and container sizes played in the late 20th century. The key challenge in the digital platforms and standards space is for government to find a sweet spot that is the equivalent of the Goldilocks zone – neither too hot nor too cold. In summary, the key lesson for other countries from New Zealand's experience with digital platforms and standards is the sweet spot where the government acts as a standard bearer – establishing the overall regulatory regime and then acting as an agile fast follower but not the leader getting out in front or acting alone.

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Appendix 1:
New Zealand Business Number – a critical piece of the digital architecture

The New Zealand Business Number (NZBN) provides a good example of government as a platform – where the state provides a trusted digital infrastructure platform that enterprises can leverage to make business processes more effective. The NZBN has been created to enable improved electronic delivery of services by providing a trusted platform that is available to all New Zealand businesses and provides access to core commonly used business information such as the business name, phone number, address, and website. Participation by businesses is voluntary, so they opt in to using the NZBN as a register.

It was introduced in 2016 and is a globally unique 13-digit identifier that covers all New Zealand businesses regardless of legal form, so it includes companies, sole traders, and nongovernment organisations, as well as government agencies. Figure A1.1 illustrates the NZBN journey. The NZBN is based on the GS1 system, using a Global Location Number which links to international standards and supply chain logistics. The website and application programming interfaces (APIs) can supply trusted business data such as the legal and trading name, contact details, and (optionally) industry classification and goods and services tax (GST) number. In early 2022, the NZBN register included nearly 700,000 companies and 140,000 unincorporated entities.

The infrastructure to allow the sharing of core information has been in place for over 7 years, as shown in the Figure, and the understanding of the value proposition has evolved over that time. The original NZBN business case focused on the benefits of fewer duplicated transactions when registering an entity or updating primary business data. Using a central register was estimated to create annual savings of NZ$60 million for businesses. Subsequent programme updates as part of the 2017 budget process highlighted that the network effects to all government agencies and businesses from the NZBN were far more significant than the savings identified in the original business case. This was because of the scope to use the NZBN to improve business processes and introduce new services (MBIE, 2017).

Figure A1.1. **NZBN – The Journey from Concept to Trusted Valuable Platform**
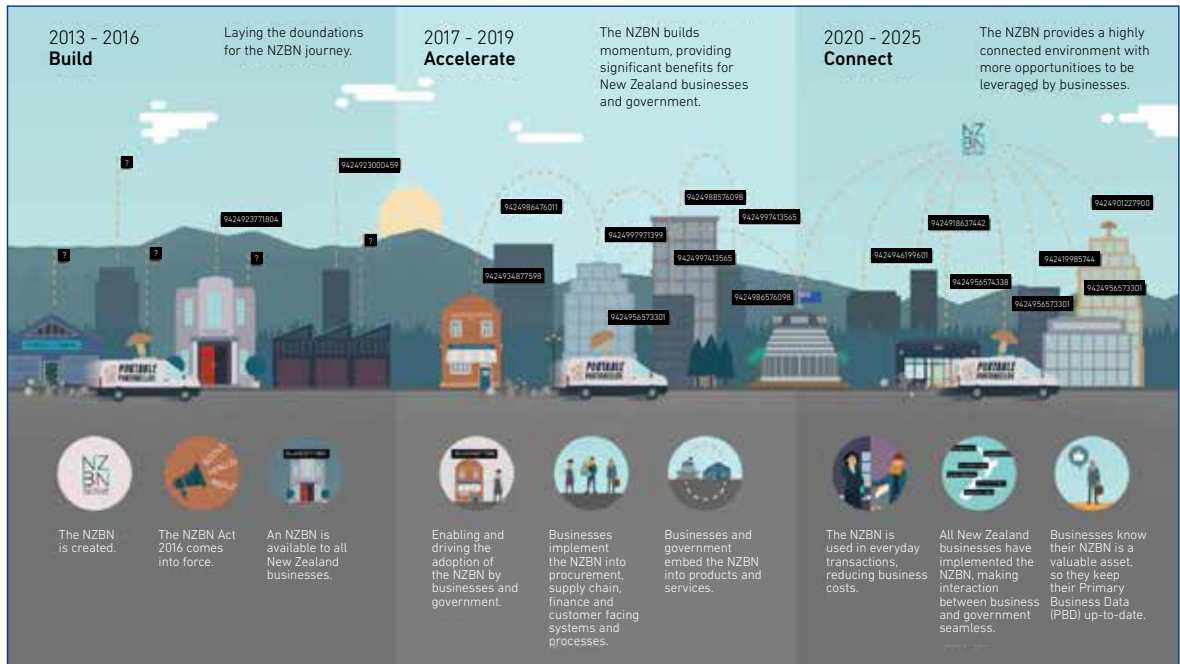
NZBN = New Zealand Business Number.

Source: New Zealand Ministry of Business, Innovation & Employment.

The central government has committed itself to fully using the NZBN in its day-to-day transactions with business. A formal whole-of-government direction was approved that binds arm's-length central government bodies as well as departments of state. All public agencies are required to prioritise implementing electronic systems over paper-based systems, including the use of APIs, and any new or replacement systems must be fully compliant with the NZBN system. That includes an agency's systems being able to identify a counterpart entity's NZBN (without requiring an additional identifier), and the public entity's NZBN must be included in any outward written communications (New Zealand Cabinet Office, 2018).

For businesses, the NZBN offers free access to a trusted repository of curated business information that is integrated into the wider GS1 ecosystem. An information updating service is provided via email alerts or APIs so that changes in core information can be updated on their systems. The trusted information provided through APIs enables organisations to automate the import of the updated data directly into their systems and process it with consequential savings, reduced risk, and great accuracy.

The NZBN ecosystem is being enlarged, so core information is extended to include sub-entity geospatial data. Using the NZBN Organisation Parts, business can assign identifiers to different physical locations (such as depot delivery addresses) or organisational components parts (branches or departments). This enables messages and physical transactions to be directed to the right place.

'The NZBN allows the New Zealand economy to adopt game-changing automation such as universal electronic invoicing' (New Zealand Government, 2019: 36). It also underpins new services such as Business Connect (Appendix 2). An unexpected use came with New Zealand's response to the coronavirus disease (COVID-19). The NZBN provides the platform for the QR codes used on posters to enable New Zealanders to sign into locations and enable contact tracing using the NZ COVID Tracer app.

The impetus for the creation of the platform came from the previous administration's Better Public Services programme, 2012–2017 (New Zealand Government, 2012). Better for Business (Result 9) targeted a 25% reduction in the cost to businesses of dealing with the government by 2017. Creating the NZBN required the commitment of both funding and legal backing. The New Zealand Business Number Act took effect in 2016 and initially applied to companies. Funding became available as part of the Better Public Services programme.

Looking ahead, challenges remain, including:
- expanding the coverage of unincorporated traders in the NZBN, as not all small businesses are on the register;
- ensuring all the data fields are complete or shareable through the APIs; and
- increasing awareness of the NZBN, as this is much higher for government transactions than for enabling business-to-business transactions.

Appendix 2:
Business Connect – a joined-up government-to-business platform

The Business Connect initiative builds on the foundation provided by the New Zealand Business Number (NZBN). It is developing a digital platform that aims to transform the way firms apply for regulatory permissions to operate (licences, permits, and other approvals), and spans both central and local government. It has a user-centric design philosophy focusing on 'putting business in charge of its information' by 'bringing all related regulatory processes into one place'.[1]

Like the NZBN case, the impetus for the platform came from the previous administration's target to reduce the cost to businesses of dealing with the government, as part of the Better Public Services programme. Research conducted by the New Zealand Institute of Economic Research (NZIER, 2015) found that the administrative costs of complying with regulatory and tax requirements were around NZ$5 billion or 2.4% of gross domestic product (GDP). Follow-up qualitative research focused on identifying businesses' 'pain points' to be addressed.

The proof-of-concept pilot projects started in 2019 and focus on the hospitality sector (liquor and food licences) and subsequently exporting (customs deferred payment). The trials found that considerable productivity gains were possible (up to 90% reductions in compliance costs) while improving the accuracy of the information reported. This is because licence renewals were pre-populated with data from the previous applications, eliminating the need for repeated data entry.

The second wave of the coronavirus disease (COVID-19) in New Zealand in 2020, which was limited to Auckland, provided an opportunity to demonstrate the platform's capabilities. Staff were able to spin up a system for producing business travel permits for businesses wishing to cross the new internal border around Auckland.

In 2020, the programme was able to secure ongoing baseline funding to underpin the programme and scale up to full production. The platform was aligned with an election manifesto commitment to reduce compliance costs for small business.

With funding secured and looking ahead, the next phase focuses on the transitions from proof of concept to scaling up the platform. Priority areas for development include international trade, hospitality, and business administration, along with building consents.

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[1]   See Eppel (2019) for a summary of a similar 'life events' approach that focuses on putting all public information together for key transitions such as birth, marriage, and death.

Interlocutors highlighted a number of challenges:

- Funding: The Better Public Services programme provided the mandate but without funding, so finances had to be secured from other sources. The Government Chief Digital Officer funded the original proof-of-concept pilot project, but other one-off sources had to be located to keep the programme running.
- Mandate: The Better Public Services programme, and subsequently an election manifesto, provided a broad political mandate. Interestingly, the wider digital government strategy provided a limited role in the development of the platform beyond funding the original proof-of-concept pilot project.
- Organisational buy-in: It was difficult to get agencies to engage in the programme despite the broad mandate. Agencies were reluctant to take part in a platform that 'was not invented here' as it was perceived as ceding control.

Appendix 3:
Beneficial Ownership – an enforcement tool to follow the money

New Zealand has been an early adopter of digitisation in the government business services space. For example, the Intellectual Property Office is fully digitised, and the Companies Office was the first in the world to make company registration fully online. However, the ease of registration had a downside as it is attractive to both legitimate and illegitimate businesses. For the latter, there is currently limited visibility in New Zealand of individuals who ultimately own or control companies and limited partnerships.

There are a number of reasons why people might not want the effective owners of businesses to be known, and many of these are not good reasons. Criminals use the opacity of corporate vehicles to hide their identity and to hide the proceeds of crime such as money laundering, bribery, and corruption. It is also a vehicle for tax avoidance purposes and potentially for the financing of terrorism.

The Financial Action Task Force, an international body that sets standards for anti-money laundering and combatting the financing of terrorism, has issued guidance for countries on beneficial ownership. These include that details about persons and legal arrangements should be sufficiently transparent, and that accurate and up-to-date basic and beneficial ownership information is readily available to the relevant public enforcement agencies. A Financial Action Task Force review of New Zealand conducted in 2020[2] was critical of the lack of ownership disclosure of beneficial corporate entities.

Following three rounds of public consultation starting in 2018, in December 2021, the cabinet decided to establish a unique identifier for individuals who are beneficial owners, directors, and general partners and to require companies and limited partnerships to disclose details of their beneficial owners to the Companies Office:

> Companies and limited partnerships [are] to provide information on their beneficial owners, which the Registrar will hold on a database. Some of this information – such as the individual's name – will be made publicly available on the companies and limited partnerships registers. Other more sensitive details – such as date of birth and residential address – will not, but will be made available under certain conditions to certain government agencies and anti-money laundering reporting entities (New Zealand Government, 2022a: 1).

Information is currently made available on corporate office holders, but cross holdings or unique identity are difficult to establish. The creation of a unique digital identifier in a registry of corporate role-holder identifiers has a number of advantages. It will be easier for businesses to undertake due diligence on other entities, reducing risks to creditors from phoenix companies, for example. It will also assist enforcement agencies to detect potential unlawful activities.

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[2]   https://www.fatf-gafi.org/en/publications/Mutualevaluations/Mer-new-zealand-2021.html

The next stage in the process is the release an exposure draft of the Bill for consultation, planned for 2023. The go-live date for the reforms will depend on when Parliament passes the legislation.

Several key points emerge from this case study:
- Actions have indirect consequences: New Zealand ranks first in the world on the ease of doing business, but this has made New Zealand attractive to illegitimate businesses as well as legitimate ones.
- Improved openness raises issues of privacy: While information on beneficial owners will be made available to enforcement agencies, only very limited information will be publicly available. Indeed, the Privacy Commissioner opposed any inclusion of beneficial owners' information on the companies and limited partnerships registers (but not the creation of unique identifiers).
- Elapsed time: Lack of information about beneficial ownership and difficulties with identifying office holders have long been recognised by key policy advisers. This has not been held back by any technical issues associated with designing the platforms required – the key challenge has been getting and keeping this development on the busy policy agenda and (with more than one budget bid failing) sourcing appropriate funding for the not insignificant establishment costs ($7.8 million). Unlike other cases in this chapter, in this case, the coronavirus disease (COVID-19) has slowed development.
- Priority and resourcing: Getting this development over the line and ready for execution will require two scarce things – sitting time in the legislature to consider legal amendments and operation funding to support the function over its life.

Appendix 4:
Global standards – the role of bar codes and containerisation

What is a standard?

In this appendix, we discuss technical standards,[1] by which we mean published documents setting out technical specifications for products, systems, or services that are typically backed by systematic testing. It is important to distinguish standardisation from the broader and vaguer concept of harmonisation, which includes interoperability as well as the adoption of common standards. The use of standards involves an agreement to do things in the same way, normally based on a written standard that has gone through a standards development process and backed by a conformance infrastructure of testing by accredited agencies.

Technical standards take four main forms: they can be international or domestic, and they can be public or private. Standards developed by intergovernmental organisations can influence national policymaking, both directly when the government adopts standards such as CODEX or indirectly through the standards development process. The national standards body either adopts standards developed by international bodies like the International Organization for Standardization (ISO) or develops domestic standards using a formal process involving explicit communication and negotiation to reach agreement. Private standards do not have a standard development path, but proprietary standards are generally developed by unilateral action. Some – like Bluetooth – involve a hybrid approach with both communications and unilateral commitment.[2]

Standards are diverse, as they can focus on physical attributes such as container and pallet sizes or intangible attributes such as sustainability, labour conditions, ethical treatment, or organic production. There are four main types of standards:
*   Proprietary standards (business to business (B2B) or business to consumer (B2C)) – typically private standards – where one firm seeks market dominance by developing incompatible technologies, both tangible and intangible (e.g. Apple vs Android).
*   Physical tangible attributes (B2B) – public and private standards that reduce common costs (e.g. pallet or container sizes).

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[1] The International Organization for Standardization (ISO) definition is: 'A standard is a document that provides requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose'. https://www.iso.org/deliverables-all.html#IS
In the World Trade Organization (WTO) Technical Barriers to Trade (TBT) Agreement (Annex 1.1), standards are defined as a 'document approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for products or related processes and production methods, with which compliance is not mandatory. It may also include or deal exclusively with terminology, symbols, packaging, marking or labelling requirements as they apply to a product, process or production method'.

[2] An ongoing unresolved debate is under way within the WTO about how private standards fit within the WTO system and whether private standards are covered. The debate has been ongoing since Saint Vincent and the Grenadines raised the issue of private standards at the WTO Committee on Sanitary and Phytosanitary Measures in 2005. See the discussion in McDaniels and Wijkström (2013).

- Value chain integration (B2B) – public and private standards that combine both tangible and intangible attributes (e.g. GS1).
- Intangible credence goods (B2C) – free range eggs, organics which can be private or public standards.

Recent world economic history provides two examples of transformational change brought about by standardisation: barcodes and container sizes.

Barcodes had significant direct and indirect effects

Since the 1960s, the introduction of barcodes and associated data standards have affected labour productivity in two ways:
- They increased labour productivity by accelerating worker throughput – an improvement in labour productivity.
- They generated labour cost savings from a combination of automation, eliminating tasks, reducing errors, and removing duplication.

Basker (2011) found that the introduction of barcode scanners to automate supermarket checkout systems from 1972 to 1982 raised a store's labour productivity by 4.5% on average, following the first few years of adoption.

The barcode's transformational change involves more than cost reductions.[3] Ellickson (2016) found that the scanner also supported four additional effects:
- An increase in the number of products sold in supermarkets from 9,000 to 30,000.
- An increase in the number of products sold per worker and the number of products per metre of shop floor space.
- An increase in market research capabilities through the improved visibility of consumer behaviour.
- An expansion of the supply and logistics sector and associated technologies to manage the coordination and delivery of an increased product range.

Containerisation – the long road to international standardised sizes

The use of containers started in the 19th century and developed slowly thereafter, so it was not a new idea that shipping goods in containers was a significant improvement on the traditional break bulk system of individual items being loaded onto and stowed on ships. The breakthrough came in 1956 with the introduction of standardised containers by American entrepreneur Malcolm McLean. McLean ran a trucking business, and his big idea was that containers provided more than just a better means of shipping goods from one port to another. Containers could be intermodal and transported by truck and train as well as ship, so they could transform the whole logistics chain from factory to destination. The growth in containerisation led to dramatic reductions in transport costs, which transformed production by allowing global value chains.

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[3] See also BBC (n.d.).

While the precise impact of containerisation on shipping costs is difficult to assess, it is generally accepted that containerisation is one of the major drivers of globalisation and the impact of international standardised containers was more important for the growth of world trade since World War II than successive rounds of tariff reductions (Levinson, 2006).

While obvious in hindsight, the task of developing a common standard involved a tortuous process that lasted nearly a decade. As there are incumbent firms with existing processes, the details adopted as part of a common standard would benefit some firms over others. The container size and design selected had fundamental implications for the design of ships, cranes, and trucks. The history of developing standardised container sizes and specifications involved parallel processes dominated by competing interests. Three competing processes were established in the United States after 1958 to develop standards for containers, culminating in a common standard being adopted by the ISO in 1966.

Levinson (2006: 149) concluded that:

in hindsight the process (of standards development) can be faulted in every particular. It led to corner fittings that were too weak and needed redesign. Several newly approved container sizes were uneconomic and were soon abandoned … No one would declare all of the subcommittees and task forces had come up with an optimal solution. Yet after 1966 compromise were reached on issue after issue a fundamental change would be seen in the shipping world. The plethora of shapes and sizes that had blocked the development of containerisation gave way to standard sizes approved internationally.