3

Data collection and harmonisation

ICT and data collection—the importance of data collection to the development of smart infrastructure

3.1 The key to smart infrastructure is data. In its submission, Engineers Australia asserted that 'data and its analysis are at the heart of smart infrastructure';[1] while Professor Bob Williamson, of NICTA, explained to the Committee that 'smart infrastructure relies upon data':

> If you cannot get your hands on the data then you cannot do anything with it. There are interventions that we believe a government can make to facilitate that access to data. We will argue why this itself is infrastructure in its own right. Opening up that data through a variety of things can enable a whole bunch of value added services.[2]

3.2 NICTA observed the connection between the collection and analysis of data and the creation of efficiencies in the planning, design and use of infrastructure. It stated that:

> … by collecting data from current infrastructure systems (such as transport networks) and building evidence-based data-driven models, infrastructure performance can be more effectively measured and operating inefficiencies identified. Medium-to-longer term large-scale planning decisions can now be made with far greater certainty.[3]

3.3 An example of this was city road networks. NICTA explained:

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1 Engineers Australia, *Submission 25*, p. 5.

2 Professor Bob Williamson, Interim CEO, NICTA, *Committee Hansard*, 21 August 2015, p. 1.

3 NICTA, *Submission 23*, p. 9.

> Transport authorities typically collect a wide range of data from the road network, from real-time traffic volumes to incident management logs and public transport information. Currently, much of this data is not used in an integrated way. The core innovation of the NICTA system is a platform to integrate and fuse transport data from all current and future data sources and to incorporate this fused data into transport models built using the most advanced analytic techniques. This can then feed into operations, planning and traveller information services.
>
> International and local evidence shows that this kind of superior situational awareness in the transport system leads to shorter and more reliable travel times for private vehicles, buses and trucks. The City of Dublin used better information systems to reduce bus travel times by 10%, and by making Sydney's M4 motorway "smart" we predict 40% faster travel times.[4]

3.4 NICTA noted that:

> Smart ICT enables active demand management by accessing and presenting data needed to understand demand and the analysis to apply optimal demand shaping. It makes better use of existing data, and fuses new data sources. Machine learning and optimisation techniques—such as mathematical modelling, simulation, visualisation—provide predictive insights to highlight ways of improving operational efficiency, to uncover latent capacity in existing systems, and improve demand prediction to strengthen investment decisions.[5]

3.5 NICTA recommended that governments 'take all actions possible to encourage data creation and access for existing and new infrastructure'.[6]

3.6 Other evidence supported this view. Intel stated that 'the potential of the Internet of Things lies not in otherwise "dumb" objects being able to communicate to each other—it's about the data that is generated'. Intel noted that 'a great deal of the potential relates to what is referred to as the "circulatory value of data"':

> If businesses, start-ups and entrepreneurial individuals have access to data—in a way that protects privacy—the opportunities to develop a range of 'spin-off' services are vast. In fact, they are

4 NICTA, *Submission 23*, p. 11.

5 NICTA, *Submission 23*, p. 14.

6 NICTA, *Submission 23*, p. 14.

> difficult to be predicted with any accuracy given data can generate surprising insights.[7]

3.7 Independent Project Analysis observed that smart ICT played a critical role in measuring the effectiveness of infrastructure projects, including governance and outcomes. The key to this was data:

> By acquiring critical data and selected performance indicators at all project phases, inputs can be linked to outcomes and key lessons learned can be captured. Critical metrics and performance parameters can then be benchmarked against historical performance and industry Best Practices. Plans and actions can then be implemented to improve productivity and future project performance.[8]

3.8 The Australian Technology Network of Universities highlighted 'the growing importance of data analytics in moving towards a knowledge based economy'. It noted the work of the joint NICTA-RMIT Data Analytics Lab in 'applying text, user and data analytics research to industry-driven projects that solve problems and provide efficiencies in areas such as health, logistics, smart cities, environment and security':

> For example, big data plays a role in managing public spaces and services by tracking behaviour and information from personal mobile devices in areas such as shopping malls, airports, and universities. Smart ICT can be used to increase public transport efficiencies, with real-time passenger data being used to optimise links between buses, trains, and trams in smart cities.[9]

3.9 For Engineers Australia, the 'essence of "smart infrastructure" systems' was 'collecting information about the system's health and how it is operating and continuously using this information to improve the services the system provides … and to improve the adaptability and longevity of system assets'. Engineers Australia believed that 'what distinguishes smart infrastructure is that information, and lots of it, must be collected, analysed and fed back into system operations adding a new layer of complexity to infrastructure management and development'.[10]

3.10 Transport for NSW argued that 'infrastructure or asset information should be considered an asset in itself and can be managed more efficiently and effectively using smart ICT'. It stated that value would be achieved through 'the application of smart ICT across the whole asset life cycle,

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7 Intel, *Submission 42*, p. 5.

8 Independent Project Analysis, *Submission 11*, p. 2.

9 Australian Technology Network of Universities, *Submission 18*,p. 2.

10 Engineers Australia, *Submission 25*, p. 1.

from supporting decisions based on demand and need, to planning the right asset to build, building that asset and then operating and maintaining the asset'.[11]

3.11 The Department of Communications noted that 'integrated spatial data is a fundamental requirement for emerging ICT design, and government has a key role in the coordination of spatial data'.[12]

Open data and smart ICT—the need for data access

3.12 Given the importance of data to the development of smart infrastructure, the value of open data access—making datasets containing non-sensitive information publicly accessible, without restriction—was emphasised in much of the evidence presented to the Committee. As Professor Bob Williamson, of NICTA, explained:

> … smart infrastructure relies upon data. If you cannot get your hands on the data then you cannot do anything with it. There are interventions that we believe a government can make to facilitate that access to data … Opening up that data through a variety of things can enable a whole bunch of value added services.[13]

3.13 In its submission, Optimatics noted that researchers now have available to them 'the techniques to build innovative new simulation models, predictive analytics and integrated optimisation models but often don't have the required infrastructure data'. However, the inability to access data stifled innovation.

3.14 The Victorian Spatial Council highlighted the role of government as a 'significant creator and provider of the information which underpins Smart ICT', and therefore the role of government in authorising access to information. The Council urged that 'to improve the design and planning of new infrastructure, these information resources should be available within and beyond jurisdiction boundaries'. It noted that:

> One of the key characteristics of digital information is that individual datasets held by many agencies and collected for a particular purpose can be brought together and readily combined to support planning and decision making in other subject areas.

11 Transport for NSW, *Submission 33*, p. 18.

12 Department of Communications, *Submission 27*, p. 9.

13 Professor Bob Williamson, Interim CEO, NICTA, *Committee Hansard*, 21 August 2015, p. 1.

> Given appropriate planning and coordination, this can happen with significant saving of costs.[14]

3.15 NICTA used the National Map as an example of what could be achieved through open data access. 'Working for the Australian Department of Communications and working closely with partner Geoscience Australia', NICTA's Terria team developed the software for the National Map initiative, 'placing government spatial data, which was previously difficult to access, into the hands of community, software developers and industry'. NICTA noted that:

> This initiative is acting as a key enabler of innovation to boost government and industry productivity, prompting new business and providing better services to the community. The National Map website also acts as an incentive to government to release more data, in a searchable and reusable format, into the community. This platform saves departments reinventing the same tools and also allows the whole community to see a single view of all the infrastructure and resources in any location. The long-term productivity Benefits will be substantial.[15]

3.16 NICTA urged mandating 'the documentation and sharing of all relevant data', ensuring that 'learning from past projects is possible'. NICTA noted that data was often restricted by 'commercial-in-confidence' considerations, but argued that 'if the rule applies to all, and applies to public infrastructure, then all players are impacted (and benefited) equally'. [16]

3.17 Ms Judy Anderson, of IBM, observed that governments collect a lot of data that can be depersonalised and applied to innovation:

> There are various apps that can be developed that we often do not realise we need until we get them and which can be in the public domain and created by small companies or people in garages—that sort of thing.[17]

3.18 Dr Michael Dixon, of IBM, emphasised that making data openly available would encourage innovation. He stated:

> … people have a lot of time and appear from nowhere to make value of these things that we do not expect. The Europeans, particularly, seem to have an unquenchable thirst for data to make

14 Victorian Spatial Council, *Submission 6*, p. 3.

15 NICTA, *Submission 23*, p. 7.

16 NICTA, *Submission 23*, p. 8.

17 Ms Judy Anderson, Government and Regulatory Affairs Executive, IBM Australia and New Zealand, *Committee Hansard*, 25 September 2015, p. 47.

> use of, which people do not really expect. Amsterdam, Berlin and Ljubljana all now have groups of incredibly talented young people who have come together because they can get access to the kind of data that people like us would perhaps just say, 'It is data'. But they find gold amongst it. I think that is a really important element of data strategy.[18]

3.19 Dr Marc Miska, of the Queensland University of Technology, urged governments 'to make that data available. If that data is not available, you will have no brilliant mind out there actually trying to help you to utilise that data.'[19]

3.20 Governments supported the principle of open data. In its submission, the Department of Communications stated that the Australian Government 'is committed to pursuing open data', and that 'nearly 7,000 Commonwealth datasets are already available from the data.gov.au website'. The Department agreed that 'the more data is openly available, the more it can be used, reused, repurposed and built on in combination with other data':

> Innovation can occur when datasets are mashed up and the findings are analysed and/or visualised. In a knowledge-based economy, opening such datasets creates value and drives social and economic innovation, growth and development, including facilitating infrastructure planning and management. Private sector expertise can also extend the value of open government data for more effective ICT design.[20]

3.21 The Department was 'proposing to publish open datasets on new developments and the carriers serving them'. This would help 'new developers identify providers of infrastructure and providers coordinate their roll-out activities'.[21]

3.22 The Department of Communications believed that 'where Smart ICT is deployed in infrastructure projects, providers should be encouraged to collect and manage the resulting data in as open and re-useable a manner as possible'.[22] It argued that 'data should be made open by default, subject to privacy, national security and commercial confidentiality

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18 Dr Michael Dixon, General Manager, Smarter Cities, IBM Corporation, *Committee Hansard*, 25 September 2015, p. 48.

19 Dr Marc Miska, Senior Research Fellow, School of Civil Engineering and Built Environment, Smart Transport Research Centre, Queensland University of Technology, *Committee Hansard*, 24 September 2015, p. 9.

20 Department of Communications, *Submission 27*, p. 8.

21 Department of Communications, *Submission 27*, p. 8.

22 Department of Communications, *Submission 27.1*, p. 5,

considerations' and suggested that 'where specialised data requests require additional resources, consideration can be given to a nominal service fee to cover costs and the resulting data should be made publicly available'.[23]

3.23 The Queensland Department of Transport and Main Roads (TMR) noted that it had developed an 'Open Data Strategy which describes the process and type of data that is released on the Queensland Government's Open Data Portal', under which 'currently, 92% of the department's datasets are released, while the remaining eight per cent have been determined as not suitable for public release'. TMR 'assesses each of its datasets to determine whether or not it can be published as open data':

> As part of this process, data custodians are required to carry out data assessments to ensure customer privacy and commercially sensitive data are protected and only released in summary or de-identifiable formats. This assessment is then validated by the department's Legal and Ethical Standards unit and approved by the relevant Deputy Director-General.[24]

3.24 The City of Melbourne had a default policy of making data available. Its submission stated:

> The City of Melbourne promotes the adoption of smart ICT in a number of ways. We lead by example and we consciously 'showcase' municipal innovation. We proactively welcome partnerships in ICT related initiatives including with small and start-up businesses, and we actively disseminate and encourage the re-use of municipal data by adopting the guiding principles in their release and presentation with a focus upon accessibility and ease of use.[25]

3.25 Mr Austin Ley explained, however, that 'open data is not just about dumping everything you have got out there':

> That just overwhelms people and does not achieve the right results, and also they might interpret it in ways that are not appropriate, because the data is not clean and is not useful. It also means that you need to have information provided in a way that the people can rely on it and that you are clear about how often it is going to be available. If they set some sort of business up on that model and then the data is not available in the future, that business has the potential not to continue. So we need to make

23 Department of Communications, *Submission 27.1*, p. 8.

24 Department of Transport and Main Roads (Queensland), *Submission 45*, p. 7.

25 City of Melbourne, *Submission 35*, p. 9.

> sure we work in partnership with the community to make information available that is useful. That is the model that we are using at the moment, and I think it is particularly important that the data that we make available is maintained and has integrity.[26]

3.26 Dr Dean Economou, of NICTA, noted that while a lot of data was available, there was still a lot 'locked up for various reasons', and that across government, progress on opening data was 'quite variable'. He stated that:

> … anything government can do to encourage its own agencies, both state and federal, to open up the data is important. Part of that is enabling the agencies themselves to do it. Sometimes they do not have the skills, the budget or the equipment. They would like to do it, but they cannot. It may be that we need to make more money available to the agencies to make this happen.[27]

3.27 Dr Economou also noted that 'it is one thing to collect the data and say that it is open; it is another thing to make it very easy to find':

> There are ways of making it easy to find. You have seen our national map. That is a way of making geospatial data easy to find. In every aspect of the data that is relevant to infrastructure, we need to make it easy to find.[28]

3.28 In its submission, Urban Circus noted that while other forms of data was already being made available, 3-D geospatial data was not readily accessible. It noted that

> … advances in survey and mapping have accelerated to the point where accurate 3d information can be produced at modest costs. Whole cities and infrastructure corridors can be scanned in 3d. We would say 3d survey is becoming commoditized.
>
> However, governments often protect and encase this data in regulation and protection. Even the "open data" States like Queensland do not open their 3d geospatial data, such as 3d lidar or contours.[29]

3.29 Urban Circus recommended that the Australian Government:

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26 Mr Austin Ley, Acting Manager, Smart City Office, City Strategy and Place Group, City of Melbourne, *Committee Hansard*, 25 September 2015, p. 16.

27 Dr Dean Economou, Acting Director, Infrastructure, Transport and Logistics, NICTA, *Committee Hansard*, 21 August 2015, p. 2.

28 Dr Dean Economou, Acting Director, Infrastructure, Transport and Logistics, NICTA, *Committee Hansard*, 21 August 2015, pp. 1–2.

29 Urban Circus, *Submission 3*, p. 4.

- Ensure that 3d geospatial data be made available to Australia owned companies.
- Ensure that this data be treated like other 'open source' data and be made available for companies like ours to innovate and experiment with—with suitable conditions (eg do not give or sell the raw data to third parties without partnership royalties etc)
  - ⇒ Geoscience Australia and CSIRO and NICTA or CRCs do not share their data openly and have unfair advantage with huge capital injections from the Federal Government and competing with small companies on an uneven playing field
- Not impose standardizing data formats and details—we can use any format available.[30]

Access to private sector data

3.30 In addition to access to government data, access to private sector data was also highlighted as an important step in promoting smart infrastructure. TMR noted that 'integrating government and private operator data will be crucial for ensuring that system-wide information is available to map, model, design and operate infrastructure using smart ICT'. TMR believed that 'the capabilities potentially afforded by achieving these linkages' included providing the 'opportunity for transport agencies to become 'information brokers'; and that 'the de-identified data collected may have valuable commercial applications'.[31]

3.31 NICTA also noted that 'probably most of the good-quality data is collected by private companies', and that 'Google, Apple and the mobile phone companies have rich troves of data that are currently not really accessible in a format that is useful for the public good'. NICTA believed that:

> We need to look into ways to liberate that data and encourage people to put it into the public domain so we can combine good publicly available government data with good public benefit private data that is not commercially sensitive.[32]

3.32 Professor Ian Bishop, of the University of Melbourne, highlighted the fact that private companies were collecting large amounts of valuable data that if available to researchers would allow highly detailed urban models. Often that data was of short-term use to the companies, but long-term use to others. Professor Bishop suggested that 'it may not be a matter of taking

30 Urban Circus, *Submission 3*, p. 4.

31 Department of Transport and Main Roads (Queensland), *Submission 45*, p. 5.

32 Dr Dean Economou, Acting Director, Infrastructure, Transport and Logistics, NICTA, *Committee Hansard*, 21 August 2015, pp. 1–2.

that data at the time it is useful to those people; it may be a matter of accepting it at a time when it is still useful beyond that'.[33]

3.33 Dr Gideon Aschwanden, of the University of Melbourne, urged a 'balance between private property and public good'. He stated:

> The question over that ownership is who is managing the data in the short term—definitely the companies themselves, because they have the interests. But in the long term the government needs to invest into an infrastructure which is taking care of that.[34]

3.34 Professor Thas Nirmalathas, of the University of Melbourne, proposed separating the issues of ownership and access, stating:

> Ownership—people who generate can own the data—is okay, but there has to be fair, flexible and equitable access to that data for the common good so that there is innovation as well as common good.[35]

3.35 On the other hand, Mr Petros Kapoulitsas, of Independent Project Analysis, highlighted the difficulties in, and limitations upon, making private sector information publicly available. He stated:

> We do not own the data, as such. Our clients, the industry, have collectively agreed to enrich the database through the provision of information for new projects. The models, the knowledge, improves. That information is then passed onto the industry, who benefit from the latest and greatest et cetera information on developing and executing projects. Technically, it is not our data to make available to the public. There are ways we can normalise the type of information. Although a particular number might not be visible for a particular project, an index would become available. So project A was 10 per cent more expensive than the average performance of similar projects in a similar part of the world.[36]

33 Professor Ian Bishop, Honorary Professorial Fellow, Department of Infrastructure Engineering, University of Melbourne, *Committee Hansard*, 25 September 2015, p. 42.

34 Dr Gideon Aschwanden, Lecturer in Urban Analytics, Faculty of Architecture, Building and Planning, University of Melbourne, *Committee Hansard*, 25 September 2015, p. 42.

35 Professor Thas Nirmalathas, Institute Director, Melbourne Networked Society Institute, University of Melbourne, *Committee Hansard*, 25 September 2015, p. 43.

36 Mr Petros Kapoulitsas, Office Director, Independent Project Analysis, *Committee Hansard*, 25 September 2015, p. 21.

Achieving compatibility of different data, devices and systems

3.36 Open data, however, requires more than a simple willingness to make data available. It requires open data formats, and the compatibility and interoperability of systems. In its submission, tech giant Intel noted that:

> The more open standards and robust security systems are applied, the more citizens and governments alike will extract the benefits of the Internet of Things.[37]

3.37 Intel observed that 'systems of intelligent devices must be connected in order to maximize the potential of the Internet of Things'. There had to be 'some level of interoperability—an ability to 'speak the same "language"'. Intel noted that:

> Proprietary technologies that are inherently antithetical to the concept of the internet of all things will limit scalability, citizen benefits, and delay economic benefits for new entrants. For this reason, with any smart infrastructure project, it is essential to build a platform based on open standards that have been adopted by the industry.[38]

3.38 Intel stated that 'an open-standards based solution also fosters industry innovation by allowing smaller entrepreneurs and larger enterprises (including government) to participate on an equal footing'.[39] Intel noted that it had 'co-founded two industry consortia focused on interoperability and open standards: the Industrial Interconnect Consortium (IIC) and the Open Internet Consortium (OIC)'.[40] Intel believed that:

> If smart infrastructure applications are implemented as open, standards-based and secure platform on which services can be incrementally added or upgraded, there can be potential for participation by a broad spectrum of private and public organisations to provide innovative solutions.[41]

3.39 Optimatics noted that 'obtaining quality data on infrastructure for research purposes is difficult' as 'much of the data required is held by private (or in the case of utilities, government owned) companies and is often stored within proprietary systems'. This stifled innovation. Optimatics believed that 'an Open Data Policy is the foundation for providing quality data for research and planning'. It recommended 'a common open data format for infrastructure with appropriate extensions

37 Intel, *Submission 42*, p. 12.
38 Intel, *Submission 42*, p. 8.
39 Intel, *Submission 42*, p. 8.
40 Intel, *Submission 42*, p. 8.
41 Intel, *Submission 42*, p. 11.

for each type (e.g., transit systems, sewer networks) to ensure sufficient details are present to facilitate innovation'.[42]

3.40 buildingSMART sought 'open standards for sharing information across all construction activities and integrating those with spatial data standards and support access to spatial data.' It argued that:

> With those standards in place, smart ICT will enable infrastructure development agencies to plan, design, test, communicate and approve all new activities within our cities before the finalised ideas are manifested in the real world—to deliver better outcomes, more quickly at less cost and with lower risk.
>
> The challenge is how to securely integrate millions of separate models under the control of millions of different entities using many different versions of software and hardware and do it with the least administrative burden. [43]

3.41 Lynnwood Consulting highlighted the difficulties in the implementation of BIM 'due to the lack of a common language used for BIM or Virtual Design Construction & Operation (VDCO) of physical assets in Australia'. It noted that BIM required the 'collaborative exchange of information across the asset life cycle supply chain, using three-dimensional models of buildings and infrastructure in electronic format, *consistent with open, non-proprietary standards*'. Lynnwood's view was that 'innovative technology is certainly beneficial and a key enabler, as long as the technology is either based on or fully supportive of *open standard architecture, open data standards and provides the user the ability to exchange data between systems in a seamless way*'. [44]

3.42 Professor Keith Hampson suggested that projects funded by Infrastructure Australia require 'use of open, interoperable digital formats that would integrate across the various phases of the infrastructure projects: planning, design, construction and asset management':

> Use IT systems that are open, meaning that they are not proprietary in respect of locking into a particular proprietary platform; interoperable, so that we are able to have IT transfer of various elements and characteristics of the infrastructure between platforms; and long lasting in respect of feeding into the asset management of the facility.[45]

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42 Optimatics, *Submission 39*, p. 10.

43 buildingSMART, Submission 10, pp. 6–7.

44 Lynnwood Consulting, *Submission 16*, p. 3. Emphasis added.

45 Professor Keith Hampson, Faculty of Humanities, Curtin University, *Committee Hansard*, 25 September 2015, p. 30.

3.43 He believed that this was 'critical to allow us to upgrade, modify and refurbish our infrastructure more effectively':

> If we are making huge investments at this stage they need to be future-proofed and able to be modified for future technologies, and the digitisation of that in *open, interoperable formats will facilitate that*.[46]

3.44 Dr Michael Dixon, of IBM, emphasised that one of the keys to governments not getting locked into highly specialised, proprietary systems was to 'stop asking for them'. He stated:

> When we talk about innovation it is more about governments finding the right words to say, 'Help us solve the problem,' rather than telling us down to the subatomic level what it is they need, which makes it very difficult for companies like mine, I think, to provide innovation.[47]

3.45 Dr Dixon argued that 'open platforms which enable the aggregation of data from disparate sources should be the foundation on which government, in conjunction with the private sector, can deliver better services at lower cost'.[48]

3.46 The implementation of open data formats was supported by government. The Department of Communications believed that 'data and interoperability of data standards are really important ',[49] and that making disparate data accessible through use of common standards was an essential step towards ensuring the compatibility of data, devices and systems.[50] The Department cited the work it was doing nationally, through ANZLIC, and internationally 'with the OGC and the international standards organisation work'.[51]

3.47 Transport for NSW believed that 'open data, stored in a standardised, non-proprietary format', was the key to the successful implementation of Digital Engineering in the infrastructure industry. Open data enabled 'interoperability across technologies and business platforms, resulting in

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46 Professor Keith Hampson, Faculty of Humanities, Curtin University, *Committee Hansard*, 25 September 2015, p. 30. Emphasis added.

47 Dr Michael Dixon, General Manager, Smarter Cities, IBM Corporation, *Committee Hansard*, 25 September 2015, p. 47.

48 Dr Michael Dixon, General Manager, Smarter Cities, IBM Corporation, *Committee Hansard*, 25 September 2015, p. 45.

49 Ms Marianne Cullen, First Assistant Secretary, Digital Productivity Division, Department of Communications, *Committee Hansard*, 14 August 2015, p. 6.

50 Department of Communications, *Submission 27.1*, p. 9.

51 Ms Marianne Cullen, First Assistant Secretary, Digital Productivity Division, Department of Communications, *Committee Hansard*, 14 August 2015, p. 6.

true data exchange that prevents information from becoming misinterpreted, duplicated or lost'. Transport for NSW highlighted the UK experience, where:

> The UK Government, in partnership with buildingSMART, is leading the development of an open industry standard called 'Industry Foundation Classes' (IFC). The intent of the IFC is "the specification for sharing data throughout the project life-cycle, globally, across disciplines and across technical applications in the construction and facilities management industries".
>
> Through the adoption of a standard open data format such as IFC, infrastructure data and information will be guaranteed future interoperability. This will also enable the industry to tap into future technologies and innovations, avoiding the constraints and costs of being restricted to proprietary systems.[52]

3.48 Transport for NSW believed that 'major software vendors will only invest in compatibility to open data formats if there is a suitable pipeline of mandated demand'. It was 'critical that *governments commit to one common data format for all asset information* to get the greatest return on investment in Smart ICT'.[53] Transport for NSW argued that 'the challenge for government is to ensure that the smart ICT systems not only serve the efficient and effective delivery of projects but the effective and efficient delivery of ongoing services'. The key to this was 'the avoidance of cost and incompatibility in the transfer and integration of data from the smart ICT used by the construction and consultant industry with government owned systems'.[54]

3.49 An example of a successful open data system was presented by the Institute of Public Works Engineering Australia Queensland Division (IPWEAQ). ADAC (Asset Design As Constructed) 'is a set of tools supported by IPWEAQ that make the exchange of standardised asset information easier between asset designers, constructors and owners'. IPWEAQ observed that 'ADAC is a standard data transfer format, not a software solution per se and is comprised of three components: Data Standard, data transfer mechanism, and supporting documentation'. It allows 'major commercial providers of survey, design, GIS and asset management systems now provide ADAC configurations "out of the box"'.[55] It also noted that:

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52 Transport for NSW, *Submission 33*, pp. 11–12.

53 Transport for NSW, *Submission 33*, pp. 11–12. Emphasis added.

54 Transport for NSW, *Submission 33*, p. 18.

55 Institute of Public Works Engineering Australia Queensland Division, *Submission 44*, p. 3.

> The most recent version of the ADAC Schema allows the inclusion of metadata to record the quality level within the asset management systems. Importantly, this allows asset data to be exported digitally from the utility/asset owner direct to external industry using fully automated request systems such as "Dial Before You Dig" in a survey accurate format. This eliminates data interoperability problems, prevents the need to recapture or "digitise" hard copy data and allows industry to value add on the product.[56]

3.50 IPWEAQ stated that the ADAC specification was 'endorsed by the National Asset Management Strategy (NAMS) and is the only data specification referenced in the International Infrastructure Management Manual'. It was envisaged that ADAC would 'become the industry standard for describing civil infrastructure asset design and as constructed data across a range of public and private asset classes'.[57]

Harmonisation—national and international standards

3.51 The need to create data standards to harmonise data and promote interoperability was identified in the evidence presented to the Committee. Mr Brett Casson, of Autodesk, stated:

> I would like to touch on harmonising data formats and creating nationally consistent arrangements for data storage and access. This is one of the keys to the success of widespread adoption of BIM in Australia. Without a harmonised national approach there will be great uncertainty and no guarantees in the interoperability of the data throughout the life cycle of the infrastructure project being through proposed design, conceptual design, detailed design, construction, delivery and operations. That is the reason why we are advocating a whole-of-government approach. If the states start developing their own systems then this would lead to possible confusion. The analogy that I would like to draw on that would be the different rail gauges between states, so that is why we are most certainly advocating a whole-of-government approach.[58]

3.52 It was indicated that creating data and making it available was not sufficient in and of itself-- there had to be an effective information management framework. The Victorian Spatial Council argued that:

56 Institute of Public Works Engineering Australia Queensland Division, *Submission 44*, p. 4.

57 Institute of Public Works Engineering Australia Queensland Division, *Submission 44*, p. 3.

58 Mr Brett Casson, Infrastructure Development Executive, Autodesk, *Committee Hansard*, 9 September 2015, p. 3.

> Critical data should be brought under a standard management regime (to ensure comparable quality); a central store for that information should be established, and the connectivity should be put in place to make that information immediately available, including through smart ICT, for an emergency (and establish physical distribution arrangements for routine operations).[59]

3.53 The Victorian Spatial Council supported 'overarching legislation'—not specific legislation but 'an overarching framework'. It cited international examples of such frameworks, including Japan, the United States and South Africa. Such a framework would define people's roles and responsibilities for data management.[60]

3.54 Professor Keith Hampson, of Curtin University, stated:

> If we look at a range of other determinants to do with the planning, design and operation of our infrastructure, the integration of data across the various jurisdictions—both federal and state and local—clearly needs to be facilitated at a central level, and that becomes an Australian government responsibility.[61]

3.55 Dr Matt Wenham, representing the Australian Academy of Technological Sciences and Engineering, was more circumspect about the need for legislation, suggesting instead 'a role for the national government as a convening authority to get agreed standards across the different jurisdictions, be that state or local government'. Nonetheless, he agreed that 'one of the key roles of a national government, which was addressed in some of the earlier submissions, is around harmonisation and standards':

> One of the issues with innovation when you have lots of different technologies, programs or initiatives starting up is that, if they use different platforms and different standards for the data, that limits the amount of interoperability you can have and that limits the benefit you can get from these sorts of technologies. Having someone, be it the national government or another grouping, set some standards on how data should be collected and stored—what format and that sort of thing—that can play a big role in enhancing the ability of the technology.[62]

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59 Victorian Spatial Council, *Submission 6*, p. 5.

60 Mr Olaf Hedberg, Chair, Victorian Spatial Council, *Committee Hansard*, 25 September 2015, p. 4.

61 Professor Keith Hampson, Faculty of Humanities, Curtin University, *Committee Hansard*, 25 September 2015, p. 31.

62 Dr Matt Wenham, Executive Manager, Policy and Projects, Australian Academy of Technological Sciences and Engineering, *Committee Hansard*, 25 September 2015, p. 10.

3.56 Mr David Hassett, of the City of Melbourne, believed it was crucial, 'when we are comparing things, we are all using the same data sources to get the same results. At the moment, we are using disparate data sources and we come up with different answers.'[63]

3.57 Mr Andrew Dingjan, of the Australian Urban Research Infrastructure Network (AURIN), identified similar problems, noting that 'it is one thing to have an open data policy and to promulgate the benefits of open data policy and access; it is another thing to have some level of harmonisation and standardisation of that data across the states'. He continued:

> This is somewhat of a problem and continues to be a problem. It is not to say that there are no initiatives or frameworks in place—for instance, the ANZ OIC initiative and some of the other projects such as the Australian National Data Service project, which are not looking at that. However, it is probably taking a lot longer and it is a more circuitous route to get there. So, in terms of an overall infrastructure solution, I think having some governmental approach to the standardisation of data—for example, how street networks are defined between the states, which is very different between Victoria and New South Wales, and how property valuations differ between each of the individual states—is all important when it comes to the development of regional centres, urban centres, and creating levels of equity in terms of economic, social and urban development.[64]

3.58 AURIN identified its work in harmonising data as an example of what could be achieved, noting that 'there is an opportunity using AURIN as the primary enabler to establish federated urban data hubs across Australia to facilitate a range of research activities related to urban settlements'. AURIN stated:

> New ICT based capabilities that augment infrastructure projects such as AURIN can systematise urban and population data standards, coverage across jurisdictions, harmonise that data and, through the application of appropriate benchmarking and analytic procedures, produce a comprehensive suite of value-added data.
>
> A corollary is the notion of frictionless infrastructure. Smart ICT may play a more active role in joining up and facilitating constructive coupling of myriad data sets, data infrastructures and all related predictive/analytical/reporting tools. Not only can this

63 Mr David Hassett, Team Leader, Geographic Information Systems, Smart City Office, City Strategy and Place, City of Melbourne, *Committee Hansard*, 25 September 2015, p. 19.

64 Mr Andrew Dingjan, Director, Australian Urban Research Infrastructure Network, University of Melbourne, *Committee Hansard*, 25 September 2015, p. 41.

> provide a greater degree of data and knowledge co-ordination and leveraging, but it may help contain the escalating cost of investing in new, software heavy infrastructure by shifting the development costs where open-source approaches are adopted.[65]

3.59 Likewise, NICTA identified its work as an example of how disparate data could be harmonised and utilised more effectively:

> As for the sort of stuff that NICTA is doing now and can already do, we have worked on harmonising data formats, which means it is easier for different bits of infrastructure to talk to each other. We know that trying to mandate a hard standard can often slow things down: 'We're going to wait till the standard's finished.' People can use that as a delay tactic. The other thing you do is have loose guidelines on how data works together, and that lets you build things like dashboards. You may have seen CityDashboard for London or something like that. You pull together a bunch of factors about how the city is performing: what is the state of traffic congestion, how is the stock market going, what is the delay on the call centre—a whole bunch of things that people care about. So we are working with some state governments on different versions of those dashboards, and they are all tied up with National Map and different kinds of visualisations.[66]

3.60 However, the need to fix standards to data and systems was questioned in some of the evidence presented to the Committee, with some practitioners arguing that they were already operating successfully without fixed standards. Intel observed that 'the technology is already available to work with and normalise siloed data sets and legacy formats' and that it had 'been involved this process in many countries, including in Singapore, where much of the government data sets are not easily consumable and external independent parties have been brought in to aggregate the data'.[67]

3.61 In its submission, the Queensland University of Technology (QUT) noted:

> Many efforts from standardisation committees are making headway in creating abstract data standards to fit all but, as mentioned, the approach of starting at the application level is preventing the effectiveness of standards in the short term and

65 AURIN, *Submission 31*, p. 2.

66 Dr Dean Economou, Acting Director, Infrastructure, Transport and Logistics, NICTA, *Committee Hansard*, 21 August 2015, p. 8.

67 Intel, *Submission 42*, p. 10.

> rendering them obsolete in the long term. Rapidly-changing technology requires responsive standards, and examples such as the General Transit Feed Specification from Google show that de-facto standards have the ability to regulate international data harmonisation without the need of lengthy ISO committee processes, if there is a real need.[68]

3.62 QUT cited trials of its Jellyfish technology, which had 'shown a large acceptance with industry to adapt a non ISO standard, purely by solving a common and agreed problem—data access in transport.[69] According to QUT, the key was to avoid 'application-driven standardisation' which 'renders itself obsolete within a short time due to rapidly changing technology':

> Infrastructure is growing at a comparatively slower pace than technology and remains in place over decades. The Jellyfish approach of attaching data in a way that is descriptive way to the infrastructure (ie asset) allows generations of applications to interpret the information as required without jeopardising the usefulness of data stored. The existence of national performance indicators in transport demonstrates the need for harmonisation and highlights the costs that arise from antiquated systems that yield false or incomplete data sets. This can be eliminated through a simple paradigm shift and by storing asset data agnostic to application models.[70]

3.63 Dr Ben Guy, of Urban Circus Pty Ltd, observed that he had never had issues with getting data to talk to other data, regardless of the system on which it was produced:

> From my personal experience, if you were to say to me, 'I have some geospatial data that was collected on a Trimble machine,' or, 'it sits in Autodesk or Bentley,' I would not mind. What I would want to know is how accurate it is, how valid it is and how good it is. I would do something magical with that, from that point. I do not care where it sits. I am impartial.[71]

3.64 All he required to do his work was access to data:

> We were in Perth recently, and you have data sitting in Esri products, in Hexagon products and in 12d, Bentley, Autodesk and

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68 Queensland University of Technology, *Submission 19*, p. 2.

69 Queensland University of Technology, *Submission 19*, p. 2.

70 Queensland University of Technology, *Submission 19*, p. 2.

71 Dr Ben Guy, Chief Executive Officer, Urban Circus Pty Ltd, *Committee Hansard*, 24 September 2015, p. 2.

> all these kinds of things. It is our skill—that is what we do—to pull that data out, mash it all up, create interesting new products and enable the clients to do various things within the planning space. So, again, it has not been a barrier for us in our 10 years and $70 billion worth of infrastructure experience. If other people are telling you different, I am not going to say that they are wrong. I would say, from my point of view, do not get too caught up on it.[72]

3.65 Dr Marc Miska, of QUT, asserted that the Geographic Information System (GIS) 'is the only representation that I have found over my career that is essentially the common truth that is out there and that we can actually measure'.[73] He stated:

> The GIS system has not changed in in a very long time, and it is the one place where we have our surveyors out there who make sure that we know actually where our land is, so to speak. With the attribute tables on top of that, as in every good computer age nowadays, you would have a certain type of attributes that is valid for the year 2016-17. There will be an update and you will keep maintaining these attribute sets. You just amend these attributes or add attributes to it, and after a couple of years you would retire the old datasets, because you would have requested that all the different states, and possibly all the local governments, have updated their data in a five-year cycle.[74]

3.66 In its submissions, the Department of Communications highlighted the work already being done nationally and internationally on standards. The Department itself participates in 'various local and international forums involved in devising standards for the ICT industry' promoting 'authoritative standards development across the ICT sector', including:

- Standards Australia
- ANZLIC—the Spatial Data Council
- International Organization for Standardization (ISO),
- Open Geospatial Consortium (OGC)
- International Telecommunications Union (ITU).[75]

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72 Dr Ben Guy, Chief Executive Officer, Urban Circus Pty Ltd, *Committee Hansard*, 24 September 2015, p. 2.

73 Dr Marc Miska, Senior Research Fellow, School of Civil Engineering and Built Environment, Smart Transport Research Centre, Queensland University of Technology, *Committee Hansard*, 24 September 2015, p. 9.

74 Dr Marc Miska, Senior Research Fellow, School of Civil Engineering and Built Environment, Smart Transport Research Centre, Queensland University of Technology, *Committee Hansard*, 24 September 2015, p. 11.

75 Department of Communications, *Submission 27.1*, p. 9.

3.67 The Department noted that:

> Open ICT standards are playing a central role in the emergence of 'hyper-connected' devices, many of which will be attached to or embedded in the built environment. Open standards will allow disparate streams of data to be meshed together and accessed on a location or position-aware basis. Bodies such as the ISO and OGC will be key to the successful development of IoT.[76]

3.68 The Department stated that the ISO was currently focussed on the Internet of Things under its 'Working Group on Sensor Networks.' The OGC was developing standards relating to 'SensorThings, Smart Cities, Sensor Web Enablement and Observation and Measurement Encoding Standards supporting location-aware and real-time services'. The Department noted that the:

> OGC is also developing new land and 3D building standards and has established a Point Cloud Domain Working Group for big spatial data. Point Clouds provide precise 3D digital modelling of the built environment, including textures and surface features.[77]

3.69 The Department highlighted Australia's own contribution internationally to the development of ITC standards:

> In the data policy area, in particular with this spatial information … we are very vocal in the international standards community. In fact, Australia is leading the international standards around addressing and geospatial information standards. At the moment that is all around looking at what we call semantic interoperability, where each of those data sets can come together in a mash-up, whereas currently that takes quite a bit of effort to do. We are leading that. We are also very closely tied with the Open Geospatial Consortium, which is a major consortium that looks at spatial standards and ICT standards. Indeed, we are holding an OGC international event in Sydney at the end of this year. We are very closely tied with them. Through Geoscience Australia, of course, we are also very engaged in the international community around global satellite navigation systems. GA are currently our lead on looking at how we are going to transition to what we call global navigation satellite systems into the future, which will give us down to five centimetre resolution on the ground. So there is a whole lot of activity going on and, certainly from a spatial

76 Department of Communications, *Submission 27*, p. 7.

77 Department of Communications, *Submission 27*, p. 7.

> perspective, our role in the standards is very strong and Australia is doing very well in that space.[78]

3.70 The Department observed that ISO and OGC standards were central to the development of the ANZLIC-sponsored Foundation Spatial Data Framework (FSDF), which was 'aimed at realising the highest degree of interoperability of these datasets across the Australian and New Zealand economies'. The Department believed that 'in collaboration with industry, government has a key role in developing authoritative standards across the ICT sector'. The Department noted that, 'in this regard, certain countries such as the United States are taking an early lead in developing key standards across a range of industry sectors'.[79]

3.71 The Department of Infrastructure and Regional Development (DIRD), highlighted its own work in this field including:

- application of international standards for local use
- collection and distribution of data to promote economic productivity and efficient use of resources
- developing Intelligent Transport Systems (though membership of Austroads)
- developing and implementing a protocol for the electronic exchange of Development Assessment data between stakeholders (including Local Government).

3.72 DIRD believed that 'harmonising infrastructure data nationally' was 'a pre-requisite for achieving significant benefits, e.g. for analytics, predictive modelling, optimisation, etc.' DIRD indicated that harmonising data would 'also enable infrastructure models to integrate to deliver even greater benefits in the future, e.g. providing a picture of relationships between assets, and to provide future new capabilities'.[80]

3.73 In its submission, Standards Australia emphasised the importance of international standards to the development of smart ICT in Australia, stating:

> The adoption of International Standards should continue to be a first consideration in Australia. Standards Australia has long supported, and continues to support, the participation in and

78 Ms Helen Owens, Assistant Secretary, Data Policy Branch, Digital Productivity Division, Department of Communications, *Committee Hansard*, 14 August 2015, p. 4.

79 Department of Communications, *Submission 27*, p. 7.

80 Department of Infrastructure and Regional Development, *Submission 28*, p. 13.

> adoption of International Standards in the Information & Communication Technology sector.[81]

3.74 Standards Australia highlighted Australia's involvement in the ISO's Joint Technical Committee on Information Technologies and participation in the work of a range of international ICT Sub Committees which 'work on the development of standards directly or indirectly related to the smart ICT design and planning of infrastructure'. Standards Australia also facilitates the development of Australian Standards related to smart ICT through a range of committees. 'Standards Australia has more than 800 publications and standards related to the ICT Sector within its catalogue of published standards'.[82] Standards Australia has also been active in the development of standards relating to cyber security. It noted that:

> Standards Australia facilitated the participation of Australian Stakeholders in the development of the ISO/IEC 27000 series of standards. The recently developed ISO/IEC 27000 Information Security Management Systems series of standards are used as the building block for IT Security.[83]

3.75 In its submission, the National Archives of Australia emphasised the importance of metadata to the interoperability of data and that 'agreed metadata standards are essential to achieve data harmonisation'. It noted that:

> Interoperability of data and systems based on standards allows data discovery, sharing, analysis and reuse, as well as enabling data to be stored, controlled, managed, understood and preserved over time. Agreed standards also enable data sharing for business continuity purposes and disaster planning and recovery.[84]

3.76 The Archives observed that 'Government can promote preservation, interoperability and optimisation of data related to infrastructure by supporting the further development and adoption of format and metadata standards'. The Archives noted that it had 'developed metadata standards for use in the Australian Government' and that it was 'developing interoperability standards based on formats and metadata'. It also noted that 'these standards are applicable outside Government and some have been adopted as national standards'.[85]

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81 Standards Australia, *Submission 43*, p. 1.

82 Standards Australia, *Submission 43*, pp. 3–4.

83 Standards Australia, *Submission 43*, p. 2.

84 National Archives of Australia, *Submission 1*, p. 3.

85 National Archives of Australia, *Submission 1*, p. 3.

3.77 The importance of metadata standards was highlighted in the submission of the University of Wollongong's SMART Infrastructure Facility. SMART advised the Committee that:

> The SMART Infrastructure Facility with the collaboration of the CSIRO has developed a SMART metadata and data management system. The metadata system is built on the open source metadata software GeoNetwork and has been developed specifically to cater to the strengths of the SMART Infrastructure Facility.
>
> The SMART Metadata System and its associated guidelines provide a central e-research platform where infrastructure planners, designers and researchers can access knowledge about infrastructure data from various sources.[86]

3.78 This system allowed SMART to 'catalogue datasets from disparate data providers, research outputs, Commercial and Academic research projects and is designed to be flexible enough so that any type of infrastructure information can be catalogued'. It used a 'subset of the ANZLIC Metadata Profile: AS/NZS ISO 19115:2005,' standard, which allows access to information that had 'previously been unmanaged, hidden and unused'. SMART observed:

> The SMART metadata system has been configured to harvest research outputs from simulations and models from a number of different research projects. The ability to automate, harmonise and standardise research in this way is an example of how Academia can innovate and contribute within the ITC space.
>
> The data climate of the SMART Infrastructure Facility has been harmonised so that Data Inputs, Outputs, Simulations, Modelling and Teaching have all been made consistent; this consistency facilitates good research outcomes for the Facility and the University.[87]

Standards—BIM

3.79 The need for consistent standards for Building Information Modelling was also highlighted in the evidence presented to the Committee. buildingSmart observed that:

> Currently Project delivery is typically based on a disjointed model as a result of the many and varied authorities, consultants, contractors and subcontractors organisations involved. Each individual organisation typically has their own formats they may

86 SMART Infrastructure Facility, University of Wollongong, *Submission 12*, p. 15.

87 SMART Infrastructure Facility, University of Wollongong, *Submission 12*, p. 16.

> output information in, and there is no incentive for organisations to share data in formats that are legible to others, in fact the opposite may be considered advantageous.[88]

3.80 buildingSMART was concerned that 'left to the market, digital infrastructure will be governed by a wide range of often-conflicting rights, responsibilities and restrictions, including different corporate terms of use, licences and contracts'. Even worse, 'each jurisdiction—be it local, State, Federal or internationally—could have their own set of rules and laws'. This would 'lead to a total lack of ability to work with other organisations or Governments in digital infrastructure'.[89] buildingSMART believed that 'a framework from the Government would provide consistent guidance about best practice implementation of BIM'. Such a framework would 'enable businesses to self-innovate and would empower greater efficiencies, productivity and quality control'.[90]

3.81 The importance of open standards was emphasised by Lynnwood Consulting. It noted that:

> BIM promotes collaboration between a number of disciplines and this collaboration needs to be enabled by adopting a "common language". Most BIM practitioners refer to this common language as open standards. Open standards and true, non-proprietary interoperability are key to the long and short term success of the Architect, Engineering, Construction, Operator and Owner (AECOO) industry as it moves forward with Smart ICT processes and technology.
>
> There is a real need for open standards when it comes to data formats, exchange, storage and access, as the potential of BIM can only be realised if the information contained in the model remains accessible and usable across a variety of technology platforms over a long period of time. For this reason, it is essential that Smart ICT (BIM) incorporates a universal, open data standard to allow full and free transfer of data among various software platforms (software applications) and between the stakeholders involved.[91]

3.82 Lynnwood argued that the advantages of open data standards was that it:

- Allowed each stakeholder to use any tools available on the open market that best suit their needs;
- Facilitated data exchange throughout the asset and project life cycle;

88 buildingSMART, *Submission 10.1*, p. 4.
89 buildingSMART, *Submission 10*, p. 7.
90 buildingSMART, *Submission 10*, p. 7.
91 Lynnwood Consulting, *Submission 16*, p. 7.

- Maintained consistent data standards across an asset portfolio or multiple projects;
- Maximized the openness and competitiveness of the market for planning, design and construction services; and
- Ensured that data created during a project remains usable in the future, independent of the policies and business decisions of individual asset owners or software vendors.[92]

3.83 Lynnwood recommended that the Australian Government, in consultation with asset owners and industry, identify and agree upon the most appropriate suite of open data standards to adopt for use in Australia.[93]

3.84 Aurecon stated that 'having a non-proprietary format that is used by the supply chain will hugely improve productivity through the efficient use of one format, as opposed to multiple proprietary formats that populate the industry'.[94] Aurecon suggested that 'Industry Foundation Class (IFC) provides an open ISO standard schema for the data structure of the digital assets to determine what information is exchanged'.[95]

3.85 Aurecon argued that:

> To realise the benefits of a universal classification system, a non-proprietary open standard data structure/file format is required. This neutral open standard is critical in ensuring interoperability across multiple technologies and platforms. This interoperability provides true data exchange that prevents information from being reproduced, lost or misinterpreted, and supports long term future access and reuse.[96]

3.86 Aurecon believed that 'for the immediate future', governments should 'collaboratively agree with industry on the right form and format of data, which is appropriate for the intended use'. Beyond that, Aurecon believed that 'data should be structured to ISO16739 (also known as IFC) and when in an ifcXML format (also known as IFC HTML), this can support an integrated, object-oriented and web-enabled dataset of the future'.[97]

3.87 Mr Brett Casson, of Autodesk, took a similar view. He explained:

> We are advocates of an open BIM platform, meaning that it is vendor agnostic. We are very much in favour of having open standards and open format so that industry can use whatever

92 Lynnwood Consulting, *Submission 16*, p. 7.
93 Lynnwood Consulting, *Submission 16*, p. 9.
94 Aurecon, *Submission 22*, p. 16.
95 Aurecon, *Submission 22*, p. 15.
96 Aurecon, *Submission 22*, p. 17.
97 Aurecon, *Submission 22*, p. 17.

> authoring tool they like, but we also recognise that there needs to be a common data environment and common framework and standards associated with those data formats so that, for example, a structural design for a bridge can marry with the road design for a bridge or the pavement design for a bridge, so the development of standards around those disciplines and the framework is absolutely critical for the success of BIM in this country.
>
> At the moment there are definitely a few open data formats, so there are definite formats that are standards. One of them is IFC, which is an interoperable format between different vendor platforms for not only the 3D context or the 3D geometry but also there are other standards for the interoperability of data, so the associated data attached to those objects. I will draw on the UK experience as well. They have actually mapped out exactly how that would look, and one of those formats they use is IFC; the other one is COBie.[98]
>
> So the British standard, BS 1192, is being developed in certain phases. The vision for all of these platforms and all of these formats is that it will develop into an ISO standard. IFC is an ISO standard at the moment.[99]

3.88 In its submission, Bentley Systems noted that 'the list of all potential standards is too long to be included' in one submission, and that constant change meant that any standards selected should be 'chosen by the relevant infrastructure owner, are project/discipline specific and are outcomes based'. Bentley noted that 'there are standards that are relatively mature such as BS 1192–2007, ISO 10007, ISO 55000' and suggested that these 'could be, and indeed are being investigated and adopted in Australia'.[100] Bentley was, however, sceptical of the value of certain formats:

> Construction Operations Building Information Exchange (COBie) and or Industry Foundation Class (IFC) or ISO16739 are often suggested as a silver bullet for information interoperability across the lifecycle of building. Neither COBie nor IFC, in their current form, are fit for purpose for civil infrastructure so we recommend that care be taken in ensuring that if standards, formats and

98 Mr Brett Casson, Infrastructure Development Executive, Autodesk, *Committee Hansard*, 9 September 2015, pp. 5–6.

99 Mr Brett Casson, Infrastructure Development Executive, Autodesk, *Committee Hansard*, 9 September 2015, p. 6

100 Bentley Systems, *Submission 29*, p. 10; see also, Mr Alan Savin, Vice President, Project Delivery, Bentley Systems, *Committee Hansard*, 24 September 2015, p. 25.

> processes are to be mandated that they are fit for purpose, industry supported and non-restrictive.[101]

3.89 The key, according to Bentley, was to take the mature standards that were available and adapt them to each new situation:

> We are absolutely saying there is a foundation of standards that you need to adopt and then adapt. It is a different one for a rail project to a different one for a road project to a different one for a bridge project to a different one for a building project because of the fundamental needs, but it is no more complex than: this is the information which is required to successfully operate and maintain the asset. That is really what is important. So it is defining that clearly upfront and how you want that information and when you want that information handed over.[102]

3.90 The Australasian Procurement and Construction Council (APCC) observed that the 'consistent application of standards will be essential for interoperability and collaboration between BIM model authors'. It stated that there was 'a need to define minimum deliverables including models at the end of building construction, and with data exchange protocols to allow maximum benefit of building information over building life'.[103]

3.91 The APCC stated that the following objectives for the development and application of BIM standards:

- The establishment of a collaborative work environment where all participants operate in the same context: that is, there are Standards for modelling, terminology, and process.
- Automation of supply chains to achieve greater industrialisation and productivity within the construction industry.
- To ensure the Australian and New Zealand construction industry is compatible and competitive in the global construction sector.[104]

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101 Bentley Systems, *Submission 29*, p. 10; see also, Mr Brian Middleton, Senior Director, Transportation, Bentley Systems, *Committee Hansard*, 24 September 2015, p. 25.

102 Mr Alan Savin, Vice President, Project Delivery, Bentley Systems, *Committee Hansard*, 24 September 2015, p. 26.

103 Australasian Procurement and Construction Council, *Submission 9*, Attachment 1, *A Framework for the Adoption of Project Team Integration and Building Information Modelling*, December 2014, p. 42.

104 Australasian Procurement and Construction Council, *Submission 9*, Attachment 1, *A Framework for the Adoption of Project Team Integration and Building Information Modelling*, December 2014, p. 41.

3.92 The APCC noted that the UK BIM Task Force had 'facilitated the development of Guidelines working with industry in their formulation', including:

- PAS 1192-2:2013 Specification for information management for the capital/delivery phase of construction projects using building information modelling
- PAS 1192-3:2014 Specification for information management for the operational phase of assets using building information modelling.[105]

3.93 The APCC recommended that:

- National adoption of ISO and related BIM standards across the Commonwealth, and all States and Territories;
- in Australia, adoption of the NATSPEC guidelines as a national standard;
- adoption of open formats to ensure data access for an owner over a building's life;
- development of digital Standards for key supply chains, e.g. AMCA BIM-MEPAUS;
- development of a standard for the asset/facilities management industry on data sets and information asset register outcome requirements to enable the handover from design and construction to operation in a BIM environment; and
- links to ISO and global BIM developments.[106]

3.94 The APCC also suggested that 'standards and other recognised protocols that are prepared should be scalable with a short version for small projects and a comprehensive Standard for large projects'.[107]

Objects library

3.95 One key element of establishing a system of standards is asset classification. Lynnwood Consulting explained:

> A classification system is an essential tool for organising information. Without an agreed, comprehensive system for organising construction information, it is impossible to ensure interoperability between different information systems, design

105 Australasian Procurement and Construction Council, *Submission 9*, Attachment 1, *A Framework for the Adoption of Project Team Integration and Building Information Modelling*, December 2014, p. 42.

106 Australasian Procurement and Construction Council, *Submission 9*, Attachment 1, *A Framework for the Adoption of Project Team Integration and Building Information Modelling*, December 2014, p. 42.

107 Australasian Procurement and Construction Council, *Submission 9*, Attachment 1, *A Framework for the Adoption of Project Team Integration and Building Information Modelling*, December 2014, p. 42.

> tools, and facilities management tools, or achieve the aim of having data entered once and re-used several times through the asset life cycle.[108]

3.96 Lynnwood noted that 'an asset classification system must include buildings, infrastructure and integrated project and office management'. It must also 'be able to map project information from the initial concept through development brief, detailed design, construction, commissioning, handover, and operation and maintenance'. Lynnwood noted that 'there are currently two main asset classification systems competing globally to fulfil this role—Uniclass and OmniClass':[109]

3.97 Aurecon agreed, stating that 'a common language is intrinsic to delivering the right data, to the right person, with the right level of detail'. Aurecon noted that:

> Within the UK , they have found a solution to delivering a common language with the creation of the Digital Plan of Works (DPoW), a classification scheme and a free-to-use system for managing the flow of design and construction information, which is being project managed by the Technology Strategy Board (TSB) on behalf of the UK BIM Task Group. The DPoW will provide greater clarity on the information needed at each stage of a project. This, combined with standardised data templates, will help to develop a common language and set of data flows.[110]

3.98 Aurecon indicated that standardised data templates would 'provide a consistent approach for product manufacturers by generating a single template for each product type that can be readily understood by all users'. These data templates would 'then allow BIM data operations to be automated and users to extract the information they require'.[111]

3.99 Aurecon believed that 'a standardised national data classification and format is an essential tool for organising information':

> Without an agreed, comprehensive system for organising construction information it will be impossible to ensure interoperability between different information systems, design tools, and facilities management tools, with data entered once and re-used several times through the project lifecycle.[112]

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108 Lynnwood Consulting, *Submission 16*, p. 8.

109 Lynnwood Consulting, *Submission 16*, p. 8.

110 Aurecon, *Submission 22*, p. 16.

111 Aurecon, *Submission 22*, p. 16.

112 Aurecon, *Submission 22*, p. 17.

3.100 Aurecon stated that 'classification is critical to industry standardisation, and if left to the supply chain will cause unnecessary complexity and confusion'. It believed that 'government must take the lead with industry to ensure consistency across the industry'. Aurecon suggested Data Classification (ISO12006) to use as reference.[113]

3.101 In its submission, Transport for NSW stated that 'Uniclass is currently the most advanced classification system in the world':

> This system was originally established by the Royal Institute of British Architects (RIBA) and is now owned and being further developed by the UK Government. Over time, Uniclass is expected to become an ISO standard, along with a number of other associated UK DE (or Building Information Modelling (BIM)) Standards.[114]

3.102 Transport for NSW observed that the development of a classification system is a 'complex and challenging problem that will require significant leadership and cross-sector alignment to solve'. It noted that 'there was currently a number of classification initiatives under development in Australia that are not harmonised. Transport for NSW stated that 'if these continue down their divergent paths, both the long-term productivity losses and rectification costs for Australia will be significant'.[115] Transport for NSW believed that:

> A standardised approach to coding and classifying model objects will also enable local industry to develop consistent, re-usable libraries of objects. This will allow designers to build-up new designs with pre-designed and assured building blocks, resulting in a significant boost in productivity on infrastructure projects.[116]

3.103 The APCC advised that industry body NATSPEC have been developing National standards, including a National Object Library, 'within the Australian and New Zealand context'. These standards were to 'provide a consistent approach for road, bridge and building projects across Australian governments and industry'. They also 'set out processes for developing strategies and establishing a series of BIM standards, policies and principles'.[117] The National Object Library would ensure that:

> Information about building and infrastructure asset elements, such as building fabric or building services or furniture and equipment,

113 Aurecon, *Submission 22*, p. 17.

114 Transport for NSW, *Submission 33*, p. 11.

115 Transport for NSW, *Submission 33*, p. 11.

116 Transport for NSW, *Submission 33*, p. 12.

117 Australasian Procurement and Construction Council, *Submission 9*, p. 3.

> necessary for the design, construction, operation and management life cycles, is shared in a common format, across all participants in the asset/facility development and management sector.[118]

3.104 Similar activity being undertaken in Australia and New Zealand included:

- The Sustainable Built Environments National Research Centre (SBEnrc) has developed a pilot on Interoperable Object Libraries that establishes a library of generic objects, accessible by the three major BIM tools in the Australian market intended to demonstrate a national solution for industry access to building product data.
- User groups for proprietary software applications such as Revit have developed Australian and New Zealand Revit Standards (ANZRS) for developing 'Families' and best practice.
- BIM-MEPAUS, an initiative by the Air Conditioning and Mechanical Contractors' Association of Australia, has implemented product data for the building services supply chain.
- The National Building Specification (NBS) in the United Kingdom provides free universal access to its National BIM Library and is a leader in the UK, and globally, of product information management & BIM technology development.
- BuildingSMART Australasia's National BIM Initiative Working Group 3—Object Libraries, has developed a more detailed version of the QUT Interoperable Object Libraries prototype and joined an international pilot of the BuildingSMART Australasia Data Dictionary creating both Australian and New Zealand versions of a ceiling tile system property definitions.[119]

3.105 The APCC asserted that:

> It is important that Australian and New Zealand manufactured products that comply with Australian and or New Zealand BIM Standards are accessible in a BIM Library. It is desirable that Australia and New Zealand share compatible systems, and international consistency of BIM objects for international services and trading competitiveness. The development of Australia and New Zealand-specific objects will maximise growth in the Australian and New Zealand BIM services markets. Development

118 Australasian Procurement and Construction Council, *Submission 9*, Attachment 1, *A Framework for the Adoption of Project Team Integration and Building Information Modelling*, December 2014, p. 38.

119 Australasian Procurement and Construction Council, *Submission 9*, Attachment 1, *A Framework for the Adoption of Project Team Integration and Building Information Modelling*, December 2014, p. 39.

of a shared international BIM Library to suit Australian and New Zealand construction practice is currently being undertaken.[120]

3.106 It recommended:

- establishment of a National Object Library system to be stewarded by NATSPEC as the authoritative national Information Broker for product information (this may be via a Memorandum of Understanding between NATSPEC and NBS);
- development of a business plan to implement an Australian National BIM Library with appropriate resourcing and funding, including evaluating collaboration with NBS UK to share potential use of the UK BIM Library, and technology development cooperation to enhance availability of digital product data;
- in Australia, liaison with CIL, NZ, to arrive at an aligned trans-Tasman business model;
- engagement of product manufacturers (particularly in specialist domains) to work with BIM users developing supply chain sector specific object libraries;
- engage the product manufacturing industry as part of the adoption of the BIM journey in the Australian and New Zealand construction industry; and
- engagement globally on object library Standards developments (for example ISO, COBie, bsDD, SPie etc) where it suits our national interests and to exploit and expedite the potential of BIM.[121]

Data collection and storage capabilities

3.107 The need to develop capacity and systems for the collection and storage of data was highlighted in the evidence presented to the Committee. In its submission, the National Archives observed that the 'consequences of inadequate data and information management include data loss, poor business decisions, unnecessary risk and compromises to safety'. The Archives believed that 'data management should be considered through all stages of infrastructure planning, development and maintenance, and that the 'creation and management of data should be incorporated into contract arrangements to ensure data remains available for the life of the infrastructure'.[122]

120 Australasian Procurement and Construction Council, *Submission 9*, p.3.

121 Australasian Procurement and Construction Council, *Submission 9*, Attachment 1, *A Framework for the Adoption of Project Team Integration and Building Information Modelling*, December 2014, pp. 39–40.

122 National Archives of Australia, *Submission 1*, p. 2.

3.108 Dr Marc Miska, of QUT, emphasised the need for consistency across government. He stated:

> … if you leave it to all the different states, everybody will have their own solution. Look at all the data portals that are out from every state now. None of those can interoperate with each other. It is very difficult to pull data from two different states and compare. It is just not possible. If this is run at a national level, you can actually compare things. You can say how New South Wales compares to Victoria, Queensland or Western Australia in terms of what return on investment they get, and you can make a fair judgement. Right now there is no way to compare, because you are comparing apples and oranges and you do not know where it actually comes from.[123]

3.109 Aurecon suggested that the Australian Government 'look at how governments such as the Singaporean government host all publically procured assets':

> Their vision is to implement the fastest building permitting process in the world. The Building and Construction Authority (BCA) led a multi-agency effort in 2007/2008 to implement Singapore e-submission, the world's first BIM electronic submission tool (e-submission). The BIM e-submission system streamlines the process for regulatory submission. Project teams only need to submit one building model, which contains all of the information needed to meet the requirements of a regulatory agency. In 2010, nine regulatory agencies accepted architectural data rich graphical models for approval through e-submission. This was followed by the acceptance of mechanical, electrical and plumbing (MEP) and structural BIM models in 2011. In 2013 the Singapore government began mandating architectural BIM e-submissions for building projects greater than 20,000 square meters. In 2015 BIM e-submissions will be required for all projects greater than 5,000 square meters.[124]

3.110 Aurecon believed that by 'centrally hosting all government procured assets this would enable a single source of truth for a digital built Australia'.[125]

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123 Dr Marc Miska, Senior Research Fellow, School of Civil Engineering and Built Environment, Smart Transport Research Centre, Queensland University of Technology, *Committee Hansard*, 24 September 2015, p. 10.

124 Aurecon, *Submission 22*, pp. 17–18.

125 Aurecon, *Submission 22*, pp. 17–18.

3.111 buildingSMART proposed the creation of Property Data Banks 'to hold and connect the official models of each property into a secure fully-integrated digital built environment'. The Banks would include 'rights of access mirroring our real-world rights, and standardised data exchange formats for use and trade'. The Property Data Banks would operate on commercial principles—'Just like traditional banks compete to hold and transact our money, new organizations should compete to hold and share our property models'.[126]

3.112 The question of the physical storage of data was also raised. Mr Carl Catalano, of BCE Surveying noted that improvements in data collection and the increasing volumes of data collected required the regular upgrade of computer systems:

> Over the last 2½ years, we have upgraded our computer systems three times to be able to handle it. We recently spent $40,000 on storage and upgrades on our computer system to be able to do our job better.[127]

3.113 Dr Catherine Ball, of URS, observed that:

> One of the things we are trying to assist our clients with across the board is their data storage, data interrogation and data amalgamation. We are going to have to start looking at cloud based services and off-site storage. … A lot of data will be collected in the next couple of years very quickly and I am not certain of the capacity of the local council to handle that and whether the federal government and the ANU need to look at their supercomputers, for example, in Canberra to have national data storage system … from my experience of working with local council, they are not quite prepared for the terabytes that are going to come flying in alongside the AUVs.[128]

3.114 Mr Andreas Wohlsperger, of AECOM, indicated that the questions of where data was stored was more easily answered:

> … once you have standards and documentation procedures in place, because that would allow you to have data stored in a distributed federated system, at maybe state government or federal level with various agencies, but, as long as you have

126 buildingSMART, *Submission 10*, pp. 7–8.

127 Mr Carl Catalano, Operations Manager, BCE Surveying Ltd, *Committee Hansard*, 4 September 2015, p. 9.

128 Dr Catherine Ball, Regional Unmanned Aerial Systems Lead, URS, *Committee Hansard*, 24 September 2015, p. 15.

> standardisation in place in terms of the data and documentation around it, you can bring the data together in a holistic way.[129]

3.115 The Queensland Department of Transport and Main Roads viewed the 'development of a common data repository into which both government and third party providers could access consolidated smart ICT-enabled information as being a valuable contribution to fostering innovation'.[130]

3.116 Telstra believed that the advent of the cloud would largely resolve the problem of data collection and storage, stating:

> The advent of cloud services has led to an abundance of computing capacity which can be used to store and process the information that is flooding in from both human and machine sources. The combination of abundant capacity and abundant data has led to a resurgence of interest in machine learning algorithms over the last five to 10 years. By feeding a machine data, we can teach it to recognise patterns in a manner analogous to human thought processes.[131]

3.117 These views were echoed in the submissions of Bentley Systems and the Government of South Australia, both of which saw the future in the power of cloud based computing;[132] while Dr Ben Guy, of Urban Circus, told the Committee:

> I have just put 5,000 square kilometres of New South Wales on the cloud. It cost me about $1,000 and took me about three days. That is about a terabyte of data. It is all aerial photography in ECW format and lidar. Amazon Web Services are not infinitely big, but they are pretty damn big. So I would say that that is not such a problem.[133]

3.118 Indeed, according to BCE surveying, such were the improvements in the spatial processing environment that 'increases in the computing capability around Geographic Information Systems (GIS) and cloud based solutions and apps can bring much of this geographic and location information to the palm of your hand'.[134]

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129 Mr Andreas Wohlsperger, Associate Director, GIS Practice Area Lead Australia New Zealand, Technology and Strategic Asset Management Lead, Northern and Western Australia, AECOM, *Committee Hansard*, 24 September 2015, p. 15.

130 Department of Transport and Main Roads (Queensland), *Submission 45*, p. 7.

131 Telstra, *Submission 14*, p. 3.

132 Bentley Systems, *Submission 29*, p. 4; Government of South Australia, *Submission 30*, p. 3.

133 Dr Ben Guy, Chief Executive Officer, Urban Circus Pty Ltd, *Committee Hansard*, 24 September 2015, p. 2.

134 BCE Surveying, *Submission 26*, p. 1.

Data security

3.119 The aggregation of large amounts of data presented security and privacy challenges; to protect data from loss, protect citizens from the misuse of personal data, and protecting data and hard infrastructure from attack. According to the Department of Defence:

> Because any Internet–connected device or computer system is highly susceptible to malicious cyber activity, our dependence on ICT also brings greater exposure to threats. The threat is not limited to classified systems and information. A wide range of institutions, both public and private, have been subjected to malicious cyber activities.[135]

3.120 In its submission, Engineers Australia stated:

> The demands of smart infrastructure emphasize the importance of engaging the appropriate engineering, ICT and risk management skills to ensure that inter-connections between infrastructure systems do not present new sources of vulnerability that could lead to system failure. Infrastructure designers, developers and managers need to be conscious of the roles played by back-up systems to mitigate the consequences of failures.[136]

3.121 Symantec, a global internet security company, has noted that data breaches continue to be common:

> In 2014, cybercriminals continued to steal private information on an epic scale, by direct attack on institutions such as banks and retailers' point-of-sale systems. While there were fewer "mega breaches" in 2014, data breaches are still a significant issue. The number of breaches increased 23 percent and attackers were responsible for the majority of these breaches. Fewer identities were reported exposed in 2014, in part due to fewer companies reporting this metric when disclosing that a breach took place. This could indicate that many breaches— perhaps the majority— go unreported or undetected.[137]

3.122 Symantec discussed an example of a high profile data breach from 2014:

> The release of nearly 200 celebrity photographs on the website 4chan in August 2014 received wide media coverage and increased consumer anxiety about privacy. According to Apple, the images were obtained using highly tailored targeted attacks on individual

135 Department of Defence Intelligence and Security, *Australian Government Information Security Manual: Principles*, 2015, Commonwealth of Australia, p. 2

136 Engineers Australia, Submission 25, p. 5.

137 Symantec, *2015 Internet Security Threat Report*, Volume 20, 2015, p. 78

> accounts rather than general weaknesses in the company's security. People's personal and financial information continues to command high prices on the black market, and that means cybercriminals will continue to target major institutions for large scores and small companies for small, easy ones. Many breaches are preventable with the right security measures, including elements such as data loss prevention, encryption, and intrusion detection systems, as well as with effective security policies and training.[138]

3.123 Symantec also highlighted a major server data breach that occurred in 2014:

> Heartbleed hit the headlines in April 2014, when it emerged that a vulnerability in the OpenSSL cryptographic software library meant attackers could access the data stored in a web server's memory during an encrypted session. This session data could include credit card details, passwords, or even private keys that could unlock an entire encrypted exchange.
>
> At the time, it was estimated that Heartbleed affected 17 percent of SSL web servers, which use SSL and TLS certificates issued by trusted certificate authorities. This had a massive impact on businesses and individuals. Not only was a great deal of sensitive data at risk, but the public also had to be educated about the vulnerability so they knew when to update their passwords. Website owners had to first update their servers to the patched version of OpenSSL, then install new SSL certificates, and finally revoke the old ones. Only then would a password change be effective against the threat, and communicating that to the general public posed a real challenge.[139]

3.124 Dr Dean Economou, of NICTA, highlighted security issues around the Internet of Things, 'where you will have a lot more relatively simple devices connected to the internet that might be measuring temperature, how many cars are going past et cetera'. He noted that 'a lot of attention needs to be paid to the security there', and advised that:

> Half of our software team looks at what we call 'trustworthy systems', which is basically trying to alter the culture and

138 Symantec, *2015 Internet Security Threat Report*, Volume 20, 2015, p. 78

139 Symantec, *2015 Internet Security Threat Report*, Volume 20, 2015, p. 32

> technology around how you store and protect data, and how the software itself maintains its integrity and cannot be hacked.[140]

3.125 Symantec has also commented on the data security issues associated with the Internet of Things:

> Computing and connectivity have enhanced our lives. Phones now play videos. Cars now have navigation and entertainment systems. In our homes, lighting, heating, and cooling can be controlled from an app. The possibilities are exciting, but there is also a dark side. For example, in May 2014, the FBI and police in 19 countries arrested more than 90 people in connection with "creepware"—using Internet-connected webcams to spy on people. Similarly, as cars get "smarter" (meaning more digital and more connected), they are also at greater risk. Researchers found that many cars are vulnerable to cyberattacks. Researchers were even able to use a laptop to control a standard car.[141]

3.126 Professor Thas Nirmalathas, of the University of Melbourne, argued that 'cybersecurity is going to be critically important. I can only emphasise that we need to scale up the investment in that space.'[142]

3.127 The Department of Infrastructure and Regional Development highlighted the security risks involved in the management of large quantities of data. DIRD stated:

> There are a couple of different aspects there. There is critical infrastructure protection and making sure that the information about infrastructure is available for planning purposes and also available for productivity purposes but is not too disclosed for interference, if you like—so making sure that the systems underneath are protected. The other aspects of security are looking at things like cyber security and hacking.[143]

3.128 DIRD noted the security compliance requirements attendant on all government agencies and the level of coordination across departments:

> That is required across all of the government. In terms of departmental security, obviously we have to comply with all of those requirements also. So, there are many mechanisms across

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140 Dr Dean Economou, Acting Director, Infrastructure, Transport and Logistics, NICTA, *Committee Hansard*, 21 August 2015, p. 3.

141 Symantec, *2015 Internet Security Threat Report*, Volume 20, 2015, p. 27

142 Professor Thas Nirmalathas, Institute Director, Melbourne Networked Society Institute, University of Melbourne, *Committee Hansard*, 25 September 2015, p. 40.

143 Ms Nicole Spencer, Policy and Research Division, Deregulation Unit, Department of Infrastructure and Regional Development, *Committee Hansard*, 14 August 2015, p. 19.

> government where departments are able to actually collaborate, but there are many different aspects to smart ITC; there is not just one issue that needs to be addressed. It is never just through one channel but many channels, which can make it a challenge.[144]

3.129 Dr Matt Wenham, of the Australian Academy of Technological Sciences and Engineering, while highlighting the benefits of data access, also highlighted the risks:

> The flip side of that is: it makes that record much more vulnerable to that sort of cyber security intrusions. That is a big issue for, in this case, governments to handle because we are talking, for the most part, about the public health system. In terms of where it should be stored, I do not think that I can say that authoritatively. But there are cyber security experts and people within government who can make those judgements. But that needs to be the guiding principle—that security of this information is incredibly important and that it is a constantly evolving threat environment. There are people in groups who are constantly trying to get at this information.[145]

3.130 From the perspective of spatial data, the Department of Communications took the view that 'there are not that many security issues, provided that we are not, obviously, making public things like Defence sites, critical infrastructure and so on'. The Department noted that 'the spatial community believes that the foundation spatial data that we are building should be open', and that 'from a policy perspective, our aim is to make it free to the end user as well'.[146]

3.131 AECOM thought that cybersecurity was very important. Mr Richard Morrison, noted AECOM's experience with handling sensitive facilities in the UK. He agreed that 'there needs to be some streaming in that data; it should not all be public access'. He noted however, that much potentially security sensitive data was already publicly available for those wishing to misuse it:

> … if you go to Geoscience Australia's website, you can obtain the GIS references to every single Australian exchange, currently. So,

144 Ms Nicole Spencer, Policy and Research Division, Deregulation Unit, Department of Infrastructure and Regional Development, *Committee Hansard*, 14 August 2015, p. 19.

145 Dr Matt Wenham, Executive Manager, Policy and Projects, Australian Academy of Technological Sciences and Engineering, *Committee Hansard*, 25 September 2015, p. 11.

146 Ms Helen Owens, Assistant Secretary, Data Policy Branch, Digital Productivity Division, Department of Communications, *Committee Hansard*, 14 August 2015, p. 4.

> if you wanted to call that targeting information, you have that targeting information right now, publicly available.[147]

3.132 Dr Ben Guy, of Urban Circus, emphasised the benefits of openness over secrecy. He stated

> I think the benefits far, far outweigh the risks, and there always will be naughty people doing naughty things. I remember hearing a story about a terrible mine incident where there were some people trapped in a mine and in my head I was like, 'Man, if you had that in 3-D you would know where they are.' You would be able to get to them, where it must be so complicated without that. So there is the safety aspect and it is the same with, say, the airport link tunnel. If there was an incident you would have it mapped exactly in 3-D and available at your fingertips.[148]

3.133 Dr Michael Dixon, representing IBM, argued that security was not so much a matter of restricting access to data as eternal vigilance:

> From a security point of view, I think the problem is bad, it will continue to be bad and it will always be difficult. I think that is because humans have been malevolent. There have been malevolent humans since Cain and Abel, and they get very, very sophisticated in wreaking havoc. The problem we have now is that very capable but malevolent people can wreak havoc through electronic means on a scale that, historically, we have not seen.[149]

3.134 Dr Dixon noted that IBM had 'a very big security practice':

> It is very important. It is something that we spend a fortune on. We work with our clients around the world to protect them from all sorts of attacks in all sorts of various ways. There is no escaping that, and I think you need to have a very clear focus on security issues in protecting systems and access to them.[150]

3.135 On the other hand, smart ICT had the potential to significantly increase the security of infrastructure assets. In its submission, Transport for NSW stated:

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147 Mr Richard Morrison, Practice Lead, Information and Communications Technology, Australia New Zealand, AECOM, *Committee Hansard*, 24 September 2015, p. 16.

148 Dr Ben Guy, Chief Executive Officer, Urban Circus Pty Ltd, *Committee Hansard*, 24 September 2015, p. 6.

149 Dr Michael Dixon, General Manager, Smarter Cities, IBM Corporation, *Committee Hansard*, 25 September 2015, p. 46.

150 Dr Michael Dixon, General Manager, Smarter Cities, IBM Corporation, *Committee Hansard*, 25 September 2015, p. 46.

> Smart ICT may be a focus for reducing the requirements for labour intensive network monitoring tasks. A reliable system (with inherent redundancy) integrating operational monitoring and incident detection technologies can enhance situational awareness, reduce response times and improve productivity across security, safety and operational continuity for critical infrastructure.
>
> Smart ICT presents opportunities in the following areas:
>
> - Integration and optimisation of CCTV networks
> - video analytics
> - electronic access control systems
> - intruder detection systems
> - vehicle tracking systems
> - response crew work status
> - (voice and data) communications networks in a single user interface.[151]

3.136 Intel noted, however, that security by design was critical—'especially when it comes to safeguarding critical infrastructure and protecting the privacy of users':

> This requires sensor to the cloud security being implemented from the beginning of any project.
>
> Merely bolting on security at the end of the project is inadequate. Usually each supplier creates their own security system. When there are attempts to link these discrete systems, security risks arise.[152]

3.137 Mr David Hassett, of the City of Melbourne, stated that there was 'no doubt that in building an ICT framework security has to be not an afterthought but something which is actually, basically, built into the entire design of it so, indeed, we can secure people's information correctly'.[153]

3.138 Privacy was another important issue. The Queensland Department of Transport and Main Roads acknowledged that 'issues around privacy need to be managed to fully realise the benefits that smart ICT solutions provide, including better practice in linking cross-agency data sets, data retention and cross-border flow'.[154]

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151 Transport for NSW, *Submission 33*, pp. 9–10.

152 Intel, *Submission 42*, p. 9.

153 Mr David Hassett, Team Leader, Geographic Information Systems, Smart City Office, City Strategy and Place, City of Melbourne, *Committee Hansard*, 25 September 2015, p. 15.

154 Department of Transport and Main Roads (Queensland), *Submission 45*, p. 10.

3.139 Professor Rod Tucker, of the Australian Academy of Science, noted that the need for privacy very much depended on the type of data and its uses:

> For example, if it is medical data for managing a smart approach to health maintenance and health care, then clearly security and privacy is of utmost importance. In that case, the data would need to be held in some very secure way, and with privacy having the utmost priority. If it is data to do with the movement of pedestrians and commuters in the inner city, to do with public transport and so on, and that data has to do with management of smart applications for people to negotiate the city transport system, then clearly it is anonymised and that kind of data could well benefit from being widely available and open. So I think the answer really depends on the particular data that one is dealing with.[155]

3.140 Intel believed it was 'critical to ensure that privacy is protected in order to encourage adoption by citizens and for that to happen, data must be secure at all points'. Intel stated that 'consumer notice and consent are important, but accountability for appropriate collection, use, and data protection must also be emphasised'. It also noted that the level of privacy required depended on what data was use for:

> For example, license plate number recognition using cameras allows vehicles to be identified to deliver personalised services and enforcement notices to drivers. Such data might be used to identify drivers who have opted in to be offered promotions by nearby retailers without divulging personal information. In such cases intelligent, programmable gateway devices should be used to encrypt and filter out personal information before forwarding them to their appropriate destination—to the city's cloud server and a retail hub respectively.[156]

3.141 The City of Melbourne had grappled with this issue. Mr David Hassett believed 'that there needs to be an understanding of the balance between privacy—which we all understand—and public benefit, and where that should be properly calibrated'. He noted:

> For example, the City of Melbourne is at the moment supporting the Melbourne Metro Rail initiative with a mail-out. We have to provide them with a lot of data. Some of that data is subject to privacy. Naturally, we understand that. Where is the proper

155 Professor Rodney Tucker OAM, Chair, National Committee for Information and Communication Sciences, Australian Academy of Science, *Committee Hansard*, 25 September 2015, p. 2.

156 Intel, *Submission 42*, p. 9.

> arrangement where we can share information easily between organisations to make these things more efficient? So it is very difficult for some of those businesses just to communicate with their stakeholders without a whole raft of legal hoops to go through. We understand why they are there, but, in some circumstances, some of those arrangements could be made significantly easier.[157]

3.142 Mr Austin Ley, also representing the City of Melbourne, thought that 'we really need to have a good discussion about what the nature of privacy is and how you can actually provide information which does not impact on privacy constraints or privacy'.[158] Dr Dixon concurred. He noted that:

> What we are seeing there is that people are prepared to exchange some level of privacy for a real or perceived level of service. I think that it is also quite different with the younger generation. They see privacy issues quite differently to, perhaps, people of our age.[159]

3.143 The Department of Infrastructure and Regional Development (DIRD) thought that 'the risks to privacy presented by data collected and distributed through Smart ICT' were being 'addressed satisfactorily by existing legislation, the Australian Public Service Big Data Strategy 2013 (for the Commonwealth) and the Better Practice Guide for Big Data 2015'. DIRD acknowledged, however, that 'significant challenges remain for Government to continue to improve regulatory frameworks that mitigate privacy risks and which have implications for liability and insurance matters that affect individuals and industry differently'.[160]

3.144 The Department of Communications thought it:

> … possible—and desirable—to safely release much of the data collected and held by government agencies publicly by adhering to best practice guidelines regarding the treatment of data and by using anonymising tools and aggregated datasets where necessary.[161]

3.145 It suggested, however, that 'opening up real-time data to general use will only be desirable in certain cases, such as weather and traffic monitoring'. The Department stated that 'sensitive data will need to be restricted to

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157 Mr David Hassett, Team Leader, Geographic Information Systems, Smart City Office, City Strategy and Place, City of Melbourne, *Committee Hansard*, 25 September 2015, p. 15.

158 Mr Austin Ley, Acting Manager, Smart City Office, City Strategy and Place Group, City of Melbourne, *Committee Hansard*, 25 September 2015, p. 16.

159 Dr Michael Dixon, General Manager, Smarter Cities, IBM Corporation, *Committee Hansard*, 25 September 2015, p. 46.

160 Department of Infrastructure and Regional Development, *Submission 28*, p. 6.

161 Department of Communications, *Submission 27.1*, p. 9.

trusted users. Providers will need to carefully consider how necessary this requirement is during system development.'[162] The Department observed that:

> In terms of data security, when releasing datasets government agencies must continue to uphold their existing public sector obligations to maintain the highest standards of privacy, national security and commercial confidentiality with respect to data that they hold.[163]

3.146 Nonetheless, the Department took the view that 'data should be made open by default, subject to privacy, national security and commercial confidentiality considerations'.[164]

Committee conclusions

3.147 The importance of data to the development of smart infrastructure was highlighted in the evidence presented to the Committee. The generation, analysis and application of information are essentially what makes smart infrastructure 'smart'. This, however, presents a range of challenges, not least of which is making provision for access to data.

3.148 The Committee acknowledges the utility of open data policies and the fact that most governments in Australia are already moving down this path. Open data allows researchers and entrepreneurs to interrogate data from diverse sources, finding innovative solutions to new problems—often in ways unforeseen. As one witness put it—the information potentially available to researchers and business is a solution looking for a problem to solve. The Committee supports the concept of open data as a default.

3.149 The Committee acknowledges, however, that there are limitations to open data, related to security, privacy and commercial considerations. Security is a critical consideration. Infrastructure needs to be protected, as does the infrastructure related data itself. This should be a primary consideration in the development of all infrastructure related smart ICT and in the release of data. Asset and data protection should be part of the development of every infrastructure project. The release of data should always take account of potential security issues; but also be realistic—there is little point suppressing data on the location of assets if similar information is publicly available.

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162 Department of Communications, *Submission 27.1*, p. 8.

163 Department of Communications, *Submission 27.1*, p. 9.

164 Department of Communications, *Submission 27.1*, p. 8.

3.150 The Committee believes that the security risks surrounding the application of smart ICT to infrastructure have been downplayed in the evidence presented. The Committee notes that there have been very graphic demonstrations around the world of problems in the cybersecurity area, where a range of organisations have sought to use publically available data for their own ends, including for commercial or terrorist purposes. Given the amount of information that has been illegally accessed and released, questions of security, storage and access to data, need to be highlighted. The challenges of terrorist organisations and their use of certain sets of key data are real; and the Committee wishes to draw attention to the problems of maintaining the integrity of the security of incoming data, the storage of it and how it is used. There are risks inherent in having a 3D map of every single building in the country.

3.151 Privacy is another concern, although, as was pointed out in the evidence, concepts of privacy are changing with technology. Personal information—such as individual medical records—should not be publicly available. Yet the value of depersonalised and aggregated data must be recognised and efforts made to make such data available. The creation and promotion of such aggregated data should be the responsibility of government and industry alike.

3.152 The ownership of data is another key consideration to accessibility. Governments own, and are increasingly willing to release, valuable data. Private corporations and utilities also own much useful data, obtained for commercial purposes and not publicly available. Some organisations store and collate data on behalf of several owners. The suggestion has been made that governments mandate the release of this data. Another suggestion is that this data be made available though some form of brokerage, perhaps through central repositories. The Committee believes that data collected through private effort at private cost should remain the property of the owner. Nonetheless, the idea that this data should be managed with a view to its sale or public release is attractive. The Committee is of the view that the Smart Infrastructure Task Force (recommended in Chapter 5) should include as part of its role the development of protocols for the release of private sector infrastructure data with a view to promoting research and innovation. The Task Group should also focus on creating consistent protocols for the release of government data nationwide.

3.153 Open data requires open standards to be accessible and useful. The locking up of data within proprietary systems has the potential to render data unusable beyond its original purpose—an outcome antithetical to the concept of smart infrastructure. However, the extent to which data standards need to be prescriptive was challenged in the evidence

presented to the Committee, with a number of organisations indicating that they could make use of any data they could access. Others highlighted the importance of metadata—that ensuring the integrity of the fundamental attributes of data would enable interoperability and harmonisation.

3.154 The Committee is conscious of the work being done in Australia and internationally to create and adapt standards for the collection and management of data—especially in relation to BIM. The Committee believes that Australia should make every effort to learn from overseas experience, particularly that of the UK, in the development of standards for data collection and management and BIM. The Committee acknowledges the value of the creation of an objects library as part of this process.

3.155 The creation of massive and increasing volumes of data presents challenges to both government and the private sector. Some have undertaken investment in increased computing capacity while others have resorted to the cloud. Different organisations will need their own solutions, but the Australian Government should seek a coordinated response to the need for improved data collection and storage capabilities within government. A whole-of-government strategy for the collection, management and storage of data related to the design, planning, operation and management of infrastructure is essential to ensure that the capacity to collect and analyse data is available as needed.

Recommendation 2

3.156 **The Committee recommends to the Australian Government that the proposed Smart Infrastructure Task Force take responsibility for the national coordination of:**

- **the development of national protocols for the release of infrastructure related data in both the government and private sectors, including creating mechanisms for the brokerage or sale of private sector data;**
- **the development of standards for the collection and management of infrastructure related data, including metadata standards; and**
- **an objects library.**

Recommendation 3

3.157 **The Committee recommends the Australian Government appoints and resources the National Archives of Australia to oversee the development of a whole-of-government strategy for the collection, management, storage and security of data related to the design, planning, operation and management of infrastructure.**