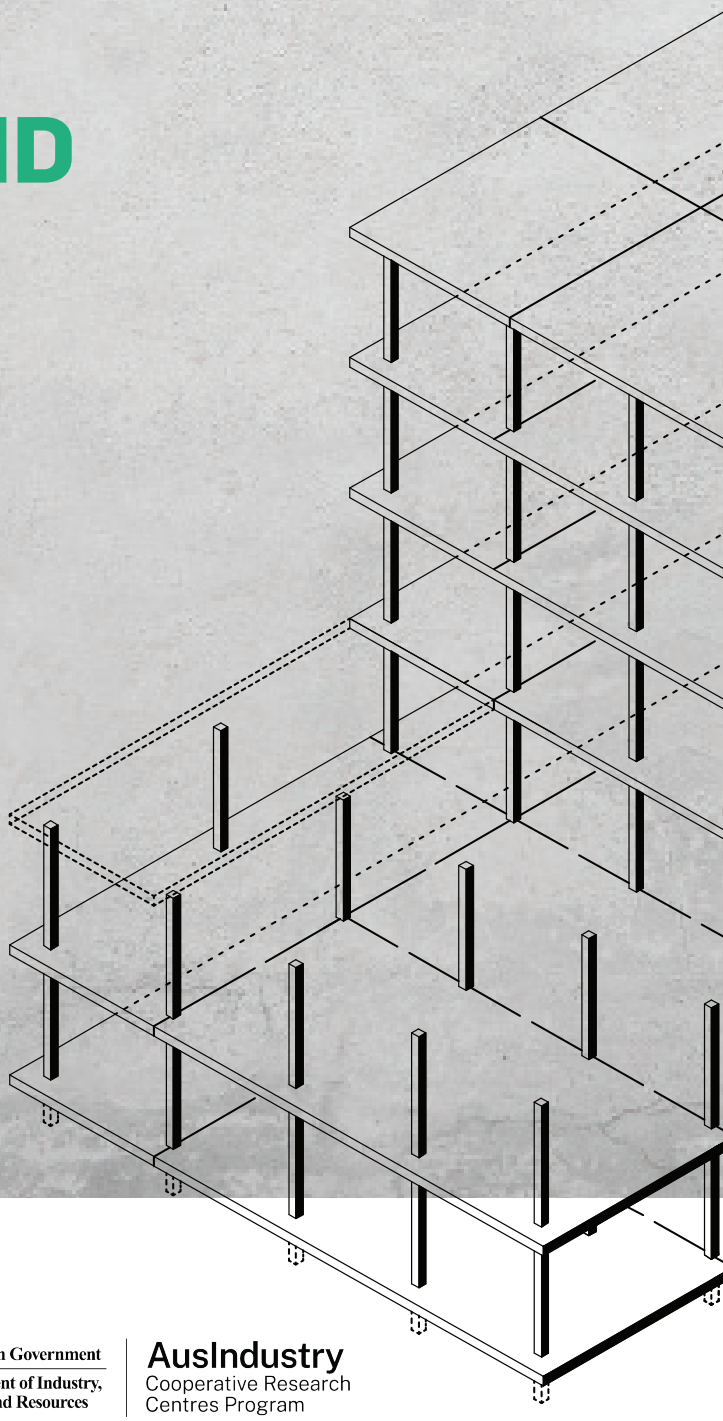
building 4.0 crc

E-PLANNING AND E-APPROVALS PROJECT:

- Technical and legal assessment report
- Current status assessment
- Benchmarking
- Gap analysis and recommendations



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- City of Wyndham
- All professional teams and associated staff and consultants.

AUTHORS

- Dr Davood Shojaei (Project Leader), The University of Melbourne
- Dr Soheil Sabri, The University of Melbourne
- Dr Eric Windholz, Monash University
- Dr Alexa Gower, Monash University
- Prof Tuan Ngo, The University of Melbourne
- Prof Abbas Rajabifard, The University of Melbourne
- Prof Colin Duffield, The University of Melbourne
- A/Prof Yee-Fui Ng, Monash University
- Dr Neda Malekzadeh, The University of Melbourne
- Dr Nilupa Herath, The University of Melbourne
- Ms Jihye Shin, The University of Melbourne
- Ms Susan Wright, Monash University
- Mr James Moutsias, Monash University
- Ms Cassandra Tremblay, Monash University
- Ms Vania Djunaidi, Monash University
- Ms Nellie Sheedy-Reinhard, Monash University

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1. EXECUTIVE SUMMARY

1. EXECUTIVE SUMMARY

1.1 ABOUT THE EPLANNING AND EAPPROVALS PROJECT

Building 4.0 CRC is an industry-led research initiative co-funded by the Australian Government. The CRC aims to develop an internationally competitive, dynamic and thriving Australian advanced manufacturing sector, delivering better buildings at lower cost and the human capacity to lead the future of industry.

Project 1 of the CRC is titled 'ePlanning and eApprovals – Scoping Study'.

Its objective is to develop a roadmap for the phased design and implementation of an innovative digital platform to facilitate effective, efficient, and timely planning and building permits and approvals, thereby removing unnecessary delays and costs that impose substantial constraints on the building and construction sector.

This objective has to be viewed in the context of what industry perceives to be a broader problem and the project's longer-term objective that extends beyond the planning and building permit process to the whole of the building lifecycle.

This broader perspective is brought to bear in this report's analysis of the planning and building regulatory space.

1.2 THE CURRENT SITUATION: STATUS OF THE PLANNING AND BUILDING REGULATORY SPACE

The planning and building regulatory space can be conceptualised as comprising five connected regulatory regimes that cover a building's lifecycle: pre-approval; approval; building; occupancy; and demolition.

Importantly, these spaces and regimes are replicated in each State and Territory, where they operate primarily at the local level. Viewed in this way, the regulatory space comprises many differing regulatory regimes.

Individually and collectively, the planning and building regulatory space is crowded, contested, complex, costly, and changeable.

Crowded: The planning and building regulatory space is occupied by:

(1) a variety of state (public) and non-state (private) actors extending beyond those directly involved with the preparation and assessment of planning and building approval applications; (2) a variety of formal legal instruments giving effect to diverse legal, economic, and social objectives; and (3) a variety of different decisions, permits, approvals, certificates, and consents made under those legal instruments.

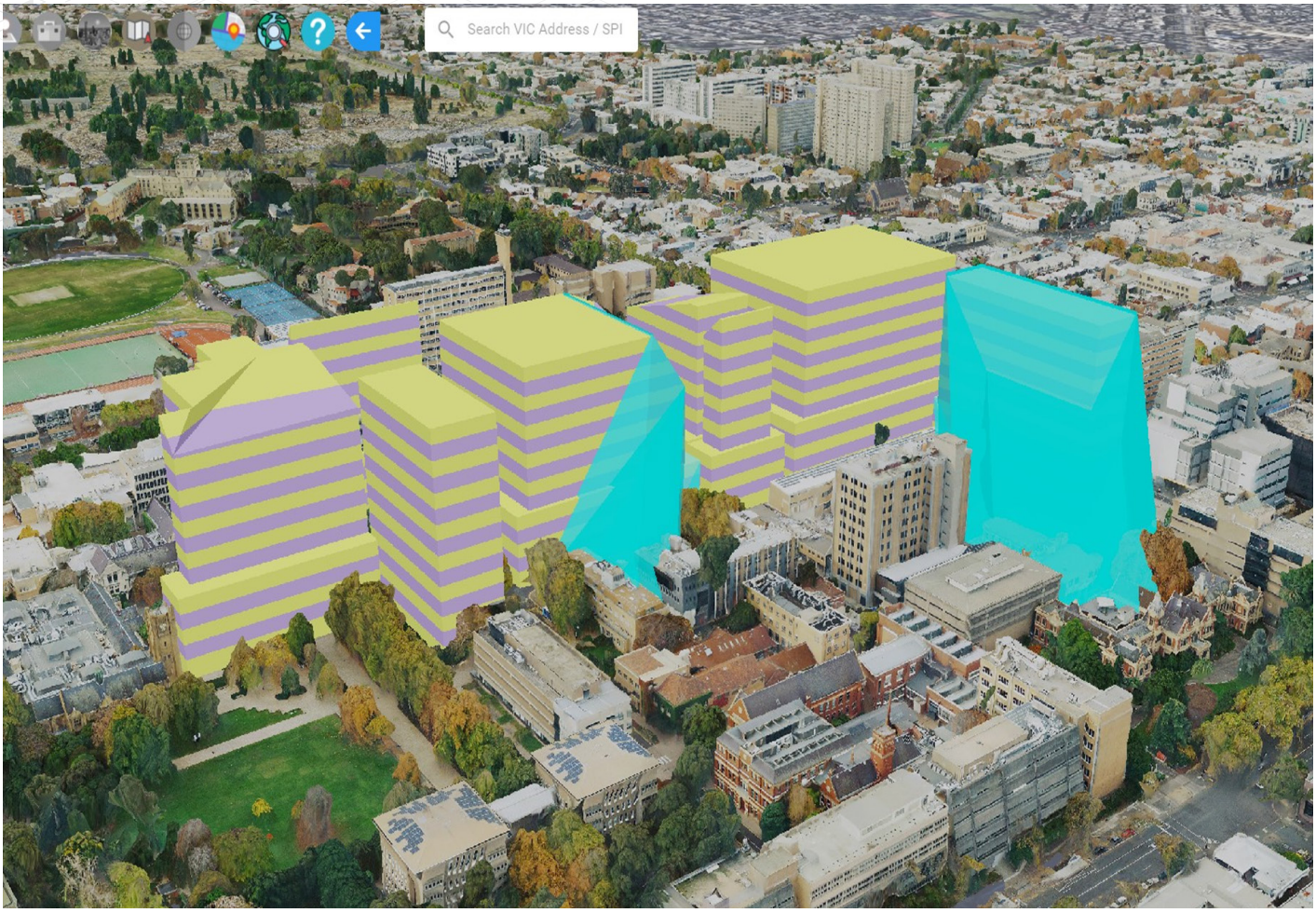
Contested: The actors occupying the regulatory space have different interests and values, and different objectives that they would like to see a building and planning system deliver. These interests, values and objectives can differ economically, socially and environmentally.

Even within the government there are agencies with different missions, priorities and regulatory roles. This is compounded by the contested development environment in which the regulatory space operates, with different building typologies with distinctive operations and characteristic pressures shaping different requirements of the planning and building system.

Complex: The actors occupying the regulatory space possess resources (information, institutional credibility, money, people) relevant to government regulation of the area. Each regulatory regime seeks to bring these actors together in a coordinated and synergetic manner that respects each actor's proprietary, legal and civic rights.

However, the networking of actors and especially regulatory authorities is suboptimal. The end result is generally perceived as being complex, cumbersome and inefficient. Moreover, this complexity is exacerbated by the different legislative and regulatory frameworks employed by States and Territories.

Approval processes necessitate decision makers devoting time to determining whether applications meet the planning system's requirements. Approval processes have many complexities in planning, and this complexity manifests itself in the requirements' complex information and forms. The Victorian Planning Authority (VPA) collects a variety of data on planning permit approvals. It



is, however, somewhat limited because the data is not currently integrated with monitoring or reporting at other stages of the process and does not always focus on timelines and delays.

The limited adoption of technologies to the planning and building approval processes in Victoria has led to avoidable delay, little predictability, and a lack of transparent monitoring in issuing building permits. The absence of a channel or system that specifically enables applicants to monitor the progress status 24/7 and communicate with permit issuers has been identified as a main contributor to these issues.

Over time, the planning legislation, Victoria Planning Provisions, and local planning provisions have been supplemented, with the approvals system now containing many layers of state and local government policies, standards, and requirements. This decentralised management of issued permits and all building records in local councils insufficiently supports the establishment of strategic plans for state-wide asset management and government administration.

Costly: The complexity in the regime translates into increased costs for industry and government (and therefore consumers and society). These costs have been estimated to be in the order of $400 to $600 million a year. In some cases, more time may also be required to decide because the quality of the information provided at the commencement of application is insufficient. Significant effort and time in reviewing and assessing building permit applications under the error-prone, manual procedure;

Changeable: The sector operates in a dynamic and changeable environment. Some of this change is brought about by changes in industry practice; some by technological change and disruption; some by events and crises; and some by government policy.

The complexity and cost of the system itself is driving calls for change to which governments are responding with proposed changes to policy, regulation and law.

In comparison, the planning and building system contains old processes and lacks some useful functionality, such as workflow capabilities, template management, and access to council data, integration of statutory clock management, and document management with the council Data Management System (DMS). It also has a long response time for changing requirements or rules. In addition, content published and produced in public planning processes may not be easily readable by computers (machine-readable).

1.3 STATUS OF BUILT ENVIRONMENT TECHNOLOGY INNOVATION AND DATA

1.3.1 TECHNOLOGY

The electronic submission and delivery of all planning and subdivision permit applications in Victoria is serviced by the Surveying and Planning through Electronic Applications and Referrals (SPEAR) online system.

This service enables applicants to lodge and manage their applications while tracking their progress, as well as permitting councils to receive, manage, refer, and approve those applications.

Also, Digital Twin Victoria, which is an innovative new digital program led by Land Use Victoria (a subsidiary of the Department of Environment, Land, Water, and Planning (DELWP)), provides opportunity for future planning and building approval process.

Victoria's digital twin proof-of-concept developed by The University of Melbourne at Fishermans Bend, for example, demonstrated how innovative technology can help solve the interconnected challenges of urbanisation.

The current situation presents old processes and lacks useful functionality such as workflow capabilities, template management, access to council data, integration of statutory clock management, and document management with the council's Data Management System (DMS).

There is also a long response time for changing requirements or rules. In addition, as aforementioned, content published and produced in public planning processes may not be easily readable by computers (machine-readable).

Vicmap Digital is Victoria's primary provider of spatial information (Geospatial Data Services). It assembles a collection of spatially related data products derived from individual datasets. In 2018, Victorian Digital Asset Strategy (VDAS) directed an innovative approach to improving the value and use of state assets through digital engineering throughout the asset lifecycle.

The VDAS relies on digital engineering technologies like Building Information Modelling (BIM) and Geographic Information Systems (GIS) to serve as a critical foundation for this whole-of-government innovation shift.

It emphasises the importance of 3D information and information technologies in realising connected information environments for asset management in order to achieve the objectives.

1.3.2 DATA

This current situation of data and standards includes challenges, such as:

Unavailability: All non-sensitive data produced during public planning processes, including development approvals data and publicly procured 3D and 4D modelling for digital twin development, are not fully available as open data;

Exclusivity: The public does not have full access to the computer code that represents the planning rules used in public or automated decision-making processes. This needs to be made available to the public in the process of digitalising the planning approval process;

Costly: The cost of software development in agencies is high, and not every agency is able to provide software. To address this challenge, public funding in the development of new digital tools is required, as is collaboration between different authorities; and

Obscurity: It is not yet clear whether the coded rules correspond to the intended planning outcomes and comply with relevant legislation. Planning rules are already being incorporated into software systems (for example, "rules as code", "legislation as code"), such as private sector applications.

1.4 STATUS OF THE PLANNING AND BUILDING PROCESS AND TECHNOLOGY INTEGRATION THROUGHOUT AUSTRALIA AND INTERNATIONALLY

1.4.1 PLANNING APPROVAL

A planning permit is a legal document that authorises a specific use or development on land. It usually includes a written document outlining the conditions that must be met as well as a set of plans.

Most planning permit applications are made to the local council, but some are made to the Minister of Planning. The planning approval process in Victoria has three main stages including preparing an application and submission, assessment and decision-making, and a possible review. The first stage of this process is conducted electronically, and the other two stages are paper-based (.PDF, .doc, .txt).

Elsewhere, realising complete digital intake and processing of planning permit applications has long been a challenge for many governments. Government electronic customer-related services have had to grow enormously.

New South Wales (NSW): In the planning approval process in NSW, lodging a Development Application (DA) and tracking it through council processes is completed digitally. An online portal is used as a single place for the planning process and transactions to take place. In this portal, viewing and interacting with the Development Control Plans and Local Environment Plans is all undertaken online.

UK: 'Planning Portal' is private digital infrastructure that, in 2002, began to transform the planning process across England and Wales. In 2008, after twice redesigning the portal to meet user requirements, the Planning Portal was able to reduce the number of form variations from around 12,000 to one.

Singapore: CORENET e-submission supports "Planning approvals" but it does not provide automatic assessment and approval services by e-PlanCheck. Appropriate infrastructure has been created to implement the digitisation of decision-making and assessment processes.

It can be noted that planners and architects at Urban Redevelopment Authority (URA) use data analytics and geospatial technologies to gain deeper insights and make more informed decisions in planning for land use, amenities, and infrastructure.

South Korea: All planning and architecture design review procedures have been placed into an integrated database, including the supporting record management of the previous review, and the sharing of review progress with applicants. This system also offers information relevant to planning and building permits to the public, such as guidelines, reports and statistical summaries.

1.4.2 BUILDING APPROVAL

A building permit is a means of regulatory control of building design and construction to ensure minimum quality requirements in compliance with the *Building Act 1993* and the *Building Regulations 2018*. In Victoria, building surveyors have the authority to issue these permits by reviewing 2D-based drawings and documents regarding the building works.

Internationally, the investigated jurisdictions show similar data requirements but vary in the approval process depending on the regulations.

A wide range of initiatives in these countries have been introduced to transform their building approval processes into a fully centralised, digitised, automated, and integrated workflow.

Of these, the integration of different processes, functions and communication among responsible authorities were introduced.

Many countries have selected BIM as the data environment of these systems, for example, CORENET of Singapore, KBIM Assess of South Korea, GeoBIM of the Netherlands, and ByggNett of Norway. Some of the initiatives are as follows:

UK: DataSpace Live (DSLive) for Building Control is a modular web-based package consisting of Submit-a-Plan, DataSpace Live, PlanShare, and My Virtual Mail Room that enables Local Authorities to receive, view, approve, download, and consult on Building Control applications online.

Singapore: CORENET is an electronic submission system that serves as a one-stop-shop in Singapore for building approval, including infrastructure for the timely and seamless exchange of information regarding buildings among all stakeholders, and the automated compliance check for building plan approval.

South Korea: Seumter is a Web portal system to provide all digitalised construction administration services nationwide, including planning, building, and occupancy permits. Its central database and intranet links to relevant authorities and all local councils and builds collaboration among them.

The Netherlands: All physical activities conducted by a business at a specific location will generally be covered by one permit. All-in-one Permit for Physical Aspects is the integrated system used for the building approval process.

1.5 PRACTICAL APPLICATION OPTIONS IDENTIFIED IN THE STAKEHOLDER ANALYSIS

1.5.1 AVENUES FOR APPLICATION

Three significant avenues for potential digitisation of the planning and building permit system were identified in the stakeholder interviews, each with a different focus, level of difficulty and benefits for stakeholders.

Stakeholders also expressed various concerns with each approach, as presented below (these approaches are further outlined throughout the report).

- **Administration system:** A simple file lodgement and processing system, which begins the application pipeline and enables applicants to check assessment status, was highlighted as an easily achievable opportunity. This could lead to significant time savings in applications and reduced strain on assessment resourcing.
- **E-development assessment (E-DA):** An E-DA as an automated compliance evaluation tool that can be used for statutory purposes, such as an initial completeness check to highlight any potential barriers and information gaps in a timely manner, or alternatively as non-statutory in-house guide to speed up the design iteration process. It can involve AI-assisted decision-making (where the decision-maker is a person assisted by guidance in the form of reports or recommendations generated by the digital platform), as well as AI-made decision-making (where the decision-maker is the digital platform itself through a fully automated process). The system options identified for this assessment include deterministic systems (that employ rules as code and are able to provide yes/no responses to objective criteria) and probabilistic systems (that utilise machine learning and are able to make predictions based on pre-programmed algorithms that can adapt to an ongoing stream of data).
- **Data for policy decision-making:** Either separately or in partnership with the above applications, a real benefit was identified in the digital modernisation process assisting the aggregate collection of data from development applications to inform better government decision-making. Other potential uses mentioned in brief, but requiring further investigation, were: demolition and reclaimed material cost benefit analysis auditing; universal environmental sustainability assessment; and building regulation auditing.

1.6 SUITABLE BUILDING TYPOLOGIES

The following four built environment typologies were raised as either suitable or not suitable by interview participants, with the different operations and characteristic pressures, often within tight budget constraints, guiding the suitability:

- **Large-scale developments** were identified by assessors as the most effective due to the sheer volume of documentation included in these projects, and the technological readiness of the Tier 1 development companies involved.
- **Greenfield, volume construction, both residential and industrial** have already undergone extensive master planning, and their repetition suits automated assessment.
- **Small-scale, bespoke projects** was contested by participants, with some feeling that the firms that work in this area would be unable to manage the shift. Others saw this as a way to improve professionalism in the area.

1.7 CRUCIAL TECHNOLOGIES

The following digital data environment technologies are essential to capturing, exchanging, and delivering required planning and building approval information in a consistent format:

- **BIM and Geospatial data** as a digital process and data model for shifting 2D document-based building information, for applying and assessing planning and building permits, to integrated 3D digital information.
- **Integration of BIM and Open Geospatial Consortium (OGC)** standard data models to connect information about physical, georeferenced, and ownership of facilities required for planning and building approval.
- **Automated compliance checking** based on digitally represented regulations, which runs code-checking using machine-readable logic from regulations for the planning and building approval.
- **Blockchain technology** to strengthen security and accountability, which could be a fundamental platform where digital submission and approval of planning and building permits occur.
- **Cloud computing** to establish a centralised system to provide online services for applying, tracking, assessing, and managing the planning and building permits, through integrated networks and databases with relevant authorities.

1.8 RISKS TO CONSIDER IN THE DIGITISATION PROCESS

Risks from the digitisation process have been identified via the stakeholder analysis and legal issue assessment, regarding both the design of the digital platform, and the legislative and regulatory framework within which it will operate.

While none of these issues are insurmountable, they require careful consideration. All risks identified vary depending on the nature and decision-making capabilities of the digital platform.

The stakeholder-identified issues include:

- **Third-party appeals:** Third-party appeal rights were highlighted as a significant barrier for the expansion of digitisation into established area infill development. This is because the high chance of design documentation change during the permit application stage deters developers from investing in sufficiently detailed 3D models for assessment at this stage.
- **Qualitative assessment and design quality:** Risks to design quality were identified from the potential separation of quantitative and qualitative regulations for assessment in planning permits. The complexity of the Victorian planning system encourages, and would benefit from, the clarity provided by separating quantitative and qualitative forms of regulation, and modes of assessment. Of concern was that, without adequate safeguards, this separation could jeopardise qualitative assessment, noted as important to realising in assessment the full value of design. If a digital, quantitative regulation-only system improved permit speed and clarity, this could encourage calls for simplification of the planning system, and the removal or reduction of the subjective and uncertain qualitative assessment from permit applications.
- **Complacency and incomprehension:** Risks to application and assessment quality were also identified due to complacency or incomprehension of the background processing occurring in E-DA. Communication of the value of the initiative, including training on the system, is vital to support both applicants and assessors.

The legal issues fall into five main categories:

- **Administrative law issues:** Ensuring that decisions made by or with the assistance of the digital platform accord with basic administrative law principles of fairness, rationality, accountability and transparency.
- **Confidentiality, privacy and data protection issues:** Ensuring the commercial, privacy and data rights of developers and users of the platform are protected.
- **Intellectual property issues:** Ensuring government owns or is licensed to use the intellectual property in the platform so they can disclose and evolve the system.
- **Dispute resolution and liability issues:** Ensuring decisions made by, or with the assistance of, the platform can be subject to review, and ensuring there are appropriate remedies if these decisions are shown to be incorrect or have the potential to cause damage.
- **Admissibility of evidence issues:** The procedural elements of the AI system, as well as the input and output data, need to be admissible in tribunals and courts.

1.9 RECOMMENDATION

The Building 4.0 CRC ePlanning and eApprovals scoping project found that the limited adoption of technologies to the planning and building approval processes in Victoria has led to avoidable delay, little predictability, and a lack of transparent monitoring in issuing building permits.

Digital and information technologies have been identified as core enablers to facilitate effective, efficient, and timely planning, and building permits and approvals; initiatives in various jurisdictions have demonstrated their opportunities and benefits.

The research makes the following technical and other enabling recommendations that will be developed by the research team into a 'Roadmap' document, to include a project vision, discipline goals, matrix of lighthouse projects, and development timeline.

Technical and enabling recommendations will be developed by the research team into a 'Roadmap' document

1.9.1 TECHNOLOGICAL RECOMMENDATIONS

The following recommendations are made to technically facilitate the process of verifying efficient planning:

- **Phased Development**: In developing the platform, it would be best to prioritise the development of components to ensure that they are interoperable. This will address what has previously been identified as a difficult and challenging exercise – developing a 'one-stop' digital platform that covers the whole-of-building lifecycle. Decisions on the phasing of components will need to consider government implementation level, building type and level of digitisation in assessment.
- **Adaptability:** Ensuring the platform can expand to cover all construction types, and other jurisdictions.
- **Aim**: In the development of digital planning systems, outcomes should be citizen-centric and improve the places, and the efficiency, of approval processes.
- **Transparency:** The platform should be able to provide a clear explanation of how it made a decision. This will be easy to do with deterministic systems; harder with probabilistic systems. The platform should provide an audit trail for each decision made, which shows each step in the process, the principles applied and considerations taken into account at each of those steps, and (where relevant) the dataset used for training purposes.
- **Cooperation:** The development of digital planning infrastructure should be a priority.

1.9.2 ENABLING RECOMMENDATIONS

The regulatory space is crowded, contested, complex, costly, and changeable, and has implications for the development of a digital platform, subject to this report. The recommendations for a digital modernisation process from the qualitative stakeholder research and legal advice are as follows:

- **Future-proofing the platform:** Ensuring the platform can evolve with changes and developments within industry, technology and government policy.
- **Future-proofing regulation**: Ensuring the regulation is sufficiently agile to adapt to rapid and transformative changes in both industry and technology.
- **Mindful integration with the existing system:** The digital modernisation process should be cognisant of the purpose and values of each existing component of the building, and planning permit application system. The process should seek to integrate with and improve these purposes and values, including those separate to the process (such as qualitative assessment in planning). If need be, safeguards should be provided to ensure all purposes and values are not put at risk by the process.
- **Extensive Stakeholder Analysis**: A fine-grain and wide-ranging understanding of all industry and stakeholder needs and barriers is important to identifying the most effective and promising avenues to commence the digital modernisation process. Further investigation should capture distinctions in the different typologies, delivery approaches of development, and stakeholder roles in the process. The platform should be developed in close partnership with industry to ensure its needs are properly understood and reflected in the final design.
- **Ownership:** The government should own, or be licensed to use, the intellectual property in the platform, to be able to disclose the platform's logic to judicial and other legal authorities, and to evolve the platform with changes in industry practice, technological developments, government policy and the law.
- **Respect and protect third-party rights:** An approach that ensures the commercial, privacy and data rights of developers and users of the platform are protected.
- **Phased development:** A transition plan to support the roll-out of the platform that leverages the drivers for change and overcomes (or at least mitigates) the barriers to change. While the digital modernisation process should focus initially on key development sectors that will be advantaged by large-scale change in the development industry, smaller opportunities for change exist, such as the creation of an as-built model library in established areas. Concurrently implementing some of these smaller changes would be more inclusive of a greater range of actors in the overall process, therefore encouraging greater buy-in to the process.
- **Broader value exploration:** In addition to the time and cost benefits for development, other broader benefits like the potential to aggregate data to improve government decision-making should also be explored to fully evaluate the value of this initiative.
- **(Algorithmic) Bias prevention:** When designing a machine learning system, the training data will need to be scrutinised for existing biases. Machine learning training should also be initially overseen, allowing for a thorough trial of the process so that errors can be detected. A gradual rollout will then enable checking for unforeseen errors.
- **Communication:** The purpose for introducing the system change and significance of each component should be clearly communicated in training to all industry and stakeholders involved in the process. This will assist with maintaining high-quality applications and assessments, and avoiding regression into only meeting the process requirements.
- **Data and leadership:** To encourage industry uptake of a digital modernisation process, as identified in the literature, there should be a focus on facilitating useful and convenient data collection and technical platforms that are highly targeted in purpose, and interfaced to specific applications. The need for organisational leadership and change was noted in all professions, as was adequately supported education and training.

2. INTRODUCTION

The building industry is an enormous contributor to the economy, employing around 1.4 million Australians and representing around 13% of GDP[1]. Australia's existing high-cost, low-tech building sector is an ideal target for the disruption that most experts agree is heading towards the sector. Through deep collaboration and new technologies of the 4th industrial age, Building 4.0 CRC will catapult the industry into an efficient, connected and customer-centric future.

The CRC aims to capture new opportunities across the whole value chain in cooperation with government, research and industry organisations. It strives to develop an internationally competitive, dynamic and thriving Australian advanced manufacturing sector, delivering better buildings at lower cost, and the human capacity to lead the future of industry.

Three integrated research programs are defined as:

1. Sectoral Transformation
2. Digital Transformation
3. Building Transformation

These research programs will help to ensure that the CRC delivers on:

- New industry-wide culture, practices and standard protocols that will enable the transformation of the entire sector;
- New building processes and techniques through leveraging the latest technologies, data science and AI; and
- Improvements to building "hardware" and processes, and their interaction with our digital and sectoral programs, to ultimately improve all aspects of the key building phases (development, design, production, assembly, operation, maintenance, and end-of-life).

The CRC is also creating pathways for future employees to develop new tech-focused skills through a deep understanding of the industry's needs and culture.

[1] https://campaign.propertycouncil.com.au/our-campaign/australias-property-industry

2.1 ABOUT EPLANNING AND EAPPROVALS – SCOPING STUDY

Project 1 of the CRC forms part of Program 2 (Digital Transformation) and is titled 'ePlanning and eApprovals – Scoping Study'. Its objective is to develop a roadmap for the phased design and implementation of an innovative digital platform to facilitate effective, efficient, and timely planning, and building permits and approvals, thereby removing unnecessary delays and costs that impose substantial constraints on the building and construction sector.

Planning and building approval processes are still largely paper-based (PDF) making them inefficient and time-consuming, in turn imposing significant costs on both industry and government. Industry is unable to effectively test plan compliance against planning controls and building regulations, track progress of their applications, and efficiently track compliance through construction.

The longer-term objective of the CRC's work in this area is to embrace the opportunities that digital workflow and digital twin technology provide, to design, develop and deliver an innovative digital platform to facilitate effective, efficient and timely planning, building permits, approvals, ongoing compliance with planning controls, building regulations, and other regulatory requirements.

The digital platform will not be a simple electronic submission system, but rather a rich digital platform that will (among other things) provide:

- An integrated planning and building development approvals process in which planning and building controls and rules are coded, thereby providing industry and regulators with a streamlined assessment tool that facilitates (to the extent that is reasonably practicable) compliance checking, certifications and approvals;
- Industry participants with an assessment tool utilising digital twin concepts to test plans for compliance with planning and building controls and regulations, thereby minimising incomplete applications and requests for further information;
- Regulatory authorities with a streamlined assessment tool that delivers enhanced speed, accuracy and transparency at less cost for both industry and government;
- Industry participants, regulators, and other stakeholders with a platform from which to compare the as-built with the as-designed building for regulatory compliance; and
- A single source of information (point of truth) for both proposed and approved designs upon which future policy, planning and regulatory decisions can be based.

In order to achieve these objectives, the project-related problem is identified as:

1. Aligning the ePlanning and eApprovals (eP&eA) scoping with international, national, state, and local strategic pathways for effective digital modernisation of planning and building development, and to develop a strategic roadmap.
2. Adapting the Data, Innovation, and Standards of Framework for Effective Land Administration (FELA) for technical features of the eP&eA scoping roadmap.
3. Adopting the **Victorian Digital Asset Standards (VDAS)** and **Spatially Enabled Digital Twin Principles** in the eP&eA scoping roadmap.
4. Introducing a **Pilot Project** for eP&eA architecture.
5. Achieving **sustainable, social, economic and environmental** development.

3. A REVIEW OF INITIATIVES IN AUSTRALIA AND KEY OVERSEAS JURISDICTIONS

This section reports on the findings of our study regarding the current development assessment process as part of statutory planning and building approval processes in Australia, and in key overseas jurisdictions.

3.1 NATIONAL EPLANNING STRATEGY 2011-2020

The Australian economy relies heavily on building and infrastructure developments, which influence the urban and rural quality of Australian lives. It is critical for liveable and vibrant communities that the built environment meets and reflects state and local policy objectives. In achieving this, development assessment plays a critical role.

The pressure on assessment systems has increased in recent years, owing to both increased levels of development activity and increased community interest and expectations about what is appropriate. Only when assessment systems are efficient and have clear policy objectives will they be able to respond to these pressures.

There is widespread agreement in Australia that existing development assessment processes could be significantly improved; many jurisdictions are already actively working towards this goal.

In 2011, the National ePlanning Strategy outlined a vision and roadmap for the future of electronic services for planning development in Australia (National eDA Steering Committee, 2011).

The vision was to harness new and emerging technologies to support planning business process efficiencies. The strategy encouraged the broader community to play an active role, as drivers for a technology push to achieve appropriate planning systems as well as accessing the comprehensive, accurate, reliable and timely development and planning information.

The process of managing and approving planning and development is currently quite complex and is not always a straight line. It involves multiple stakeholders with diverse interests, and the roles and responsibilities of stakeholders change over time and are not always clear.

The current state assessment attempts to account for this complexity while producing outputs that are relevant and actionable based on the National ePlanning Vision, presented in Figure 1 Australia's National ePlanning Vision 2011-2020. Adopted from: National eDA Steering Committee, 2011.

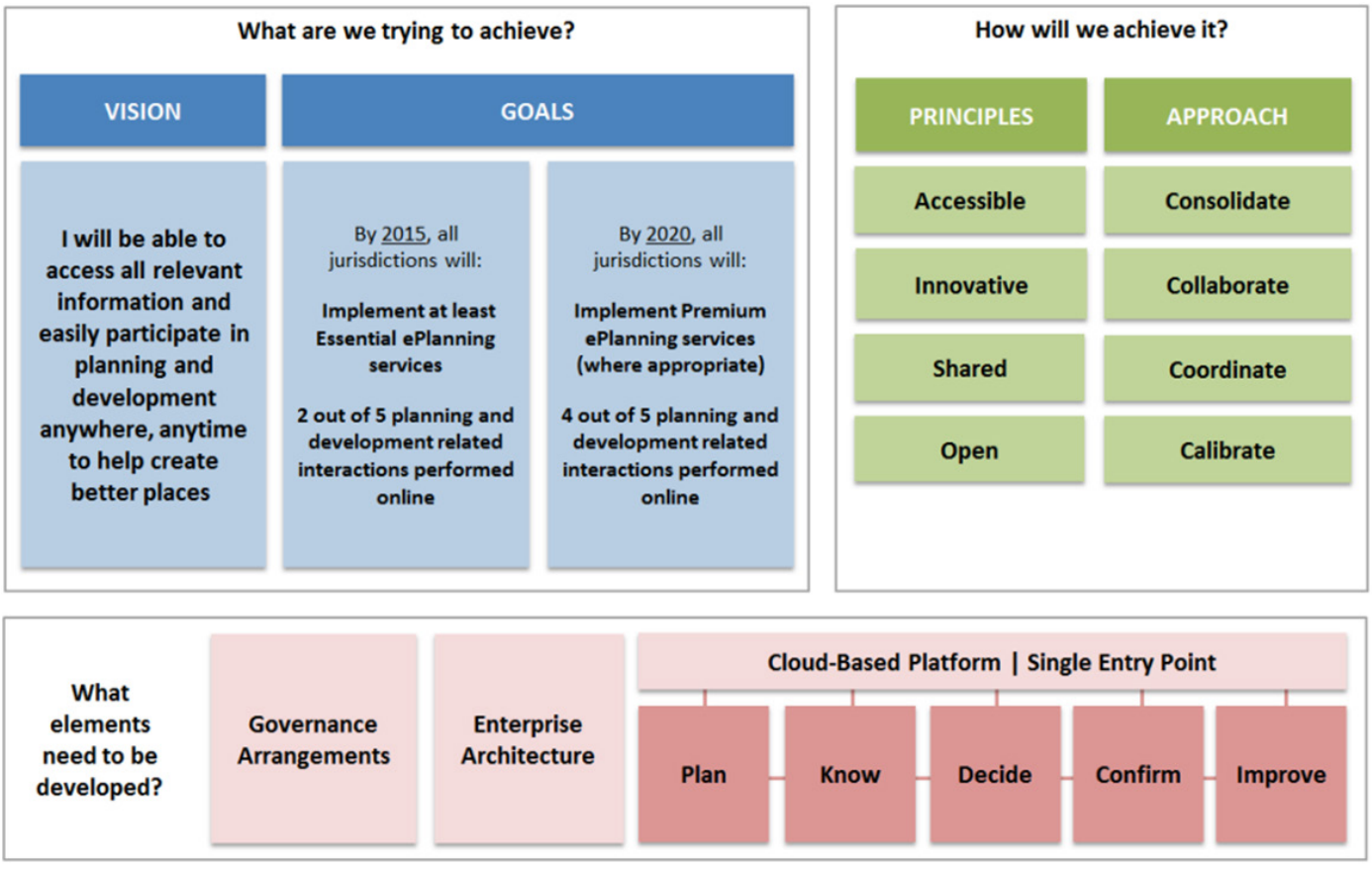


Figure 1: Australia's National ePlanning Vision 2011-2020. Adopted from: (National eDA Steering Committee, 2011)

3.2 PLANNING APPROVAL PROCESS IN AUSTRALIA AND OTHER JURISDICTIONS

3.2.1 PLANNING APPROVAL PROCESS IN VICTORIA

The planning permit is preferred for the development approval process in the Victorian planning system. It is central to the planning system, determining what a landowner may do on their property. The responsible authority issues permits, which must be dispensed consistently with the planning scheme.

This approval process is the primary means by which a council and the community can determine whether a proposed use and development of land meets state and local planning objectives for that land.

The planning scheme regulates the use and development of land. One approach requires that certain types of use or development be carried out only with planning permission. Planning permission is the preferred form of development approval in the Victorian planning system.

Through the permit process, planning schemes allow for a diverse range of uses to be considered in each zone.

Figure 2 Simplified Planning approval process in Victoria illustrates the general planning approval process in Victoria. When the completed application form is submitted to the responsible authority, the process officially begins, with a full description of the proposal and the prescribed fees. In practice, the applicant will benefit from a thorough discussion of the proposal with the responsible authority prior to submitting the formal application.

The detailed process is represented in Appendix B.

The regular permit process has three main stages, as follows:

PREPARATION AND LODGEMENT STAGE

Before beginning any construction or changing the use of land, the owner must first determine whether a planning permit is required, given the property's zoning and overlays.

The applicant must describe their proposal in plans and other documents, and provide any information required by the planning scheme when preparing the planning permit application. The more effort put into preparation, the less likely it is that the application will be delayed. Some councils provide pre-application services to assist applicants with their preparation.

The formal assessment process begins when the applicant submits an application to the responsible authority, along with the required fee and information. The council planning staff then enters the application into the planning permit register and begins the formal approval process, which may include providing notice, referring the applicant to another agency, or requesting additional information from the applicant.

After receiving an application, the council is expected to make a decision within 60 statutory days. The statutory clock, on the other hand, is not continuous and can pause and reset at various stages of the assessment process, potentially extending the total timeframe (Better Regulation Victoria, 2019).

Many proposals will necessitate the input of other agencies before the responsible authority can make a decision. Based on the proposal, the location, and other factors,

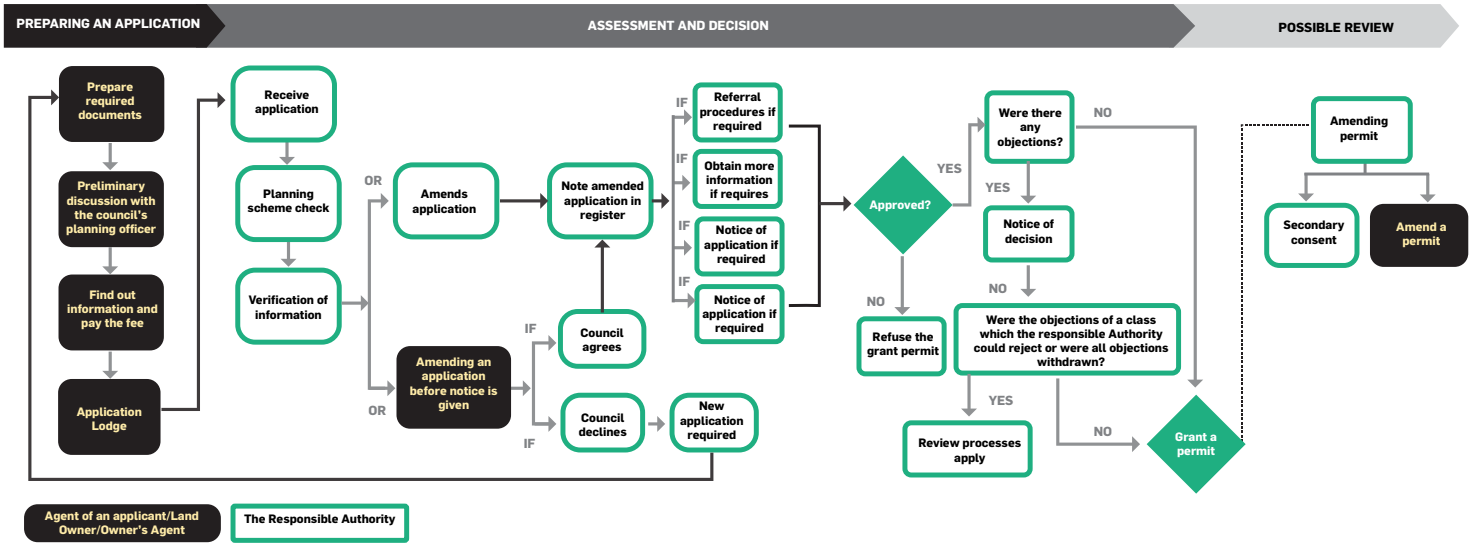


Figure 2: Simplified Planning approval process in Victoria

these agencies will be prescribed in the planning scheme. The responsible authority will send copies of the request to these agencies for comment. In some cases, the responsible authority will give or require notice to adjoining owners and occupiers, unless it determines that no material detriment will be caused to any person, or the planning scheme expressly allows an exemption from the notice requirements. There are several standard procedures for providing notice of an application (Department of Planning and Community Development, 2007).

Notice may be given depending on the size and intensity of the proposed use or development:

- mailing notices to property owners or occupiers who may be impacted by the proposal;
- displaying a notice on the land;
- putting a notice in the local newspaper; and/or
- any other technique deemed necessary.

Before making a decision, the responsible authority may also request additional information (Department of Planning and Community Development, 2007).

ASSESSMENT AND DECISION STAGE

After gathering all necessary information from the applicant, receiving input from any referral authority, and considering all public comments, council planning officers evaluate the application and prepare a recommendation on whether it should be approved and, if so, what conditions should be included in the approval.

The council, as the responsible authority, is legally required to make a decision on a planning application. In practice, most applications are decided by senior planning staff who have been delegated authority. Delegations are handled differently by different councils (Better Regulation Victoria, 2019).

The responsible authority can decide on the application once notice (if required) has been given and the relevant timeframe for submission of objections or comments by any referral authority has elapsed.

The responsible authority will issue a permit, a notice of decision to grant a permit, or a notice of refusal to grant a permit, depending on its opinion and whether objections have been received.

An application to the responsible authority can also be made to amend an existing permit. The application is processed similarly to a permit application, with the responsible authority eventually issuing an amended permit, a notice of decision to grant an amendment to a permit, or a notice of decision to refuse to grant an amendment to a permit.

In certain circumstances, an applicant or, in many cases, an objector, may request that the decision be reviewed by the Victorian Civil and Administrative Tribunal (VCAT) (Department of Planning and Community Development, 2007).

An applicant may apply to VCAT for a review of the following:

- a requirement to notify;
- a requirement for additional information;
- the failure of a council to make a permit decision within 60 days; or
- a decision by a council to deny a permit.

VCAT applications can take several months to be heard. The procedure may include a mandatory conference followed by a formal hearing before an expert Tribunal member. VCAT review rights are also available to community members who objected to the application. A legal dispute can be brought before the Supreme Court (Better Regulation Victoria, 2019).

POSSIBLE REVIEW STAGE

The Victorian planning system recognises that the intentions of a permit holder can change over time. Rather than having to submit a new permission application each time a change is planned, there are two other options: (1) Application to amend a planning permit; and (2) Secondary consent.

Before submitting an application, an applicant should review their amended idea with the council planner to identify the best course of action.

3.2.2 CHALLENGES OF PLANNING APPROVAL PROCESS IN VICTORIA

A planning permit is a legal document that authorises a specific use of or development on land. It usually includes a written document outlining the conditions that must be met, as well as a set of plans.

Most planning permit applications are made to the local council, but some are made to the Minister of Planning. The planning approval process in Victoria has three main stages, including preparing an application and submission, assessment and decision-making, and a possible review.

The first stage of this process is conducted electronically, and the other two stages are paper-based (.PDF, .doc, .txt).

This current system has complex challenges including insufficient information; decision complexity, costs and delay; multi-layer planning legislations; and multiple authorities.

This is reflected in the planning approval process.

Insufficient information: In some cases, more time may be required to make a decision because the quality of the information provided is insufficient.

Decision complexity, costs, and delay: Approval processes necessitate decision-makers devoting time to determining whether applications meet the planning system's requirements.

Approval processes in planning have many complexities, and this complexity manifests itself in the requirements' multifaceted information and forms.

The Victorian Planning Authority (VPA) collects a variety of data on planning permit approvals. It is, however, somewhat limited, as the data is not currently integrated with monitoring or reporting at other stages of the process, and does not always focus on timelines and delays.

Multi-layer planning legislations: Over time, the planning legislation, Victoria Planning Provisions, and local planning provisions have been supplemented, with the approvals system now containing many layers of state and local government policies, standards, and requirements.

Multiple Authorities: In the assessment, there are numerous decision-making authorities, and so decision stages can incur significant costs and delays as these authorities navigate the system.

To facilitate the process of verifying efficient planning, digital transformation is needed. This transformation requires consideration of implications and recommendations, such as:

- Digital planning should start at the local level in accordance with the existing contextual and local differences, considering needs as well as local standards.
- In the development of digital planning systems, outcomes should be citizen–centric and improve the places and the efficiency of approval processes.
- Digital decision-making systems should be held accountable and be transparent.
- Cooperation in the development of digital planning infrastructure should be a priority.

3.2.3 PLANNING APPROVAL PROCESS IN NEW SOUTH WALES (NSW)

According to The World Bank topic analysis, all administrative tasks for obtaining building and occupancy permits of a 2-story warehouse (1300.3 m^2) require 11 procedures, and it takes around 120.5 days (The World Bank, 2019).

In NSW, the Construction Certificate (CC) can be obtained from the local council or a registered certifier.

This certificate confirms that the construction plans and development specifications are consistent with the development consent, and comply with the Building Code of Australia and any other council requirements. A construction certificate is used to verify the following:

- the work carried out complies with the Building Code of Australia (BCA);
- the design and construction work as depicted in the plans and specification is consistent with the development consent;
- any conditions of development consent that must be complied with before a construction certificate is issued have been met; and
- structural strength and fire protection issues have been satisfied.

Further, a fire safety schedule is issued as part of the construction certificate.

The planning system in New South Wales enables and guides development to ensure the state has housing, jobs, and a healthy environment.

Many types of development necessitate council approval, also known as development consent. An applicant applies for development consent by lodging a Development Application (DA).

The planning process in NSW has seven stages, including pre-lodgement, lodgement, assessment, determination, after the decision, construction certificate, and occupation certificate.

The stages, participants, roles and responsibilities are summarised in Figure 3: Simplified Planning approval process in NSW.

The pre-lodgement stage is the first stage of the development evaluation process. In this stage, obtaining information from the planning control process is considered, and in the second stage a site analysis is performed.

Then, a pre-lodgement meeting with council is held and, in the last step, the DA is prepared.

Lodgement and initial administration of applications by the council is the second step of the planning approval process in NSW. The formal start of the DA process is lodgement. Council will ensure that all necessary information has been provided.

The EP&A Regulation specifies the timeframes and procedures that a consent authority must follow when assessing a DA (step three of the planning approval process).

If the information provided is adequate, the 'clock', which measures the time the council has to evaluate the application, will begin.

This is significant because if council does not determine DA within the specified timeframes, the applicant may have the right to go to court to seek a determination of DA.

The council has internal experts who will provide input on various environmental issues. Many councils hold a meeting of experts to review submitted DAs, to ensure that the information is sufficient to make a decision.

In step four, determination, there are three possible outcomes for a DA, including development consent (granted, with conditions), DA refusal (with reasons), and deferred commencement consent (a consent not operating until one or more important matters are resolved).

If DA is denied or granted with unfavourable terms, the applicant has three options, all of which will

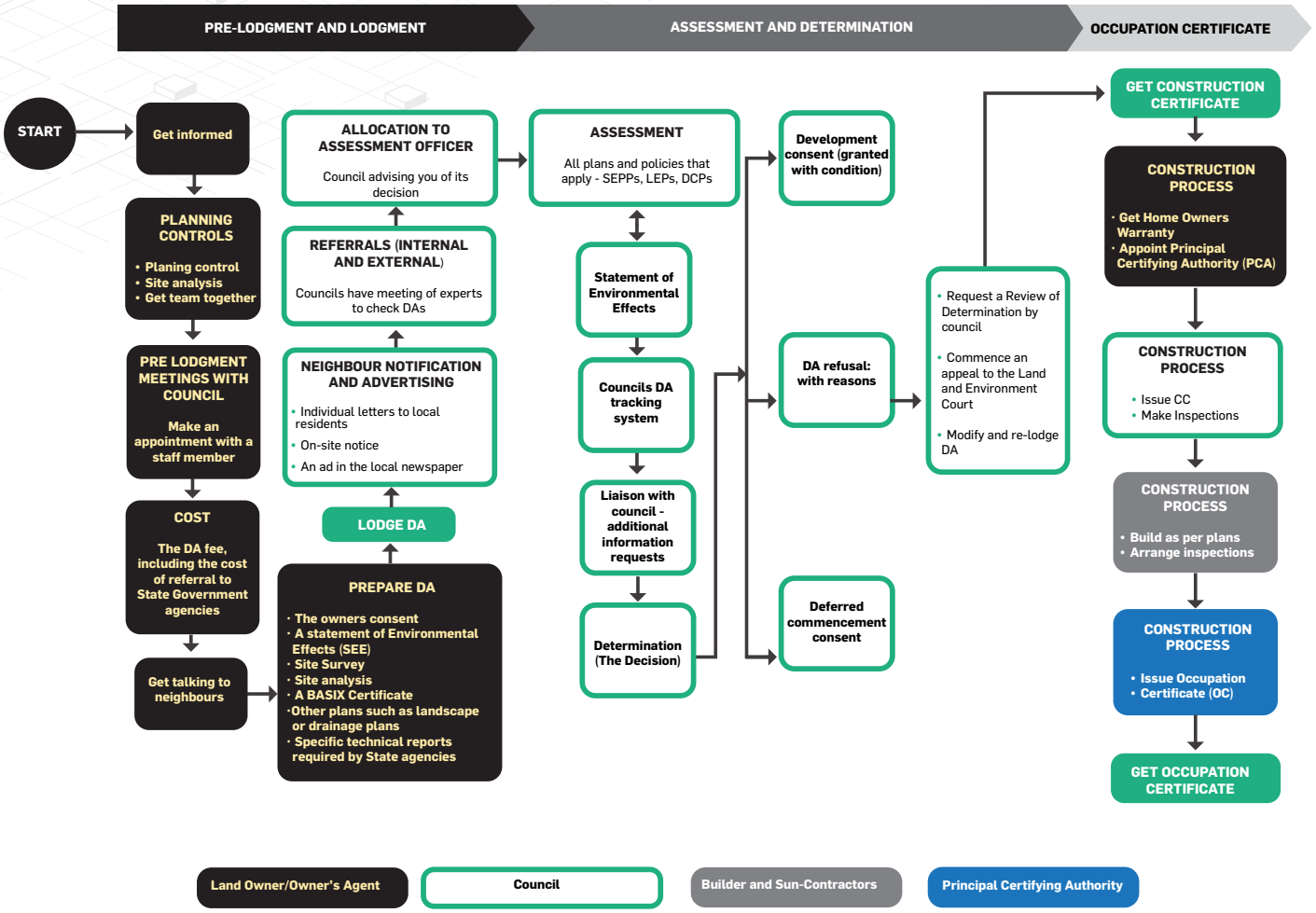


Figure 3: Simplified Planning approval process in NSW

take time and money: request a review of determination by council; commence an appeal to the Land and Environment Court; and modify and relodge the DA.

Stages five and six of planning approval process involve acquiring the Construction Certificate (CC) and acceptance certification.

The CC must be obtained from council or an accredited certifier, and includes detailed building plans/engineering details and specifications.

The plans will most likely contain a lot more information than approved DA plans, to allow the builder to work directly from them (NSW Government 2018).

3.2.4 PLANNING APPROVAL STATUS IN SOUTH AUSTRALIA

3.2.4.1 PLANNING REFORMS IN SA

South Australia has recently undergone the most significant modernisation of its planning system in 20 years.

The new planning system is supported by the new *Planning, Development and Infrastructure Act 2016* (the Act), which introduced a range of new tools, including a digital ePlanning system that is available 24 hours a day, seven days a week. As of 19 March 2021, a new planning system in South Australia came online.

The Planning and Design Code is the new system's cornerstone, having replaced all council development plans to become the single source of planning policy for assessing development applications.

The Code replaces all 72 development plans as the state's single source of planning policy for evaluating development applications.

The Code is a statutory instrument established by the *Planning, Development, and Infrastructure Act 2016* for the purposes of development assessment and related matters in South Australia.

The Code aims to provide South Australians with consistent and clear planning policy, making the planning process faster, simpler, and more equitable. It is intended to help applicants navigate the planning system when building a house, starting a business, or moving forward with large commercial developments.

3.2.4.2 THE PLANSA

The PlanSA website serves as the gateway to South Australia's new ePlanning system. The planning and development system is brought online by PlanSA. South Australians can apply for development permits online.

The Chief Executive of DIT established this website, which is part of the SA planning portal for the purposes of section 48(1) of the *Planning, Development, and Infrastructure Act 2016* (the Act).

The Act establishes the new SA planning portal, which serves as a one-stop-shop for information, online services, and community participation in the South Australian planning system. South Australians now have easy access to planning information and can use their computer, phone, or tablet to access the system 24 hours a day[2]

South Australians can use PlanSA for:

- Online lodgement of development applications;
- Online monitoring and tracking of development applications;
- Receiving decision notices electronically and getting approvals faster;
- Gaining instant access to searchable and reliable planning information, publications, maps, and data 24 hours a day, seven days a week;
- Easily obtaining the most recent planning news and updates;
- Onlining access to planning policy and spatial map information;
- Onlining tracking of Planning and Design Code amendments; and
- Accessing the online directory of accredited professionals.

Realising complete digital intake and processing of planning permit applications has long been a challenge for many governments. Government electronic customer-related services have had to grow enormously.

In this project, our aim has been to provide a review of initiatives that have been implemented on a digital planning approval process, and to identify success and failure factors.

3.2.5 PLANNING APPROVAL PROCESS IN OTHER JURISDICTIONS

3.2.5.1 UNITED KINGDOM (ENGLAND)

A building permit is required by almost every city in the UK in order to construct or alter a building or structure. *The Building Act 1984* (the Building Act) is the most wide-reaching law controlling buildings in England; it sets the enforcement powers.

The Building Regulations 2010 go into more detail about building work, and most building work carried out in England must comply with the Building Regulations. Generally, the Building Regulations set out the required standards for the building work.

According to The World Bank topic analysis, all administrative tasks for obtaining building and occupancy permits of a two-storey warehouse (1300.3 m^2) require nine procedures and it takes around 89 days (The World Bank, 2019).

The United Kingdom, like all other developing countries, has a planning system that regulates development, including changes in land and building use in the public interest. There are various definitions and understandings of the purpose of the UK's planning system that vary depending on one's own perspective. However, the government's view is that the purpose of the planning system is to save what is the best of their heritage and improve the infrastructure on which they rely for a civilised existence[3].

The regulatory dimension, which assesses and determines proposals to undertake development with reference to policy, is the accompanying pillar of the planning system to the national and local policy contexts.

Most planning applications are handled at the local level, and decisions are made in accordance with national and local policy. The precise relationship between plans and decisions is complicated, and there is a lot of case law on the subject.

In general, decisions on applications for planning permission must be made in accordance with the development plan, unless material considerations indicate otherwise.

The process varies depending on the type of application (for example, major proposals require more consultation and involvement of other public bodies) and the area (for example, whether the area is a National Park), but the basic process remains the same (refer Figure 4: The process of preparation and adoption of a local plan in the UK).

Any matter relating to land development can be considered by decision-makers. Planning considerations are primarily concerned with external physical matters, such as appearance, the relationship between buildings, or other factors such as building density, landscaping, parking provision, and so on.

[2]https://plan.sa.gov.au/our_planning_system/plan_sa/this_website
[3]Planning Portal (2018), https://www.planningportal.co.uk/info/200127/planning/102/about_the_planning_system.

Figure 4: The process of preparation and adoption of a local plan in the UK

Figure 5: The process for application for planning approval in the UK

3.2.5.2 THE NETHERLANDS

In the early 1980s the Dutch government came up with proposals to simplify and reduce building regulations and permit procedures.

It intended to achieve several objectives: to reduce the number of rules and make them more transparent; to centralise regulation and make it more uniform; to reinforce the legal rights of all parties; and to expedite the procedures (reducing the workload and the expenditure on administration).

All these desires were translated into new regulations. Three categories of construction work were introduced. A new centralised and standardised system of technical building control was established.

Checking procedures for notifiable construction work were simplified, and absolute deadlines were introduced.

According to The World Bank topic analysis, all administrative tasks for obtaining building and occupancy permits of a two-storey warehouse (1300.3 m^2) require 13 procedures and it takes around 161 days (The World Bank, 2019)

3.2.5.3 SINGAPORE

The construction industry in Singapore once accounted for 4% of GDP.

Although in 2020 its growth reversed due to COVID-19, the growth rate of GDP contribution from construction sectors had increased from 2015 to 2019.

The Building and Construction Authority (BCA) projected a steady improvement in construction demand from 2022 to 2025, to reach between S$25 billion and S$32 billion (Building and Construction Authority, 2021).

According to The World Bank topic analysis, all administrative tasks for obtaining building and occupancy permits of a two-storey warehouse (1300.3 m^2) require nine procedures and it takes around 35.3 days (The World Bank, 2019).

In Singapore, all building works must comply with Building Control Act and Building Control Regulations. These legislations provide requirements and standards to ensure safety, accessibility, environmental sustainability, and buildability in built environments.

Building works require Building Plan Approval from the *Commissioner of Building Control,* which serves as a building permit in Singapore. The building works refer to the erection, extension, alteration, or demolition of a building. The exemption applies to minor building works under the Regulations.

3.2.5.3.1 Gross Floor Area (GFA) AutoChecker

Leveraging BIM, URA has developed an automated checking system for Gross Floor Area (GFA) AutoChecker. It is a rule-based checking system for verifying GFA of the submitted proposals prior to issuance of Written Permission. URA launched this project in 2020 and will run a pilot over a period of one year.

In 2020, BCA published the BIM Modelling Guideline for GRA Autochecker System under the current submission requirements and Modelling Guidelines (CoP for BIM e-submissions)

3.2.5.3.2 Planning Approval Process

The *Urban Redevelopment Authority* (URA) is an authority to approve applications for planning approval and register any approved plan of works. Urban Redevelopment Authority is responsible for enforcing the Act and Regulations; they assess, approve, and register the planning permit.

Figure 6: The planning permit process in Singapore depicts the typical planning approval process, which consists of two main stages.

Preparation & Application stage

To apply for planning approval, the Qualified Person (QP)[4] should determine whether planning permission is required.

The Planning Permission Exemption List contains information on minor development or building works that do not require planning approval or permission from URA. Following the completion of the submission checklist, the development control submission checklist only serves as a guide for Qualified Persons (QPs) to ensure that the planning submission requirements are met.

QPs are not required to submit this checklist to the Development Control Group, URA. The Handbook on Parameters for Residential and Non-residential Development contains information on the planning requirements.

In the final stage, the submission summary of applications is sent to URA for decision-making.

Decision-making and grant the permit stage

After the submission is made by the QP, URA control checks compliance of the planning guidelines. If the development complies with the guidelines, URA issues Written Permission (WP).

If the development does not comply with guidelines, URA can agree or disagree with the proposal with conditions. In the event of a disagreement, URA issues advice, and resubmission is required. In the event of agreement, URA issues provisional permission (PP).

If URA agrees to a proposal with conditions, including obtaining approval from certain authorities, some works including substructure works can commence, and it is valid for six months. After resubmission, if the development complies with guidelines, URA issues Written Permission (WP) stating that the URA agrees to the proposal, and this is valid for two years.

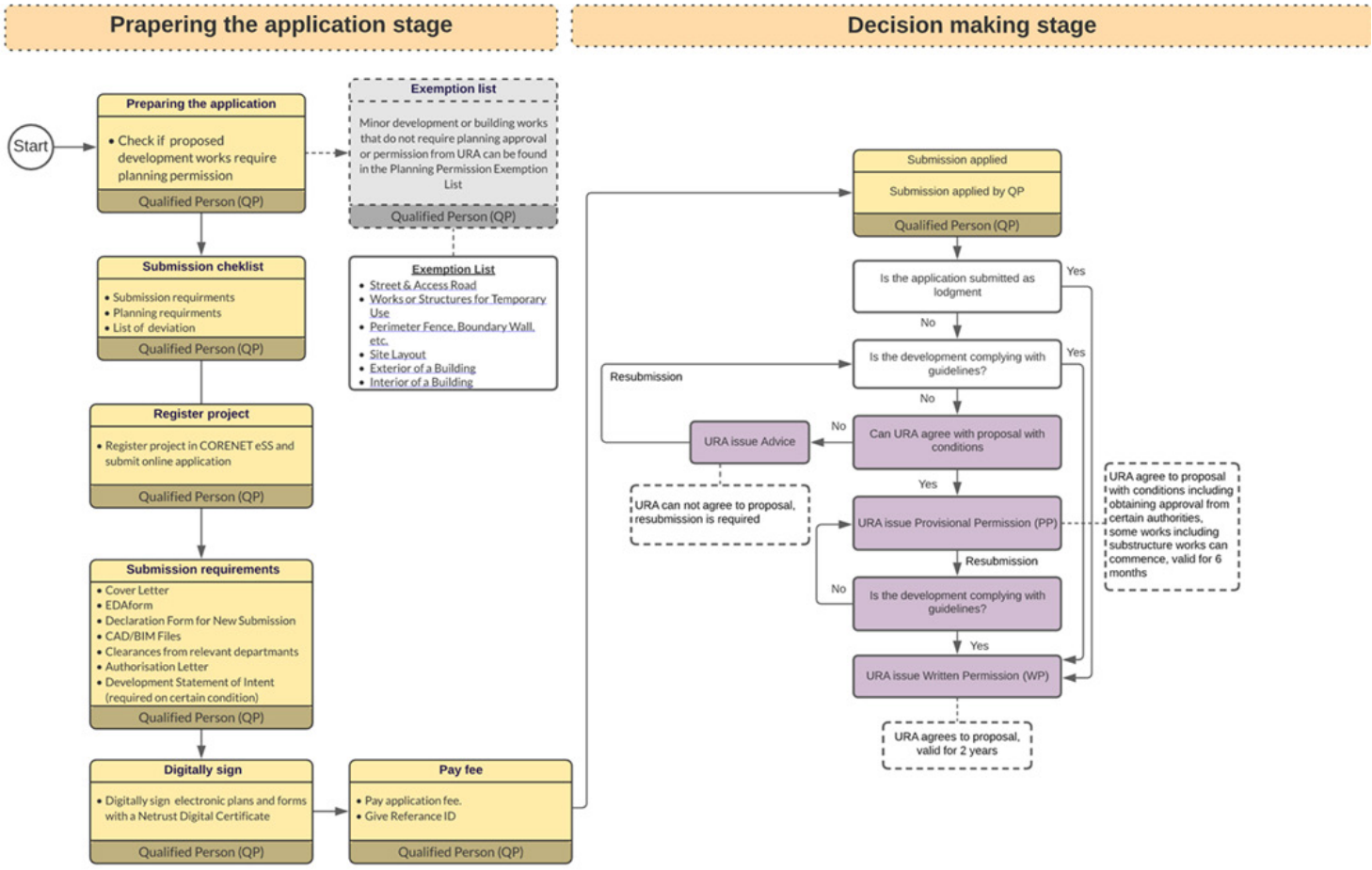


Figure 6: The planning permit process in Singapore

[4]Qualified Person (QP) such as registered architects, registered surveyors and/or professional engineers

3.2.5.4 SOUTH KOREA

In South Korea, the construction industry has been an important sector, being the growth engine of the economy.

The GDP from this sector showed overall growth until 2017 and started to decrease from the year after; this industry contributed to around 13.2% of GDP in 2020 (Statistics Korea, 2021).

In South Korea, the Building Act and Building Regulations are legislation that establishes the standards for, and purposes of, the use of sites, structures, and facilities of buildings.

They formulate processes and required standards of building permits to improve the safety, functions, environment, and fine view of buildings and promote public welfare.

According to The World Bank topic analysis, all administrative tasks for obtaining building and occupancy permits of a two-storey warehouse (1300.3 m^2) require ten procedures and it takes around 27.5 days (The World Bank, 2019).

In 2020, around 223,000 building permits were issued by the city or local councils across the nation (Korean Ministry of Land Infrastructure and Transport, 2021).

3.2.5.4.1 Planning Approval Process

In South Korea, the regulated standards for planning permits are formulated by the National Land Planning and Utilisation Act (NLPUA).

It is key legislation that enables regulation and encourages land utilisation management. The Act and its Enforcement Decree provide matters necessary for the formulation and implementation of plans to utilise, develop and conserve national land to promote public welfare and to improve citizens' quality of life.

It includes specific requirements and standards for metropolitan plans, urban plan/master plans, urban management plans, permission for development activities, and permissions of land trade.

In South Korea, all development activities are managed under the Enforcement Decree of the NLPUA. Planning approval provides administrative activities for issuing legal documents permitting land use and development to secure efficient land use and execute urban management plans smoothly.

The activities of land use development include: (1) construction of buildings, or installation of structures; (2) changes in the form and quality of any land; (3) extraction of earth and stone; (4) subdivision of land; and (5) piling up goods within the green area, control area, or natural environment conservation area.

For building works, issued building permits also serve as the issued planning permit for those activities. Owners or developers do not have to apply for the planning permit. Figure 7: The planning approval process in South Korea shows the generalised process of planning approval consisting of three stages.

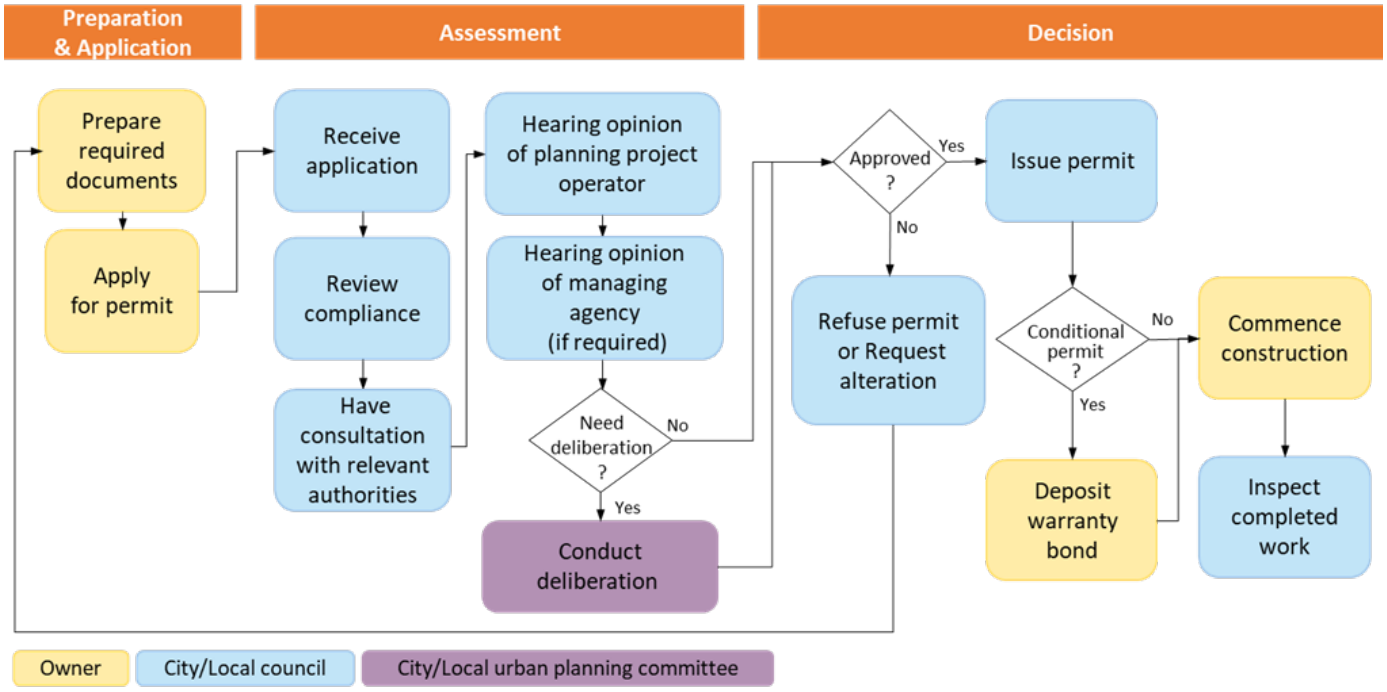


Figure 7: The planning approval process in South Korea

Preparation & Application stage

In this stage, an applicant first checks whether the proposed plan is exempt from the NLPUA. If a planning permit is required, the applicant prepares the submission, which includes the following documents: application form; land title declaration (proving ownership or right to use land); detailed documentation of activities of land use development (including engineer's certification on the slope, plantation layout, and design documents for site construction); existing land profile and photography; construction documents including site plans; design documents and estimation of new buildings, facilities or infrastructures; and design documents and estimation for activities to prevent hazard or environmental pollution in the scenery or landscape.

In South Korea, city councils and local councils are the authority to evaluate, approve and issue planning permits. The scale of work determines the council from which an applicant obtains permission. For instance, an application for 500,000 ~100,000m² of stone extraction should be submitted to the city council, while 30,000~500,000m² of stone extraction ix submitted to the local council.

Assessment stage

Once applications are lodged to an e-submission system, *Seumter*, council officers access, review, and evaluate the application. The applications are manually evaluated in compliance with the NLPUA and the following aspects are mainly evaluated:

- The establishment of relevant infrastructure;
- Appropriateness of the infrastructure establishment plan;
- Suitability for characteristics of corresponding land utilisation zoning;
- Correspondence with urban management plan and urban growth management measures;
- Impediment in urban planning project/undertaking;
- Impact on surrounding land use planning;
- Harmony with the surrounding scenery (building height, viewshed analysis) and natural environment (Soil slope, plant types, water drainage); and
- Slope evaluation.

The permitting authority holds consultations with relevant authorities to ensure compliance with policy objectives and plans in related administrative agencies.

The authority is required to hear the opinions of the planning project operator regarding their proposal. It is also necessary to hear the opinions of the managing agency of public facilities on the application, if the proposal includes matters on installing new public facilities or substituting for existing public facilities.

Deliberation on development activities by the urban planning committee at city or local councils is required. The exemption is applied to it when development activities are not on areas under specific plans (e.g., district-unit plan or growth management plans) or are subject to examination on impact assessments (e.g., traffic, environmental).

Decision stage

The committee is a decision-making entity that deliberates and advises on matters related to the proposed plan in line with urban master plans and urban management plans. The committee determines the planning permission if the proposed planning requires deliberation, while council officers decide it.

The council issues planning permits as conditional when development activities require installing infrastructure, or securing sites to prevent hazard or environmental pollution, the sceneries, and landscape.

In this case, the permit authority may request any person who obtains permission to deposit a warranty bond to guarantee the development performance.

Once the planning permit is issued, the planning project operator can commence the development activities. The completed work should be inspected by the permitting authority in compliance with the permission.

3.3 BUILDING APPROVAL PROCESS IN AUSTRALIA AND OTHER JURISDICTIONS

3.3.1 BUILDING APPROVAL PROCESS IN AUSTRALIA

In every country, there is a building regulatory system encompassing the building regulations and the building control system.

Building regulations set minimum quality requirements to ensure that buildings are safe, healthy, energy efficient, and accessible to everyone who lives and works in and around them. Building approval aims to guarantee the application and enforcement of these minimum requirements.

To guarantee that these requirements are applied, a building approval system is critical. The realisation of complete digital intake and processing of building permit applications, however, has been a long-time challenge for many governments; their electronic customer-related services have had to expand enormously.

This section provides a review of the current status of the building approval processes in various jurisdictions, including Victoria, as well as initiatives towards digitalisation and modernisation. Furthermore, potential risks, benefits,

and success and failure factors have been identified.

Building permits are written approvals verifying building design and construction in compliance with the Building Regulations.

All construction, demolition, and alteration works require building permits, while exemptions apply to some minor works for maintenance purposes under the Regulation.

The detailed process of building approval varies from the class and type of building works and the scale of construction projects.

However, there are five stages shared by various types of projects in the building permit process (see Figure 8: Simplified building approval process in Victoria). The detailed process is represented in Appendix C.

Various stakeholders and authorities are involved in this process. Of these, building surveyors registered with Victoria Building Authority (VBA) are responsible for assessing building permit applications.

Private building surveyors and municipal building surveyors in a local council serve as the building surveyor. They remain involved for the entire duration of a building project.

The building surveyors have the authority to issue building permits, conduct building inspections at mandatory notification stages, give directions to fix non-compliant works, and issue certificates of final inspection and occupancy permits.

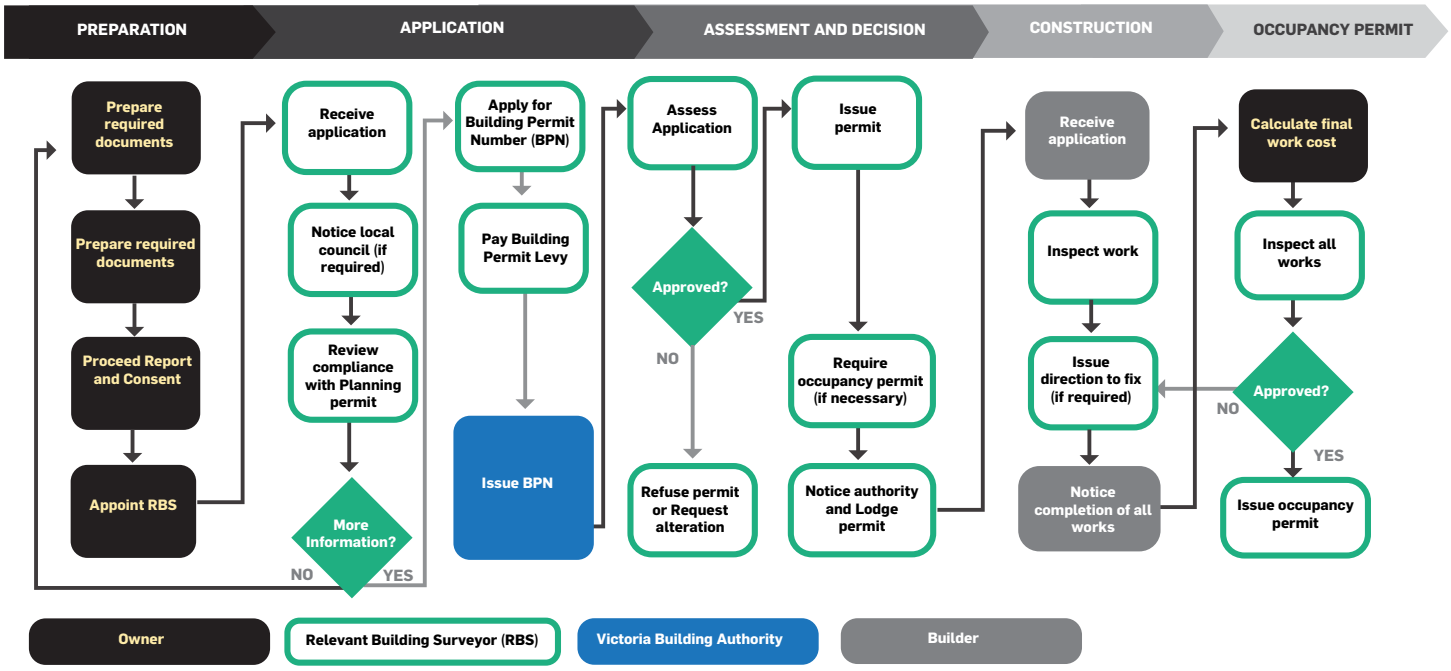


Figure 8: Simplified building approval process in Victoria

They independently review building permit applications to ensure whether the proposed building works meet requirements and standards in the Building Regulation and National Construction Codes (NCC).

Preparation stage

Once all required documents for building approval are ready, owners or their agents should appoint a building surveyor to their application, known as Relevant Building Surveyors (RBS).

Enough information must be given to the RBS for checking compliance of the application against the regulation and NCC.

The cost and overview of building work, drawings, specifications, Certificate of Compliance, title documents, and report and consent from reporting authorities are required.

The authorities include the council responsible for the land and relevant services (drainage, sewerage, electricity, gas, water supply) affected by the proposed work.

Application stage

If a private building surveyor accepts the appointment, they must notify the relevant council in writing of the appointment, the building, and building work.

Once an application is submitted with all documents, the RBA checks whether it is consistent with the relevant planning permit and other prescribed approvals.

The building surveyor calculates the building levy and applies it to the VBA for a Building Permit Number (BPN) for the proposed permit. To obtain the number, RBS should provide VBA with all required information relating to the permit and pay the levy.

If the RBS is a private building surveyor, they need to notify a local council of the application. From 1 July 2019, VBA has had to issue PBN before the building surveyor can issue a building permit.

Assessment & Decision stage

In this stage, the RBA assesses the building permit application as follows:

1. Check compliance of drawings and specifications (including architectural plans, materials schedule) with regulations;
2. Check compliance of engineering computations and structural designs with regulations;
3. Review Certificate of Compliance from the certifying engineer;
4. Check whether all required reports and consents are obtained from the reporting authorities; and
5. Check builder's qualification to conduct the work at the required level of the Act and the Regulation.

If the application complies with all requirements, the RBS issues the building permit; it may be with or without conditions.

The building surveyor specifies mandatory inspections, and can vary required inspections or carry out additional inspections if necessary.

They also determine whether an occupancy permit is required, which is then specified in the building permit. An issued building permit can be for the whole project, or just a stage.

If the RBS is a private building surveyor, a copy of the issued permit and all associated documents should be lodged to a local council.

If the proposal fails to meet the requirements, the RBS may request alteration or refuse the permit. The owners can appeal the refusal to the Building Appeals Board (BAB).

Construction stage

In accordance with the issued permit, the nominated builder commences building works.

Builders are responsible for ensuring the building work complies with the requirements. In this stage, the RBS is responsible for inspecting the building works, to independently assess them in compliance with the building permit and the Act and Regulations.

The inspection may be done by building surveyors, or by qualified engineers for specific works (civil, mechanical, electrical, fire safety). If the works are not compliant with the requirements, the RBS gives directions to fix them.

From July 2019, owners or their agents have had to monitor and maintain records of the cost of building work through the building process.

For non-staged permits, the revised final cost must be calculated at the end of the building work. If the final cost is at least $15,625 higher than the initial estimate, the owner should notify VBA of this revised final cost. For staged permits, VBA may contact the owner at the end of the building work and request the final cost of work, together with supporting documents.

Occupancy Permit stage

If the building permit requires an occupancy permit, the RBS assesses whether the building is fit for its purpose and then determines whether to issue the permit. The building surveyor issues a certificate of final inspection when it is not required.

3.3.2 CHALLENGES OF BUILDING APPROVAL PROCESS IN AUSTRALIA

A building permit is a means of regulatory control of building design and construction to ensure minimum quality requirements in compliance with the Building Act 1993 and the Building Regulations 2018.

In Victoria, building surveyors have the authority to issue these permits by reviewing 2D-based drawings and documents regarding the building works.

This current system is inefficient and has little transparency in its workflow, which relies on the manual, fragmented, and decentralised practices from application preparation to issuing permits.

To facilitate a more effective and transparent building approval process, the need for digital transformation has been increased to address issues such as:

- Absence of a channel or system enabling applicants to monitor the progress status 24/7 and communicate with permit issuers.
- Significant effort and time in reviewing and assessing building permit applications under the error-prone manual procedure.
- Ineffective data management in updating and synchronising all required documents for building permits in line with design changes during construction stages.
- Lack of connection of networks among relevant authorities that would otherwise allow an efficient procedure of report and consent.
- Difficulties in the management of building records in inconsistent data formats resulting from different lodgement platforms and procedures of local councils (i.e., online form, email, post).
- Decentralised management of issued permits and all building records in local councils that insufficiently supports establishing strategic plans for statewide asset management and government administration.

3.3.3 BUILDING APPROVAL PROCESS IN OTHER JURISDICTIONS

Every country has a building approval system as it is one of the most critical aspects of the construction industry, aiming to safeguard buildings' quality, safety, and appearance.

The investigated jurisdictions show similar data requirements, but vary in the approval process depending on the regulations. A wide range of initiatives have been introduced into these countries to transform their building approval process into a fully centralised, digitised, automated, and integrated workflow.

Of these, the integration of different processes, functions and communication between responsible authorities was introduced.

Many countries have selected BIM as the data environment of these systems, e.g., CORENET of Singapore, KBIM Assess of South Korea, GeoBIM of the Netherlands, and ByggNett of Norway. Some of the initiatives are as follows:

3.3.3.1 BUILDING APPROVAL PROCESS IN UK

There are 15 technical requirements regarding the Building Regulations (as seen in Table 1: List of approved documents and the description of what they cover, UK).

Each requirement corresponds to a letter, which set out some of the legal requirements of the Building Regulations – the rules that must be followed. There are also other requirements in the Building Regulations, some of which refer to keeping energy use low.

Once it has been established that an application needs to be made to a Building Control Body (BCB), there are three main types of application: Full plan application, Building notice application, and Regularisation application.

The process map of these three application types is shown in Figure 9: Building approval process for UK.

Full plan application is the most thorough option, where decisions on whether plans meet building regulations are made within five weeks or two months, with the consent of the applicant.

A completion certificate (or 'final certificate' if processed by an Approved Inspector) is issued within eight weeks of completion of the approved building work, so long as it complies with building regulations.

The full plan application is suitable for any type of building work. In the case of works to a commercial, industrial or retail building, a full plans application is the only way to apply, as long as the work has not already been carried out. The approval process could be conducted through either a local authority building control or a

Dwellings		Other buildings	
New	**Existing**	**New**	**Existing**
A: Structure			
B: Fire safety, Volume 1: Dwellings		B: Fire safety, Volume 2: Buildings other than dwellings	
C: Site preparation and resistance to contaminants and moisture			
D: Toxic substances			
E: Resistance to the passage of sound			
F: Ventilation			
G: Sanitation, hot water safety and water efficiency			
H: Drainage and waste disposal			
J: Combustion appliances and fuel storage systems			
K: Protection from falling, collision and impact			
L: Conservation of fuel and power L1A New dwellings	L: Conservation of fuel and power L1B Existing dwellings	L: Conservation of fuel and power L2A New buildings other than dwellings	L: Conservation of fuel and power L2B Existing buildings other than dwellings
M: Access to and use of buildings Volume 1: Dwellings		M: Access to and use of buildings Volume 2: Buildings other than dwellings	
P: Electrical safety – dwellings		P: No approved document	
Q: Security – dwellings	Q: No requirement	Q: No requirement	
R: Physical infrastructure for high-speed electronic communications networks			

Table 1: List of approved documents and the description of what they cover, UK

licensed, approved inspector. Once the application is checked and found to be satisfactory, it will be approved.

The approval is valid for three years. If not, advice will be provided to the applicant on what amendments and/or additional information is required to enable approval to be issued. If no response is received, or the revisions are not satisfactory, an application can be rejected.

Work can begin as soon as 24 hours after submission of the application, but it is not certain that any work carried out before the formal approval complies.

Work is inspected at the start, the end, and at various stages to ensure it meets building regulations standards. The stages are discussed with the applicant at the start of the project.

As aforementioned, the approval process could be conducted through either local authority building control or a licensed approved inspector. Approved inspectors are registered with the Construction Industry Council.

They must re-register every five years to maintain high standards. A building inspector is appointed through LABC and an approved inspector will carry out the same duties for a self-builder.

They will check plans for compliance when a full plan application is made, and carry out site inspections when requested to check on-site work at various stages.

However, only an inspector from the local authority has powers of enforcement. An approved inspector must hand the project over to the local authority if there are problems

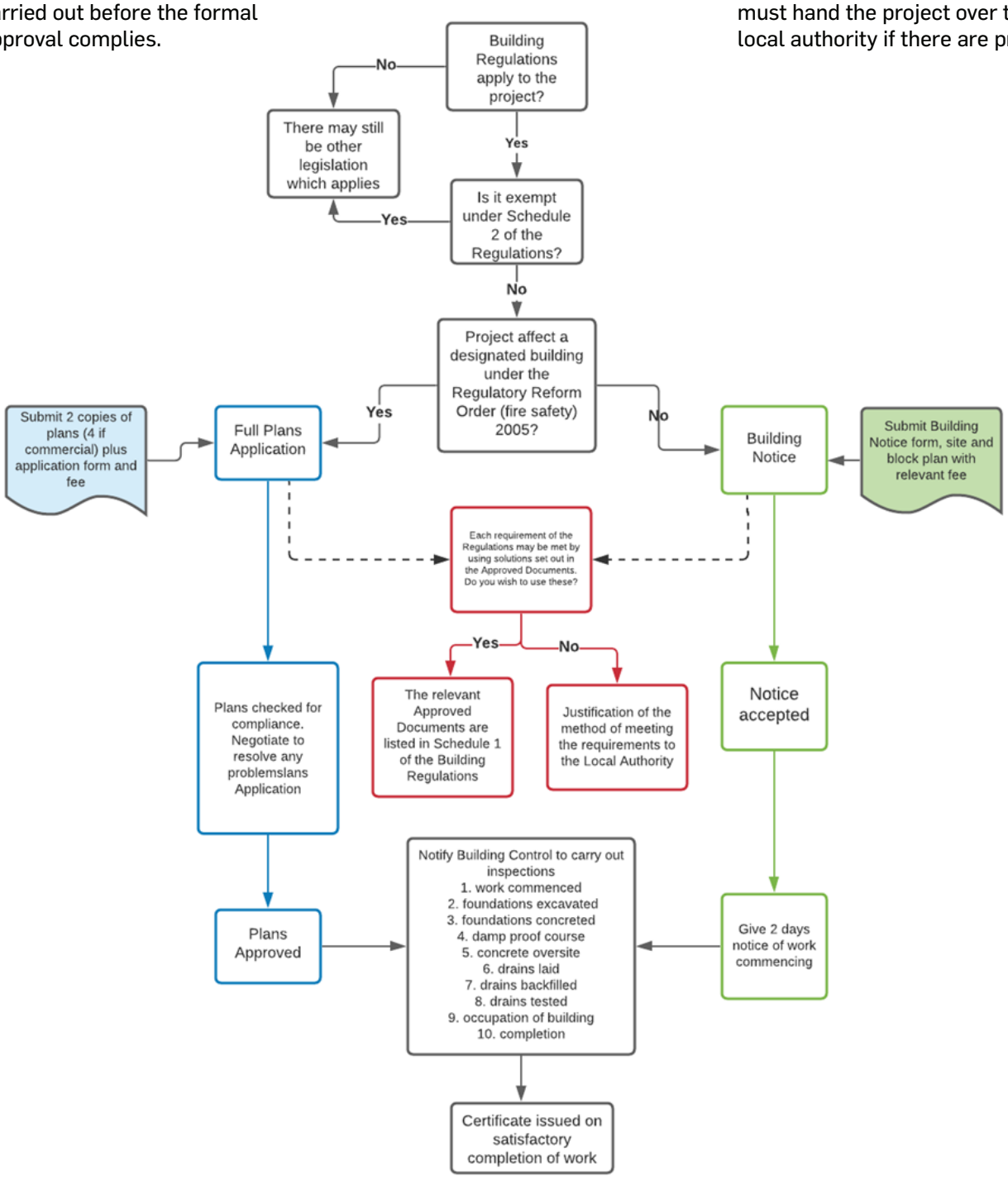


Figure 9: Building approval process for UK (Durham City Council, 2010)

with the project that cannot be resolved informally.

The separate processes for local authority building control and a licenced approved inspector are shown in Figure 10: Approval process route through local authority and approved inspector.

Submit-a-Plan is a Local Authority Building Control National Portal for making electronic and offline Building Control applications to any local authority in England, Wales and Northern Ireland.

The site has been designed as a single location for both the general public and professional users to submit Building Control applications directly to their intended local authority.

Users can also track the progress of their application online. Ability to work with all CAD applications and paper scans, eliminating sending multiple paper plans, fully web-based access and open to access at any time, are some of the key features of the system.

Submit-a-Plan is a direct response from Local Authority Building Control (LABC) services to feedback from its clients and partners. LABC identified a growing need for a simple electronic application system that would extend to Building Control surveyors.

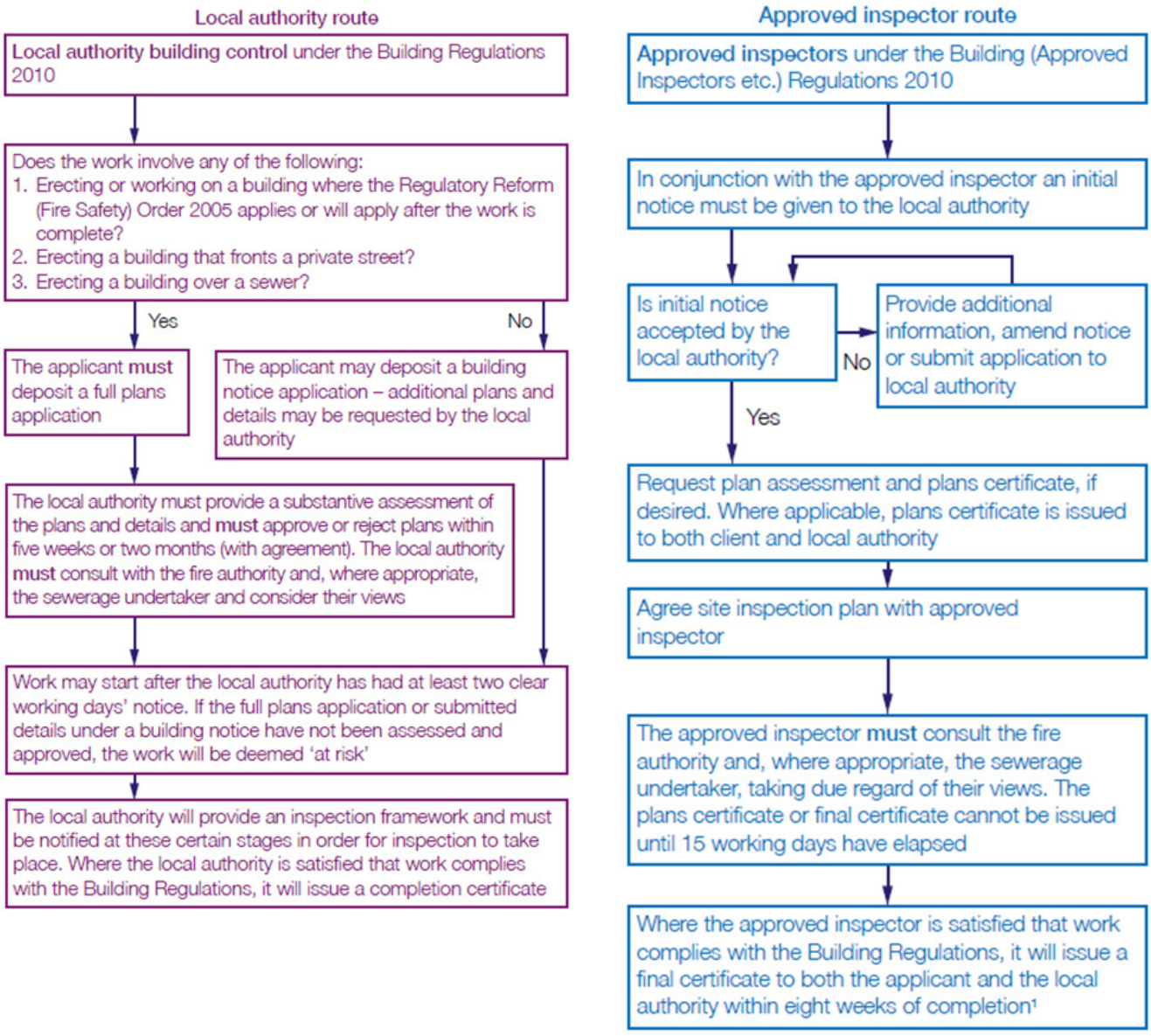


Figure 10: Approval process route through local authority and approved inspector

3.3.3.2 BUILDING APPROVAL PROCESS IN THE NETHERLANDS

In the Netherlands the municipal department of planning and building control is in charge of permit procedures, review of the blueprints, and inspection during construction.

When the building application is subjected to review, a distinction can be made between planning regulations and technical requirements.

Both requirements are checked within the building-permit procedure. The review for compliance with zoning plans involves checking if the structure in question is allowed to be built on the intended site.

As early as 1983, the Dutch government proposed simplifying the regulations, especially for residential construction. The 1992 proposal aimed to simplify and reduce building regulations and permit procedures (Meijer and Visscher, 1998).

In 1999, Enschede was the first Dutch municipality to open an electronic counter on the Internet (Meijer, 2005). Since then, it has become possible to access the Local Authority Building Control Departments of almost all Dutch municipalities online.

The main purpose of online municipal services is to cut down the queues at municipal offices. The websites of most Dutch municipalities provide information on how to apply for a building permit and offer facilities for downloading forms and pamphlets.

The website 'procedure' is basically the same for most municipalities.

3.3.3.3 BUILDING APPROVAL PROCESS IN SINGAPORE

The BCA is an authority to approve applications for building plan approval and register any approved plan of works. *Commissioners of Building Control,* who are officers of BCA, are responsible for carrying out and operating the Act and Regulations; they assess, approve, and register the building permit.

The typical process of building plan approval consists of four stages, as illustrated in Figure 11: Simplified building approval process in Singapore.

Here, building plan approvals need to be submitted to BCA through a Qualified Person (QP). QPs are architects registered to the Board of Architects or professional engineers with the Professional Engineers Board. The appropriate QP depends on the type of building works.

The coordinating QP is normally an architect, if there are architectural plans for the project, while a professional engineer may be a QP when projects involve mainly structural components and minor architectural components.

Preparation & Application stage

To apply for building plan approval, the QP prepares all plans of building work for approval and issues a project reference number that enables the lodging of building plans to the BCA. Before submitting the application, the QP needs to lodge the reference number and job title to the BCA.

QPs may be required to consult the BCA on major requirements subjected to interpretation or may apply for waivers. At the same time, the QP

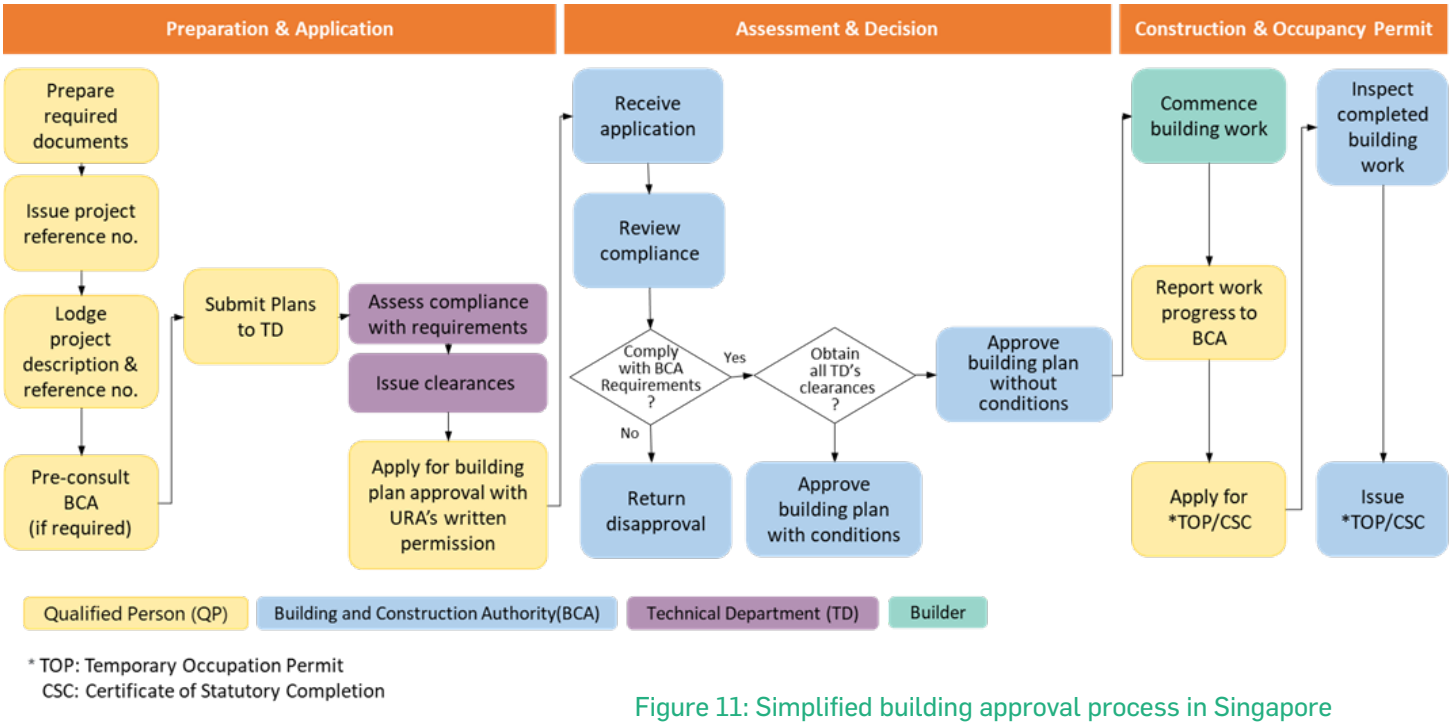


Figure 11: Simplified building approval process in Singapore

submits plans to the relevant technical departments to obtain their advice and clearance.

The relevant departments include Singapore Civil Defence Force, Land Transport Authority, and the Housing and Development Board. If there are any requirements from departments, the QP incorporates them into the building plans. It can proceed in parallel with the process of obtaining Written Permission (WP) from URA.

Once WP is issued, the QP submits formal application of building plan approval to the BCA via the CORENET e-Submission System. Building plans, clearances for building plan approval obtained from technical departments, and WP must be submitted.

The following building plans are requirements in accordance with the Regulations: building plans; detailed structural plans and design calculations; site formation plans; and pile layout plans.

Assessment & Decision stage

The BCA approves the application within seven working days from the date of submission if all clearances are submitted, and building plans comply with all BCA requirements.

The Commissioner of Building Control checks compliance of building plans using CORENET e-PlanCheck. The BCA approves the submitted building plans without conditions, if it complies with all requirements of the Act and the Regulations and obtains all clearances from the department.

The BCA may approve the application when any clearance is still outstanding, if it complies with BCA requirements. In this case, outstanding clearances must be obtained and submitted prior to or with a Temporary Occupation Permit (TOP) or a Certificate of Statutory Completion (CSC) application.

When plans of building works have been disapproved, the Commissioner of Building Control may return the disapproved plans to the QP.

Construction and Occupancy Permit Stage

Once building plan approval is issued, the QP needs to obtain a permit from BCA to carry out structural works before commencing works.

The QP, builder, and owner/developer must jointly apply to BCA for a permit to commence works after obtaining structural plan approval and planning permission. When building work commences, the QP submits progress reports to BCA.

When all building works are complete, the QP applies to BC for (1) the CSC on building works carried out, or (2) the TOP for the occupation or use of the building.

After inspecting the completed works, the BCA determines whether to issue CSC or TOP.

3.3.3.4 BUILDING APPROVAL PROCESS IN SOUTH KOREA

In South Korea, building approval is a process of examining the compliance of building works with the Building Act. Similar to Singapore, registered architects apply for building permits on behalf of owners.

All building works require a building permit unless there is an exemption for the proposed work under the Act. Like planning approval, the permitting authority for building approval is the city council and local councils.

Building works are controlled differently according to the type and scale. As summarised in Figure 12: Three types of building permission according to building work in South Korea, large-scale building works are approved by the city council, which

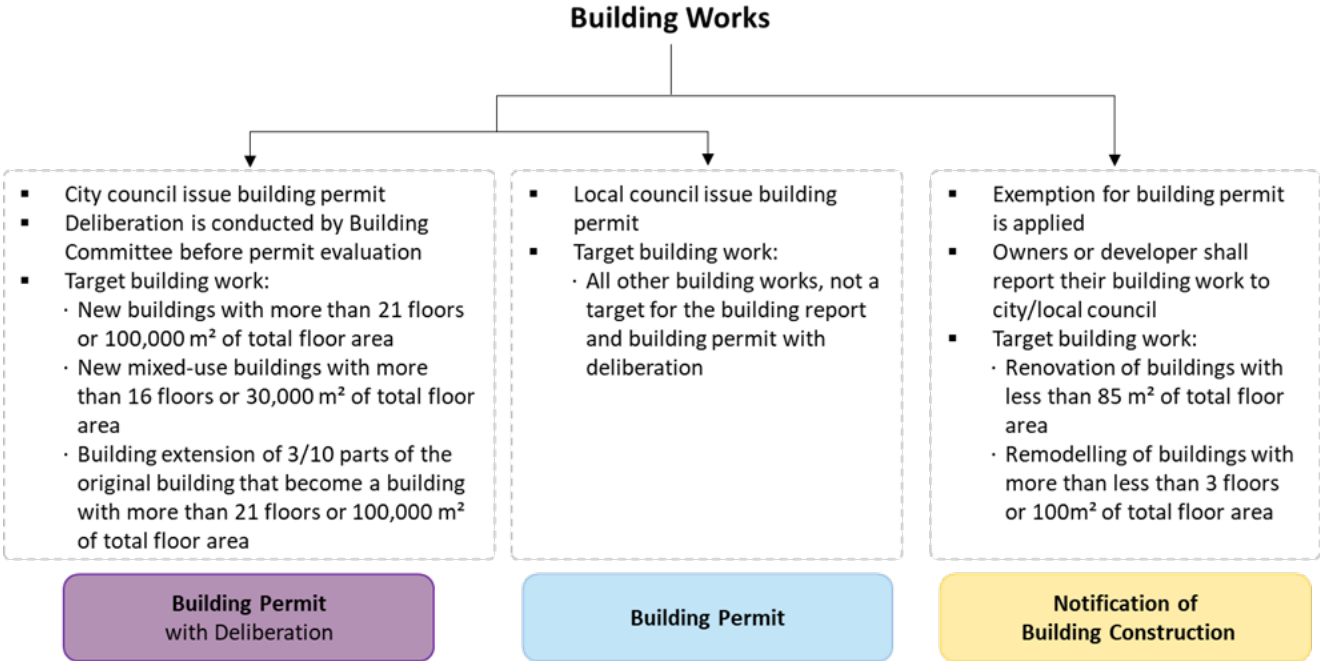


Figure 12: Three types of building permission according to building work in South Korea

requires deliberation of building committees.

The exemption is applied to several works, such as renovating buildings with less than 85m² of total floor area, or remodelling of buildings with more than three floors or 100m² of total floor area. Building permission is granted for these works if a report is pre-filed with the permitting authority.

The building works that are not subject to permit with deliberation or notification, are approved by the local council.

This research investigated the building approval process in South Korea, focusing on the Seoul Metropolitan council. The three stages have been identified, as illustrated in Figure 13: The building approval process in South Korea.

Preparation & Application stage

Registered architects appointed as agents of owners/developers are responsible for preparing all application documents and applying for a building permit with the documents.

If the proposed building is more than 21 storeys or 100,000 m², the architect needs to apply for deliberation by the Building Committee. It aims to review building design from the following planning perspectives ahead of the building approval process: city aesthetics, public welfare, wind path, daylight analysis, transportation impact, environmental impact, disaster prevention, and safety.

The committee belongs to each city council and consists of government officers and experts (planning, design, structure, MEP, disaster prevention, energy, landscaping, aesthetics, urban planning, site planning, transportation).

Once the building work is approved and improved according to the review, the architect applies for the building permit with all required documents (including certificate of title, construction overview, building drawing and specifications, structural/mechanical/electrical drawings and calculations, specification).

Both applications for deliberation and building approval are submitted to the city council via Seumter.

Assessment & Decision stage

Council officials examine all building permit applications submitted to Seumter. Once the application is allocated to the officer, they then use Seumter to access the application and its relevant documents and manually evaluate its compliance with the Regulations.

The official also the consultation with relevant departments or authorities to report the proposed building work and obtain their consent and advice.

The official issues the permit when the application complies with all requirements and standards in the Regulations, and is approved by the authorities.

Construction & Decision stage

In South Korea, building works are supervised by registered experts known as Construction Supervisors.

To commence building work, the appointed Construction Supervisor files a report about demolishing existing buildings, and a report on commencement of the building work, to the relevant city council.

The supervisor conducts regular inspection on essential milestones of the building work. Once the work is completed, the supervisor prepares a Completion Supervision Report and applies for an occupancy permit, with the report and as-built drawings. The council official examines the application and approves the occupancy permit.

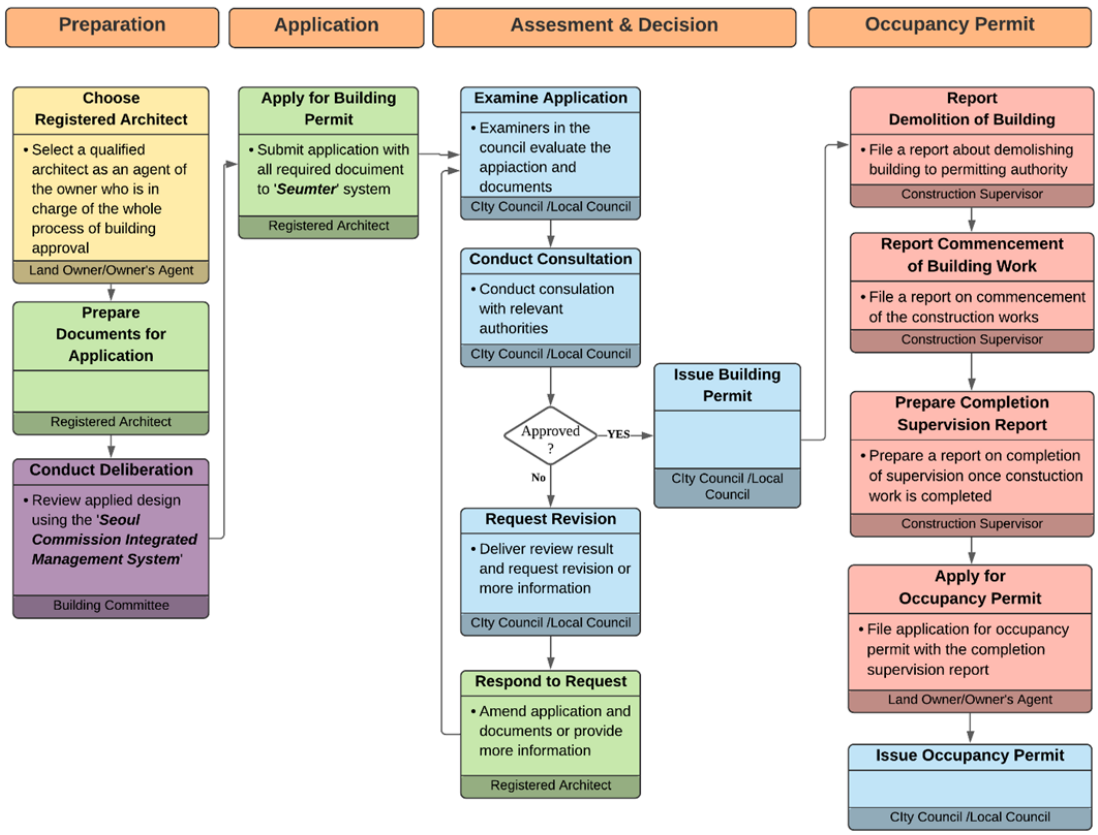


Figure 13: The building approval process in South Korea

3.3.3.5 BUILDING APPROVAL PROCESS IN HONG KONG

In Hong Kong, any person who intends to carry out building works is required to appoint the following Building Professionals under the Buildings Ordinance (BO) to prepare and submit plans for the approval of the Building Authority (BA): (1) an Authorised Person (AP); (2) a Registered Structural Engineer (RSE), where necessary; and (3) a Registered Geotechnical Engineer (RGE) for building works at any stage involving geotechnical elements.

The applicant is also required to appoint a Registered Contractor to carry out the building works, and consent to commence building works is required from the Building Authority before the works start.

A building development project involves the submission of different types of prescribed plans, such as general building plans, foundation plans, superstructure plans, site formation plans, drainage plans, demolition plans, and excavation and lateral support plans.

The Building Department has adopted a curtailed check system in the plan approval process, in which non-fundamental issues will not be checked and will not be raised as disapproval items.

The AP/RSE/RGE therefore must ensure that all non-fundamental issues have fully complied with the relevant regulations and codes of practice before the commencement of the works.

A centralised processing system is adopted for building plans to ensure that all interested government departments are consulted. The comments on private development proposals are collated by the BA within time limits allowed for processing building plans.

The system also serves the purpose of making the Buildings Department a focal point, where issues arising from private building development precipitate.

The Building Department processes consent application for the commencement and carrying out of any building works shown on the approved plans made in the specified form to the BA.

Under the BO, the BA may consent to the commencement of any part of any buildings, the plans of which have been approved upon the receipt of all documents, as may be prescribed by regulations, and the compliance/ fulfillment of any condition or requirement imposed in the approval for consent application.

Under the BO, no new building shall be occupied unless an Occupation Permit (OP) in respect of such building has been issued.

Application for OP should be made by the AP, RSE, RGE and RC responsible for the project. They should certify on a specified form that the building has been completed in accordance with the provisions of the BO and its regulations, and that the plans approved in respect of the new building are structurally/ geotechnically safe.

Upon receipt of an OP application, an OP inspection is undertaken and the required documents examined. An OP will only be issued when the building is ready for occupation. The simplified building approval process is shown in Figure 14: Simplified process model for Hong Kong.

Design Checking Procedures in Design and Build Contracts

The Employer's Requirements stipulate the requirements for design checking. If stated in the Employer's Requirements, the Contractor appoints a Design Checker, independent of the Contractor and their designer.

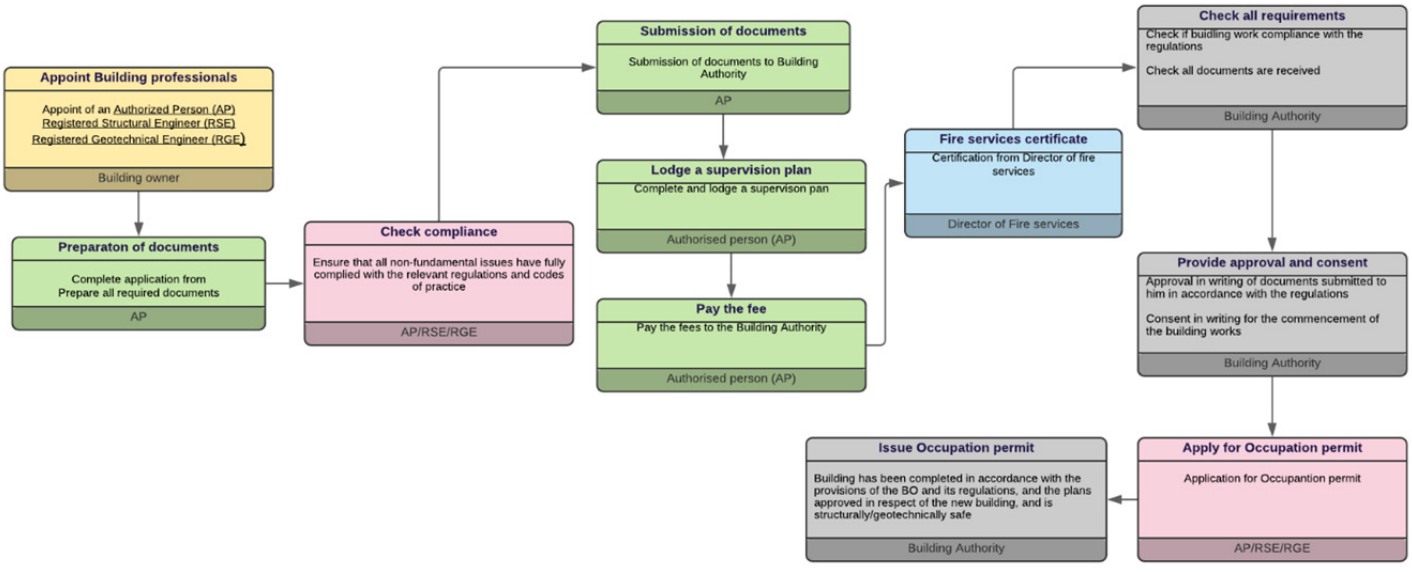


Figure 14: Simplified process model for Hong Kong

Alternatively, if the Employer's Requirements do not require a Contractor to appoint a Design Checker, the design check is carried out by the Supervising Officer (or their representative) as part of the consent procedure.

The extent of the design check is specified in the Employer's Requirements. The obligations for the Contractor or Design Checker(s) to seek approvals from Government Departments/Offices prior to any certification by the Design Checker(s) are stated in the Employer's Requirements. The procedures for dealing with proposed changes to checked drawings are also stipulated.

The basic objective of the design checking procedures is to encourage the progressive processes of submissions, discussion and endorsements to avoid delays to the project.

Approval in Principle (AIP):

This indicates the sequence for AIP submissions where an independent Design Checker is appointed by the Contractor.

Time allowed for certain activities is stipulated in the Employer's Requirements. If there is no Contractor appointed Design Checker, time is allowed in the activity for the Supervising Officer to give their consent for their design check.

Normally, before commencing the detailed design of any element of the works, the contractor seeks the AIP from the Supervising Officer.

The specific purpose of AIP is to check that all aspects of the works, including Temporary Works that could affect the integrity or performance of the structure, stated in the Employer's Requirements, are identified and have been taken into account before detailed design and construction commence.

In considering the Contractor's AIP submission, the Supervising Officer must be satisfied that, where required, the design has been independently checked and return the document endorsed according to one of the following categories: Consent to proceed to detailed design; Consent as above but with conditions; Consent not granted for reasons to be listed.

The design checking procedures should specify the time limit under which the Supervising Officer should give their reply. On having received AIP for a design package, or for the whole of the works, the contractor does not vary any of the design criteria used in the AIP submission without seeking the consent of the Supervising Officer.

A revised AIP document must be submitted if the contractor wishes to vary the design criteria used in the AIP.

Detailed Design Approval (DDA):

This indicates the sequence for DDA submissions i.e., checking of detailed design drawings and calculations where an independent Design Checker is appointed by the contractor.

Time allowed for certain activities is stipulated in the Employer's Requirements. If there is no contractor-appointed Design Checker, time is allowed for the Supervising Officer to give their consent for their design check.

If there are any design changes, previously approved DDA documents must be resubmitted to incorporate minor changes resulting from corrections of errors, or Variations may be allowed to follow a streamlined approval process.

However, where the Supervising Officer considers that the changes are not minor, then the approval process must be repeated.

4. POLICY, LEGISLATIVE, AND REGULATORY CHALLENGES AND REQUIREMENTS

4.1 CONCEPTUAL AND ANALYTICAL FRAMEWORK

4.1.1 REGULATION

Regulation can be conceptualised in many ways. For the purposes of this exercise, regulation is conceptualised as a 'structured process undertaken by, or under the auspices of government, designed to modify the behaviour of persons to entities according to defined standards'.[5]

As such, it does not include private regulation, unless it is authorised by government. Numerous tools or methods can be employed to regulate, as consistent with the above definition of regulation. Numerous taxonomies also purport to categorise and explain them.

The focus of this exercise is on the rules promulgated by, or with, the authority of government.

This includes both:

- Legal regulation, being primary legislation (Acts of Parliament) and delegated legislation (regulations and other forms of subordinate legislation) – sometimes referred to as hard law; and
- Quasi-legal instruments such as policies and guidelines that, while not legally binding, exercise influence over the regulatory process – sometimes referred to as soft law.

4.1.2 REGULATORY SPACE

Regulatory space is an analytical construct employed to describe and examine the environment within which regulation takes place.[6]

It is a useful tool for understanding who regulates and how regulation occurs,[7] the answer to which can often depend on the distribution of regulatory power and the allocation of resources within it.[8]

When mapping a regulatory space, there are several dimensions to consider, consistent with any 'geographic space'.[9] These include its boundaries (the issues subject to public decision), occupants (actors, institutions and instruments), climate (legal, economic and social norms), and topography (the structures and processes that shape and direct the actions of the actors within the space).[10]

Thinking in terms of regulatory space draws our attention to the variety of actors, institutions, instruments, and norms within it, and how best they may be harnessed and coordinated in support of the regulatory endeavour.

This brings us to the concept of regulatory regimes.

4.1.3 REGULATORY REGIMES

A regulatory regime refers to the network of actors involved in regulating an issue, the aggregate activities undertaken by them to modify the behaviour of the target audience, and the norms, principles, rules, instruments, and decision-making processes according to which, and through which, those activities are coordinated.[11]

One result of adopting a broad conception of regulation is that regulatory regimes can rarely be visualised in a simple linear fashion. Rather, a regulatory regime comprises a network (or web) of regulatory systems, actors, institutions, rules and instruments.

Thus, a regulatory regime can be conceptualised as consisting of rules (that can range from formal legislation, policies and guidelines, through to social norms), institutions and institutional arrangements for administering and enforcing those rules (which, again, can be formal or informal), and the processes through which they do so.

Thinking about regulation as a regime focuses our attention on the systematic nature of regulation and, in particular, on the three main roles of the regulatory process: rule making, rule administration and rule enforcement.

And, as Levi-Faur et al point out, different approaches can be taken by each of these roles (or even just part thereof), whereby regulatory regimes might include a hybrid of actors, functions and instruments across different roles.[12]

4.1.4 REGULATORY MAPS

The complexity of the regulatory network (or web) that is a regulatory regime can be overwhelming.

For that reason, regulatory maps are developed to assist with understanding and navigating them.

Like all maps, regulatory maps are diagrammatic representations of the real world. By definition they are generalisations and simplifications of that world designed to assist us with describing and explaining the complexity of the system, without being overwhelmed by it.

Their succinct nature means that not every scenario is covered, nor are all possible details shown.

The maps in this Report were produced using Lucidchart and reproduced using design software for illustrative purposes in areas of this report.

The maps show: the key regulatory actors and institutions, legal and regulatory instruments, and the interconnections and information flows between them.

However, as noted above, the maps are generalisations, and are simplified.

They are not a forensic legal examination of each individual element of the regulatory space or regime. Specifically, they are not at the level of detail necessary for assessing the potential for digitisation and digital information capture. This detail can be found in the other project deliverables.

The following key has been used in the maps.

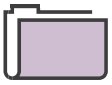
Key	Representation
	Government
	Actor
	Legal / Regulatory Instrument
	Decision / Notice / Report
	Industry
	Community

Table 2: Keys used in development of process maps

[5] Eric L. Windholz, *Governing Through Regulation: Public Policy, Regulation and the Law* (Routledge, 2018) 8.
[6] Eric L. Windholz, *Governing Through Regulation: Public Policy, Regulation and the Law* (Routledge, 2018) 69.
[7] See Arie Freiberg, *Regulation in Australia* (Federation Press, 2017) ch 4.
[8] Leigh Hancher, and Michael Moran, 'Organizing Regulatory Space' in Leigh Hancher and Michael Moran (eds), *Capitalism, Culture, and Economic Regulation* (Clarendon Press, 1989) 271; Arie Freiberg, Regulation in Australia (Federation Press, 2017) 63.
[9,10] Eric L. Windholz, *Governing Through Regulation: Public Policy, Regulation and the Law* (Routledge, 2018) 69.
[11] Eric L. Windholz, *Governing Through Regulation: Public Policy, Regulation and the Law* (Routledge, 2018) 74. For variations on this theme, see: David Levi-Faur, 'Regulation and Regulatory Governance' in D Levi-Faur (ed), Handbook on the Politics of Regulation (Edward Elgar, 2011) 3, 13; Christopher Hood, Henry Rothstein and Robert Baldwin, *The Government of Risk* (Oxford University Press, 2001) 9; Colin Scott, 'Regulating Everything' (Discussion Paper No 24/2008, UCD Geary Institute, 26 February 2008) 7.
[12] David Levi-Faur, Yael Kariv-Teitelbaum and Rotem Medzini, 'Regulatory Governance: History, Theories, Strategies, and Challenges' in *Oxford Research Encyclopaedia of Politics* (26 May 2021; accessed 13 Jun. 2021) 5 - https://doi.org/10.1093/acrefore/9780190228637.013.1430.

4.2 THE PLANNING AND BUILDING REGULATORY SPACE: AN OVERVIEW

Most Australian planning and building regulation occurs at state and territory (and local government) level[13]. Each state and territory (and in some cases, local government area) has its own unique regulatory and institutional environment. While conceptually aligned, significant differences exist in the legal, regulatory and operational detail. In this report we focus on Victoria, and discuss New South Wales to provide a comparator.

4.2.1 VICTORIA

Victoria's planning system is primarily regulated through the *Planning and Environment Act 1987* (Vic) (Planning and Environment Act), the objectives of which are: providing for the fair, orderly, economic and sustainable use and development of land, and securing a pleasant, efficient and safe working, living and recreational environment for all Victorians[14]. Victoria's building system is primarily regulated through the *Building Act 1993* (Vic) (Building Act), which has its own objectives: protecting the safety and health of people who use buildings and places of public entertainment, and enhancing the amenity of buildings.[15]

Combined, the systems are designed to facilitate development that delivers a range of economic, environmental and social benefits, and that prevents inappropriate development and building that might cause health, safety, environmental and social harm.

One of the principal means by which the Acts seek to achieve these objectives is by requiring owners and developers of land to obtain approvals and to meet certain conditions to use, develop and build upon their land.

For the purposes of this exercise, we have conceptualised the planning and building lifecycle as comprising five interconnected stages:

- pre-approval,
- approval,
- building,
- occupancy, and
- demolition.

The lifecycle starts with the pre-approval stage. From the government's perspective, the pre-approval stage involves ensuring an appropriate legislative and regulatory framework is in place to achieve its policy objectives.

Central to this framework is the planning scheme. A planning scheme contains the policies and provisions that control land use and development within a prescribed geographical area (usually a local government area).

These documents set out what uses and developments are permitted within that area, prohibited, and/or require a permit to be undertaken.

From the landowner or developer's perspective, the pre-approval stage comprises: establishing the feasibility of the project; determining whether a permit is required under the applicable planning scheme; and undertaking the work to produce the design information necessary to apply initially for a planning permit, then a building permit.

The second stage is the approval stage. This involves the landowner or developer applying for, and obtaining, a planning permit.

The building stage is next. It involves applying for and obtaining a building permit, building in accordance with the permit (and all other associated permits and certificates), through to receiving an occupancy certificate or certificate of final inspection.

The fourth stage is occupancy. Several regulatory requirements continue through occupancy. These include maintaining the building in accordance with the requirements specified in the occupancy certificate, and complying with fire and other safety essentials. It may also mean obtaining a planning and/or building permit for proposed renovations, refurbishments or other building works.

Finally, there is demolition. Demolition may require a demolition permit and possibly a planning permit if the building is subject to a heritage overlay.

Each of these stages are explained in more detail in the following sections. Regulatory space maps have also been developed for each stage, excluding the occupancy stage, where the level of complexity does not warrant it.

While the maps have been developed at a (high) level of generality that make them applicable to a number of building classes, they are primarily based on the lifecycle of a National Construction Code Class 2 building (i.e., a multi-unit residential building).[16]

[13] There are no specific international regulatory regimes which apply to building planning and approvals in Australia. There are a number of places where national level regulatory instruments and actors are relevant (e.g., the National Construction Code (NCC) is a national standard for all building and plumbing work in Australia that is given effect by State and Territory legislation; and the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) that requires landowners and developers to seek Commonwealth government approval (in addition to any state, territory and local government approvals) if their plans might significantly impact on matters of national significance.
[14] Planning and Environment Act, s 4(1) (a) and (c).
[15] Building Act, s 4(1)(a) and (b).
[16] Victorian Building Authority – Building Classes - https://www.vba.vic.gov.au/building/regulatory-framework/building-classes.
[17] Local council is used here broadly. Local council strictly speaking refers to the council of elected politicians. Here it is used broadly to refer to the local government administration they head and form part of. Note the Planning and Environment Act refers to 'municipal council' and the Building Act refers to just 'council'.
[18] Victoria Planning Provisions - https://www.planning.vic.gov.au/schemes-and-amendments/browse-planning-scheme/planning-scheme?f.Scheme%7CplanningSchemeName=vpps.

4.2.2 NEW SOUTH WALES

The New South Wales (NSW) planning system is regulated by a complex mix of legislation, regulation, policy, guidelines, codes and standards.

The primary legislation – the *Environmental Planning and Assessment Act 1979* (the Act) – provides the framework through which planning and development in NSW is governed.

Under the Act, the NSW planning system can be divided into two parts: land use planning; and development control.

Land use planning is concerned with the short and long-term social, environmental and economic objectives for an area, and is achieved through the use of environmental planning instruments and strategic plans.

Development control is achieved using processes for assessment and approval by the relevant planning authority, through one of eight planning pathways. Each pathway contains specific statutory and policy requirements.

The NSW planning system is also responsible for public infrastructure planning and delivery, as well as building and subdivision certification.

4.3 PLANNING SCHEME REGULATORY SPACE (VICTORIA)

The Victorian planning scheme regulatory space map is shown in Figure 15.

In Victoria, planning takes place under the *Planning and Environment Act,* which sets out the objectives, principles and rules that govern the planning system, and defines the roles and responsibilities of the various actors within it.

The system operates at both state and local government (municipal) level, and at both a policy and operational level, as illustrated in 00000 'State and Local Level Policy and Operational Roles'.

As can be seen from Table 3 State and Local Level Policy and Operational Roles, two documents are central to Victoria's planning scheme: the Victoria Planning Provisions, and the Planning Scheme. In this section we overview each document, who develops it and how, and how it might be amended.

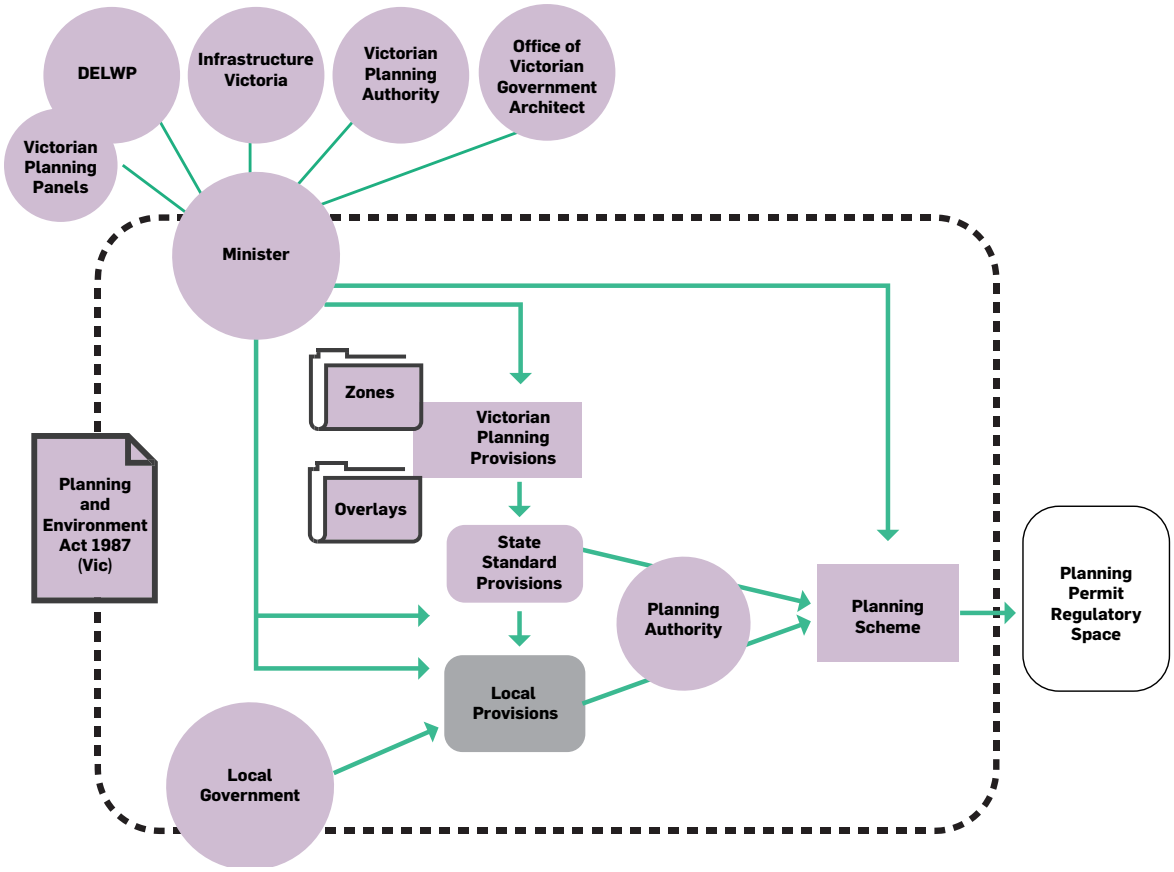


Figure 15: Victorian Planning Scheme Regulatory Space Map

	State Level	Local Government Level
Policy	Minister for Planning prepares State-wide Victoria Planning Provisions to guide the development of local government level specific Planning Schemes	Each local council prepares its own Planning Scheme, drawing from the Victoria Planning Provisions and its own municipal-level provisions
Operational	Minister for Planning must approve Planning Schemes and any Planning Scheme amendment adopted by a local council and can "call in" permit applications in some situations	Each local council is primarily responsible for administering and enforcing a Planning Scheme, including granting approvals and permits under the system

Table 3: State and Local Level Policy and Operational Roles

4.3.1 VICTORIA PLANNING PROVISIONS

The Victoria Planning Provisions (VPPs) are the planning policies and controls upon which all land use planning decisions are made.[18]

They guide the development of planning schemes, thereby providing a consistent and coordinated framework for planning schemes across all of Victoria.

VPPs can be best understood as a toolkit of parts from which planning authorities choose when compiling their planning schemes. Some provisions of the VPP must be included in every planning scheme; others are chosen as relevant and appropriate.

The VPPs have been heralded as 'one of the most innovative and significant reforms of the Victorian planning system', an 'enduring example of "regulation by design" that implemented a consistent planning scheme structure and format across all planning schemes', and one that provides 'clear, consistent and accessible rules'.[19]

This is fair praise, but the advances in consistency and clarity do not mean they are not complex. On the contrary, not only is there internal complexity, but they reference dozens of other pieces of legislation (federal and state), and numerous state government policies, plans and guidelines.

The planning schemes derived from them also can be long and complex documents.

VPPs are a form of subordinate legislation made by the Minister for Planning under the Planning and Environment Act.[20] The Minister for planning stands at the apex of Victoria's planning system[21]. They make the rules (VPPs and other Ministerial Directions) that establish the framework for all planning schemes and decisions.

They are responsible for administering the Planning and Environment Act under which all schemes and decisions are made and operate; and they are the responsible authority for many decisions, with the power to 'call in' others.

The Minister is advised in the discharge of these powers, functions and responsibilities by:

- The Department of Environment, Land, Water and Planning (DELWP). Of interest are the functions with which planning is paired in the Department. Bringing the environment, land, water and planning portfolios into a single department is designed to strengthen connections between the environment, community, industry and economy.[22]
- Infrastructure Victoria, which prepares Victoria's infrastructure strategy, advises the government on specific infrastructure matters, and supports government departments and agencies in the development of sectoral infrastructure plans.[23]
- The Victorian Planning Authority (VPA) provides advice to the Minister on how best to achieve Victoria's planning objectives, with a focus on the future growth and transformation of Victoria's cities and regions – from new suburbs in growth areas, to areas undergoing change: growth in inner and middle Melbourne, and growing regional towns and cities.[24]
- The Office of the Victorian Government Architect provides strategic advice to the government about architecture and urban design generally, and with respect to capital works, individual projects and broader planning initiatives in particular.
- Planning Panels Victoria that, while under the auspices of DELWP, provides independent advice to the Minister on issues or proposals referred to it, which can include VPPs and the operation of planning schemes.

4.3.2 PLANNING SCHEME

A planning scheme is a form of subordinate legislation approved by the Minister for Planning, which sets out the objectives, policies and provisions relating to the use, development, protection and conservation of land and buildings in the areas to which it applies.[25]

A planning scheme determines the zoning of land, specifies how land in a zone may be used and developed, and specifies the uses and developments for which a planning permit is required and the conditions on which it may be granted.

From the landowner or developer's perspective, it is arguably the most important document in the planning system. It sets out what uses and developments of land are permitted within the area covered by the scheme, and what uses and developments are prohibited and/or require a permit to be undertaken.

While the Minister for Planning must approve each planning scheme (and any amendment), the scheme itself is prepared by a planning authority. The *Planning and Environment Act* states that a planning authority can be a local council, the Minister for Planning, or any other Minister or public authority. Most planning schemes are prepared by local councils covering their local government area.

Local councils are also responsible for most of the day-to-day administration of the planning system, and for selecting from the overwhelming majority of applications for planning permits within their local government area.

Notable exceptions to this general rule are significant sites and venues in and around the City and Port of Melbourne, and significant tourist areas (e.g., Alpine resorts), for which bespoke planning schemes exist and the Minister for Planning is the responsible authority.[26]

Section 7 of the *Planning and Environment Act* states that a planning scheme must include -

a. state standard provisions selected from the VPP; and

b. local provisions that apply only to the area of the planning scheme.

Moreover, all planning schemes must have the form, content and structure specified in the Ministerial Direction on the Form and Content of Planning Schemes.[27] The Ministerial Direction states that Planning Schemes must have a standard structure comprised of state standard provisions drawn from the VPP, and local provisions, usually in the forms of schedules.

Planning schemes also may apply, adopt or incorporate external codes, strategies, guidelines, plans and other similar documents that relate to the use, development or protection of land, and that may inform, affect the operation of, or guide decision-making under, the planning scheme. The VPP lists 26 documents that may be incorporated into a planning scheme.

In this section, we review the key elements of a planning scheme[28] and discuss how it might be amended.

4.3.2.1 MUNICIPAL PLANNING STRATEGY / PLANNING POLICY FRAMEWORK

Planning schemes are currently being amended to require either a Municipal Planning Strategy (MPS) or a Planning Policy Framework (PPF). The previous requirement for a Local Planning Policy Framework is being removed, with its content to be integrated into the Planning Policy Framework.[29]

The MPS sets out the vision and strategic directions for future land use and development for the municipality, based on the municipality's location and regional context, history, assets, strengths, key attributes and influences.

The PPF sets out and integrates state, regional and local planning policies that must be taken into account when implementing the strategic directions in the MPS at a local level.

The PPF provides context for spatial planning and decision-making by planning and responsible authorities, and provides guidance for day-to-day decision-making with respect to specific planning matters.

Together the MPS and PPF form the strategic basis of a planning scheme.

[19] Andrew Natoli, 'Victorian Planning Provisions: Adopting a Regulatory Design Protocol' (2021) (April) *Law Institute Journa*l 34, 34-5.
[20] Planning and Environment Act, s 4A.
[21] Stephen Rowley, *The Victorian Planning System: Practice, Problems and Prospects* (The Federation Press, 2017) 15.
[22] See the Planning Division of DELWP's website - https://www.planning.vic.gov.au/home.
[23] See Infrastructure Victoria's website - https://www.infrastructurevictoria.com.au/.
[24] See the VPA's website - https://vpa.vic.gov.au/.
[25] This section draws from DELWP, *Using Victoria's Planning System* - https://www.planning.vic.gov.au/guide-home/using-victorias-planning-system. See also Stephen Rowley, *The Victorian Planning System: Practice, Problems and Prospects* (The Federation Press, 2017).
[26] For copies of all planning schemes go to - https://www.planning.vic.gov.au/schemes-and-amendments/browse-planning-schemes.
[27] Issued by the Minister under s 7(5) of the Planning and Environment Act.
[28] For a more detailed description and explanation see DELWP, *Using Victoria's Planning System* - https://www.planning.vic.gov.au/guide-home/using-victorias-planning-system.
[29] See DELWP - Planning scheme structure (Website) - https://www.planning.vic.gov.au/schemes-and-amendments/planning-scheme-structure. ing-victorias-planning-system.

4.3.2.2 ZONES

All land in Victoria has a zone. Zones specify the purposes for which land can be used (i.e., residential (Clause 32), industrial (Clause 33), commercial (Clause 34), rural (Clause 35), public (Clause 36) and special purpose (Clause 37)), and includes controls relating to the construction of new buildings and the subdivision of, and other changes to, the land.

A zone sets out land use controls in three sections: (1) land uses that do not require a planning permit; (2) land uses that require a planning permit (with details of information that must be submitted with a planning permit application and matters the Council must consider before deciding to grant a permit); and (3) land uses that are prohibited (e.g., because they may conflict with other uses such as industrial use in a residential zone).

Standard zones for state-wide application are included in the VPP and are used in all schemes as required. Each planning scheme includes the zones required to implement its MPF/PPF. Zones can only be created and amended by the Minister for Planning through an amendment to the VPP (see below).

Some zones have schedules that allow for local content to be included.

4.3.2.3 OVERLAYS

Overlays attach issue-specific requirements or conditions to land use or its development.

There are overlays dealing with, for example: environmental significance, vegetation protection and landscaping (Clause 42); heritage and neighbourhood character (Clause 43); and erosion, flooding, bushfires and other land management issues (Clause 44).

Standard overlays of state-wide application are included in the VPP. Each planning scheme only includes the overlays required to implement the municipality's local strategic directions.

Many overlays also have schedules that allow for local objectives and requirements.

4.3.2.4 PARTICULAR PROVISIONS

While zones and overlays are generally location based, particular provisions impose issue or use-based requirements and controls.

Issues addressed by particular provisions include advertising signs, car parking, uses with adverse amenity potential, home businesses, and uses involving a liquor or gambling licence.

Of particular relevance are the provisions that comprise the core of what is commonly known as 'ResCode'.

These include Clause 54, dealing with single dwellings or one dwelling on a lot; Clause 55, which deals with two or more dwellings on a lot and residential buildings of up to four storeys; Clause 56 that deals with residential subdivisions; and Clause 58, which deals with specified apartment developments.

Only particular provisions in the VPP can be included in planning schemes, and apply in addition to the requirements of a zone or overlay, unless otherwise specified.

Particular provisions apply consistently across the state, although some have schedules that allow for local requirements.

4.3.2.5 GENERAL PROVISIONS

General provisions also apply consistently across the state and deal with operational requirements and administrative matters.

Notwithstanding their innocuous title, they cover several important matters, including: exemptions from use and development restrictions and permission requirements (e.g., for fences and signs); grandfathering existing uses that subsequently may have been prohibited; and setting out general decision, referral and notice guidelines.

General provisions can also have schedules that allow for local requirements.

4.3.3 AMENDING A PLANNING SCHEME

The regulatory space map for amending a planning scheme is shown in Figure 16 Victorian Planning Scheme Amendment Regulatory Space Map.

As noted above, only the Minister for Planning may approve amendments to a planning scheme. However, the Minister may authorise a local council, another Minister, or a public authority to prepare amendments to a planning scheme (as well as retaining the power themselves).

Importantly though, a council cannot prepare an amendment unless it has been authorised to do so by the Minister.[30]

There are numerous reasons why an amendment to a planning scheme may be sought. Relevant to our purposes, one of those reasons may be to allow a prohibited use or development to take place.

The person seeking the amendment may approach the Minister directly or may approach another planning authority (most often the relevant local council). If the latter, the first step in the formal process would be the planning authority applying to the Minister for authorisation to prepare an amendment.

The Minister, with advice from DELWP (and other government agencies), will either authorise the preparation of the amendment or refuse the request.

If the former, the planning authority will prepare the proposed planning scheme amendment, which must then: (1) be given to the local council (if the amendment applies to its local government area), the Minister, and anyone else specified by the Minister; (2) be made available for public inspection; and (3) be notified to every Minister, public authority and local council that may be materially affected by the amendment, the owners and occupiers of land that may be materially affected by the amendment, and any other Minister, public authority, local council or person prescribed by regulations[31].

The Act specifies the nature and form of the notice, which varies for different types of amendments, and which can be dispensed within certain limited circumstances.

Any person may make a submission to the planning authority about an amendment for which notice has been given.

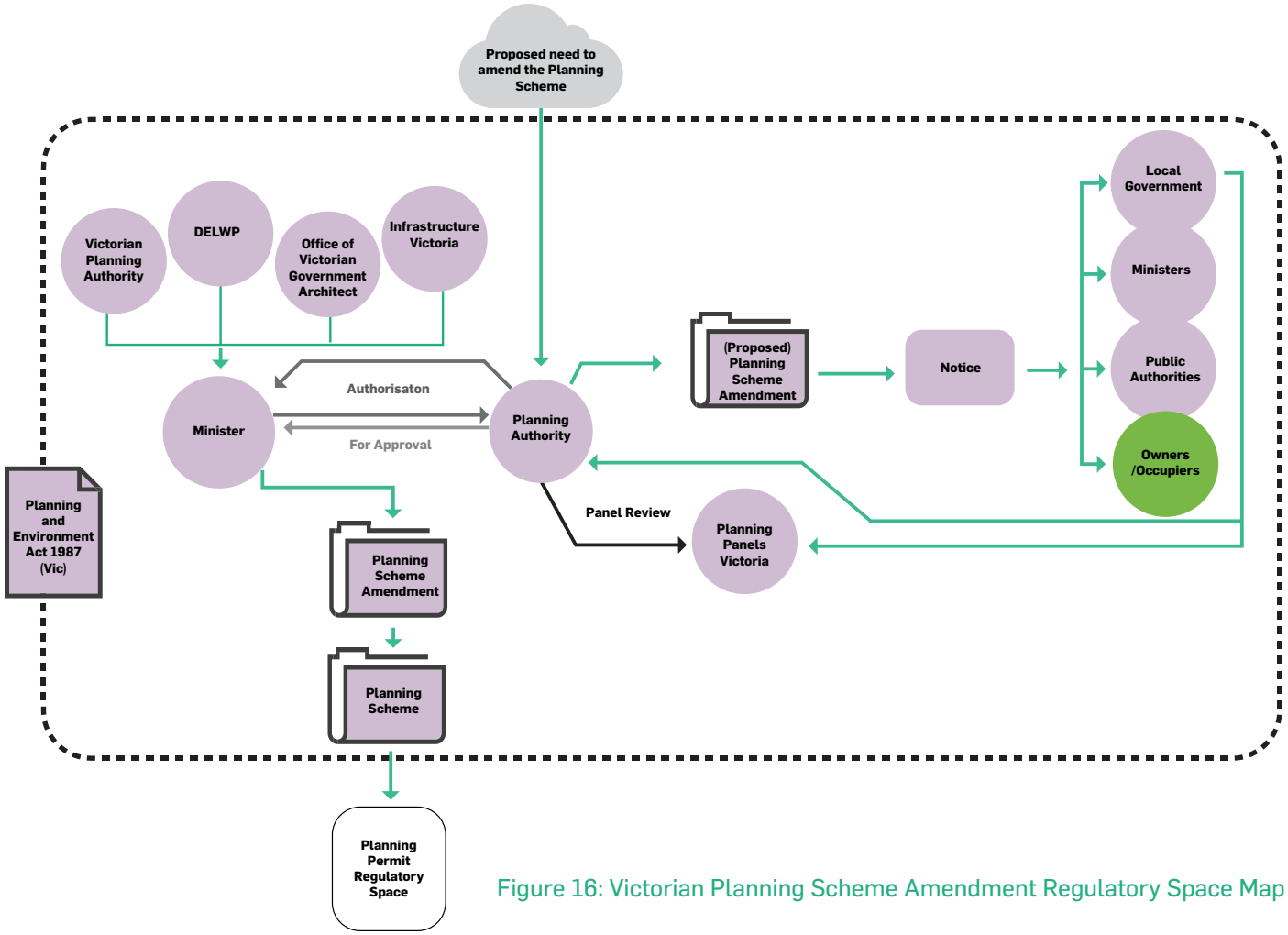


Figure 16: Victorian Planning Scheme Amendment Regulatory Space Map

[30] Planning and Environment Act, ss 8A, 8B and 9.
[31] Planning and Environment Act, s 19.

A submission may support, oppose or seek changes to an amendment. The planning authority must consider each submission and, after having done so, must either change the amendment in the manner requested, abandon the amendment (or that part referred to within the submission), or refer the submission to an independent panel established by Planning Panels Victoria.

In other words, submissions that seek a change to the amendment and are not accepted by the planning authority must be referred to an independent panel (unless the amendment is abandoned).

The role of a panel is to provide submitters the opportunity to be heard by an independent forum in an informal, non-judicial manner, and to provide independent advice to the planning authority and Minister on the proposed amendment in light of the submissions.

The planning authority must consider the panel's advice and any recommendations, decide what alterations (if any) should be made to the amendment, and if it decides to proceed with the amendment, submit the adopted amendment to the Minister for approval under section 35 of the Act.

If the Minister approves the amendment, it is published in the Government Gazette and notice is given (usually in a local newspaper).

4.4 THE PLANNING PERMIT REGULATORY SPACE (VICTORIA)

The Victorian planning permit regulatory space map is shown in Figure 17: Victorian Planning Permit Regulatory Space Map.

The *Planning and Environment Act* again is the dominant regulatory instrument in this space and prescribes the planning permit approval process that is at the heart of the planning system. That process comprises several steps (described below).

In addition, the following might also be applicable:

- *Subdivision Act 1988* (Vic), which sets out the procedures for the division of land.
- Commonwealth and State environmental protection legislation (e.g., *Environment Protection and Biodiversity Conservation Act 1999* (Cth) and *Environment Effects Act 1978* (Vic)), which requires approvals for developments or uses that might endanger species of flora and fauna; and the *Environment Protection Act 2017* (Vic) that requires approvals and licences for uses that may adversely impact the environment.
- *Heritage Act 2017* (Vic), which requires permits and approvals for changes to Victorian heritage-listed places, and the *Aboriginal Heritage Regulations 2018* (Vic) (made pursuant to the *Aboriginal Heritage Act 2006* (Vic)) that imposes permit and approval requirements for Aboriginal cultural heritage sites. A heritage overlay may also be part of a planning scheme. It may require local government approval for developments and uses of land or buildings covered by the overlay.
- Restrictive covenants being contractual arrangements that attach to land, are registered on the title, and binding on the landowner. Examples of common covenants include limitations on the number of houses that can be built, or that prohibit certain businesses being conducted, on the land. Restrictive covenants interact with the planning system in two main ways. First, planning permits cannot be granted if they breach a registered restrictive covenant that attaches to the land; and second, the planning system provides mechanism for restrictive covenants to be removed or varied.[32]

4.4.1 PREPARATION AND LODGEMENT

The process starts prior to the lodgement of an application. First, the applicant (usually the landowner) needs to establish whether a planning permit will be required, given the zoning and overlays that apply to the property.

If a permit is required, the applicant will then lodge an application with the authority that has responsibility for determining it (the 'responsible authority').

In most instances, the local council is the responsible authority for its local government area, but there are exceptions.

The responsible authority generally has 60 days within which to make a decision on the application. However, the 'statutory decision clock' is not continuous.

It can pause and reset at various stages through the assessment process.

One reason it may pause is because the applicant is requested to provide additional information that the responsible authority considers necessary to understand and determine the application. Another cause can be actions arising in and out of the referral and notice step.

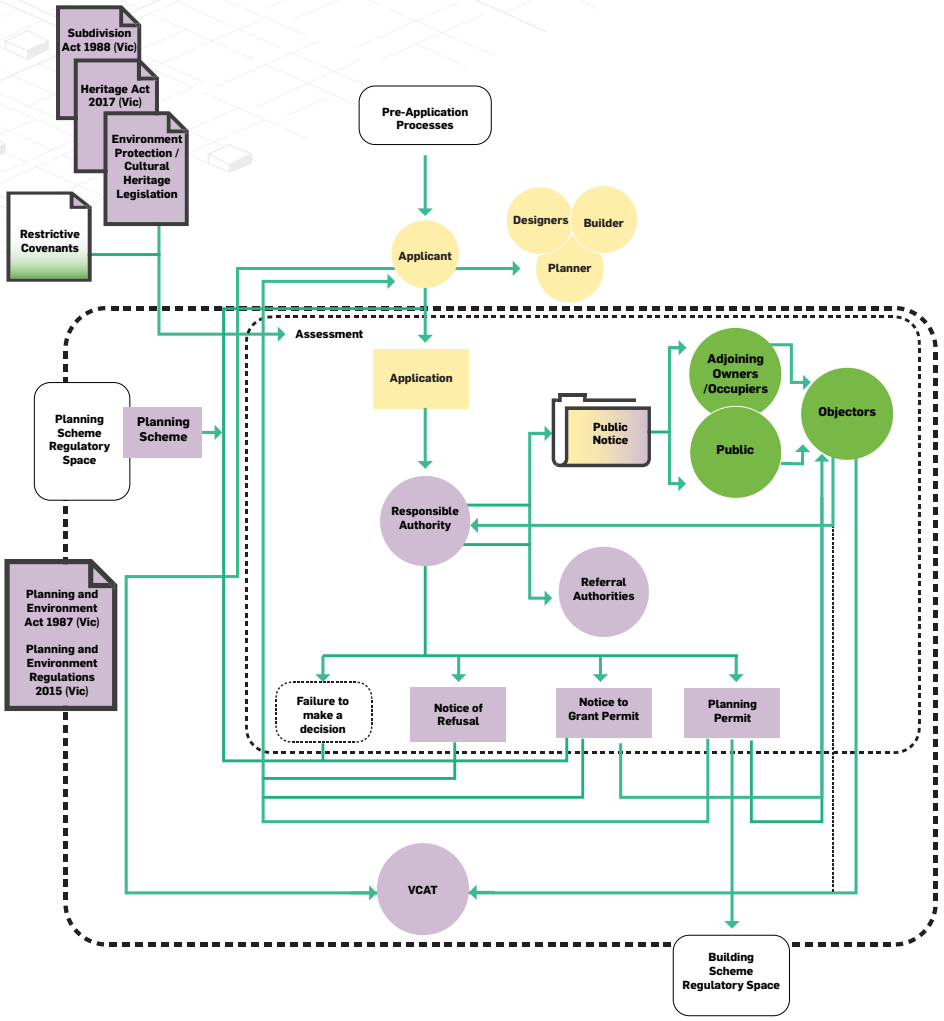


Figure 17: Victorian Planning Permit Regulatory Space Map

4.4.2 REFERRAL AND NOTICE

After receiving the permit application, the responsible authority must refer the application to a 'referral authority', where required by the planning scheme.[33]

This process is generally referred to as 'a referral'. Referral authorities are either 'determining authorities' whose decisions (and conditions attaching to them) must be adopted by the responsible authority and included in the planning permit, or 'recommending authorities', whose advice must be considered but need not be adopted by the responsible authority.

A recommending authority can apply to VCAT for a review of a responsible authority's decision, to reject the recommendations.

There are approximately 68 referral authorities in the Victorian planning system.

These include planning bodies, water authorities, electricity and gas utilities, as well as Ministers and their departments, managing approvals for environment, roads, public transport, health service providers and health and safety and resource regulators.[34]

The referral process is there to ensure the requirements of all these authorities are known and reflected in the one decision. And having the responsible authority coordinate the referrals avoids the applicant needing to seek separate approvals from each of these authorities for each aspect of the proposal. In this sense, the process is designed to reduce the burden on the applicant.

Nevertheless, the process is cumbersome and time-consuming and can lead to confusion and rework if different referral authorities make different or inconsistent decisions and recommendations with respect to the one application.

A responsible authority must also ensure notice of the planning application is given in accordance with section 52 of the *Planning and Environment Act*. Section 52 requires that notice be given unless the planning scheme exempts the application from the notice requirements. Exemptions most commonly apply to applications that are unlikely to have a significant

[32] Stephen Rowley, *The Victorian Planning System: Practice, Problems and Prospects* (The Federation Press, 2017) 143-8.
[33] Planning and Environment Act, s 55.
[34] For a list of referral authorities by planning scheme, see https://www.spear.land.vic.gov.au/spear/app/spear/action/ReferralAuthorityDirectoryPrepare.ro

planning impact or where the use or development generally complies with a policy or plan that has previously been subject to public scrutiny as part of its approval process.

The persons to whom notice must be given are also set out in Section 52.

They generally include: owners and occupiers of land adjoining the land to which the permit application applies; the municipal council of land to which the application applies, or which may be materially affected by it; the owners and occupiers of land subject to a restrictive covenant that might be breached or varied by the application; any persons whom the planning scheme requires notice to be given; and any other persons the responsible authority considers might suffer material detriment from the grant of the permit.

The methods for giving notice also are set out in section 52. They include written notice to specified persons, placing a sign on the land, placing a notice in a local newspaper, and any other method the responsible authority considers appropriate.

Notice may be given by the responsible authority itself, or the authority can require the applicant to give the notice. In either case, the applicant pays the costs involved.

Any person affected by the grant of a permit (and not just persons to whom notice is given under section 52) may submit an objection to the responsible authority.[35]

An objection must be in writing, state reasons for the objection, and state how the objector would be affected by the grant of a permit.

An objection may be rejected if the responsible authority considers it has been made primarily to secure or maintain a direct or indirect commercial advantage for the objector. Otherwise, the responsible authority must consider any objections received before it makes its decision.

4.4.3 ASSESSMENT AND DECISION

Having obtained all necessary information from the applicant, input from the referral authorities, and having considered any objections, the responsible authority then assesses and makes a decision on the application.

Different councils have different approaches to delegations.

Some elected councils make the decisions themselves on the basis of recommendations prepared for them by council planning staff, while other councils delegate decision-making authority to senior planning staff.

Planning permits often have conditions attached to them. A condition may be that certain matters be resubmitted to the responsible authority and/or further approvals be obtained from the responsible authority (and/or from other authorities) before the development can commence (these are called post-permit conditions and approvals).

4.4.3.1 POST-PERMIT CONDITIONS AND APPROVALS

As noted above, post-permit conditions can require the (now) permit holder to require further approvals.

This can include: approval by the responsible authority of amended or further plans required to be submitted by the conditions; approval by the responsible authority with respect to issues such as waste management, landscaping and heritage; or the approval of another authority with respect to matters within their authority.

Examples of the latter could include Heritage Victoria, or EPA Victoria, or Commonwealth Government authorities responsible for nationally endangered flora and fauna.[36] And, of course, a permit holder may decide to change their plans or the timing of the project, which can also trigger the need for a variation to the permit.

Better Regulation Victoria report that stakeholder feedback suggests the post-permit approval phase can be the longest and most challenging part of the development process, as it may involve obtaining approvals from authorities outside the planning process and sometimes from the Commonwealth.[37]

4.4.4 VCAT APPEAL

The outcome of the application process could be:

- the grant of a planning permit (which usually is preceded by a Notice to Grant Permit);
- a refusal to grant a permit; and
- a failure to make a decision.

In all these cases, persons whose interests are affected by the decision can apply to VCAT for a review on the merits.

An application also may be made by an applicant with respect to a requirement to give notice or to provide further information.

Proceedings in VCAT can include a compulsory conference and, if required, a formal hearing before a Tribunal member.

From VCAT, challenges on a question of law can be taken to the Supreme Court.

4.5 BUILDING SCHEME REGULATORY SPACE (VICTORIA)

4.5.1 LEGISLATIVE FRAMEWORK

In Victoria, the *Building Act 1993* (Vic) (Building Act), the B*uilding Regulations 2006* (Vic) (Building Regulations) and the *Building Code of Australia* (BCA) combine to provide the legal and regulatory framework for building in the state.

The Building Act provides the framework for building works, building standards, building permits and occupancy certificates, and for the regulatory enforcement and maintenance of buildings.

The Building Act also creates the state's building regulator, the Victorian Building Authority (VBA), and the framework for regulating and registering building practitioners, and for the accreditation of certain building products and methods.

The Building Regulations prescribe the specific requirements and standards necessary to implement the policy objectives of the Building Act, and the Building Regulations and the BCA (which is incorporated into the Building Regulations) combine to set out the standards required to be met for building work.

While the Building Act is the primary piece of legislation regulating building in Victoria, other legislation is also relevant to how – and the standards to which – building work is carried out.

They include:

- The Planning and Environment Act, which establishes the legal framework for land use and development, and may require a planning permit for any building work;
- The Domestic Building Contracts Act 1995 (Vic), which regulates the contractual relationship between builder and building owners for domestic building works;
- Legislation that provides for the registration of professionals involved in the building process (e.g., in addition to the Building Act that provides for the registration of builders and building surveyors, the Architects Act 1991 (Vic). which provides for the registration and regulation of architects and the Professional Engineers Registration Act 2019 (Vic), which provides for the registration of engineers that provide structural, civil, electrical, mechanical and fire safety engineering services);
- Legislation and technical standards that provide other building standards (e.g., Disability (Access to Premises — Buildings) Standards 2010 made under the Disability Discrimination Act 1992 (Cth), and Australian Standard AS 3959-2018 – Construction of buildings in bushfire-prone areas referenced in the Building Regulations).
- The Electricity Safety Act 1998 (Vic) and Gas Safety Act 1997 (Vic) that provides for Energy Safe Victoria (ESV) oversight of building issues relating to electricity or gas.

[35] Planning and Environment Act, s 57.
[36] Better Regulation Victoria, Planning and Building Approvals Process Review: Discussion Paper (State of Victoria, 2019) 83-4.
[37] Better Regulation Victoria, Planning and Building Approvals Process Review: Discussion Paper (State of Victoria, 2019) 83.

4.5.2 BUILDING PERMIT AND OCCUPANCY CERTIFICATE PROCESS

The map of the building (and building permit and occupancy certificate) regulatory space is shown in Figure 18.

The map diagrammatically represents the actors and instruments involved in, and the process prescribed by, the Building Act for obtaining a building permit and then an occupancy certificate.

The process comprises the steps laid out below.

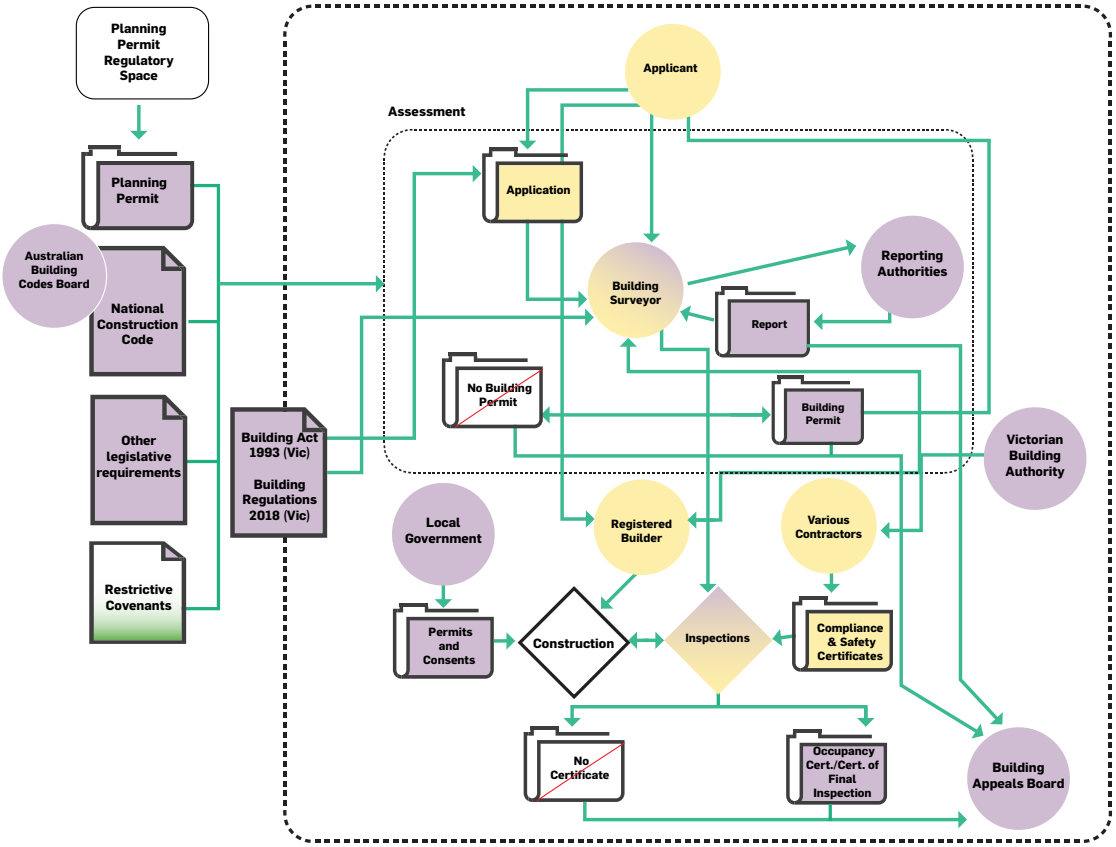


Figure 18: Victorian Building Scheme Regulatory Space Map

4.5.2.1 APPLICATION AND APPOINTMENT OF A BUILDING SURVEYOR

Section 16 of the Building Act provides that a person must not carry out building work unless a building permit in relation to the work has been issued and is in force.

Section 17 then enables an application for a building permit to be made to a municipal building surveyor by, or on behalf of, the owner of the building or land. Two points of importance emerge from these provisions.

First, the process for obtaining a building permit (and ultimately an occupancy certificate) commences with the lodgement of an application.

Second, that application is made not to the local council or other government agency, but to a municipal building surveyor. This requires the owner of the property (or their agent) to appoint a municipal building surveyor to receive and assess the application. That building surveyor might be a private building surveyor, or a building surveyor employed by a local council.

The appointment of the building surveyor is critical. The surveyor performs the core regulatory functions involved in all subsequent steps of the process.

They assess the building permit application and decide whether to grant a building permit; they conduct the inspections mandated by the Building Act to ensure the building complies with the Act, Regulations and building permit; and they grant the occupancy certificate or certificate of final inspection at the end of the process.

Building surveyors must be registered with the VBA and, to be eligible for registration, must satisfy skill, competency and probity requirements, and hold professional indemnity insurance.

4.5.2.2 NOTICE TO REPORTING AUTHORITIES

Like referral requirements for planning permits, a building permit application must be referred to a reporting authority by the building surveyor. Public notice, however, is not required.

Reporting authorities include the council responsible for the land where the proposed building work will occur, any other affected council, and any relevant service authorities such as for drainage, sewerage, electricity, gas or water supply.

The purpose of the referral is to ensure that the proposed building work does not adversely affect the assets and infrastructure of the reporting authorities, the operational requirements of emergency services, or the amenity of the community.

The reporting authority is required to provide a report (and in some cases, consent to) the proposed construction.

If the reporting authority does not provide a report within the prescribed time (usually between 10 and 15 days), the building surveyor may proceed to make a decision with respect to the building permit.

An applicant may appeal a referral authority report, or lack of a report, to the Building Appeals Board (BAB).[38]

4.5.2.3 ASSESSMENT AND DECISION

Next, the building surveyor must assess the building permit application and make a decision. In deciding to grant a building permit, the surveyor must be satisfied that:

- the permit application complies with the Building Act and the Building Regulations;
- the builder who will carry out the work meets the requirements of the Building Act and the Building Regulations; and
- any reports and consents required from reporting authorities have been obtained.

A building surveyor may issue a permit (with or without conditions) or refuse a building permit. If a permit is refused, the building owner may appeal the decision to the BAB.

The building surveyor must also lodge a copy of the building permit with the relevant local council. This enables the council to maintain a public register of all building work in its local government area.

4.5.2.4 CONSTRUCTION AND INSPECTION

Once the permit is issued, the building work can start. It must be carried out in accordance with the Building Act and Regulations, and any building permit conditions.

A building surveyor, a building inspector, or an engineer registered with the VBA, must inspect the building work at the end of each prescribed mandatory stage, and at other times specified in the building permit.

The purpose of the inspections is to provide an independent assessment to ensure that the building work complies with the Act, Regulations and building permit.

Local government permits and consents also may be required if the building works affect council assets or community amenity.

Examples include asset protection permits and bonds (to protect council assets such as roads, footpaths, kerbs and nature strips), consents to build over easements and permits for temporary road occupation, open space storage of materials and equipment, and vehicle crossovers, to name but a few.[39]

There may also be a range compliance and safety certificates required throughout the construction process.

Some of these may relate to structural, civil, hydraulic and mechanical issues, which are issued by certified engineers. Others may relate to water, gas and electrical works, fire safety and energy efficiency matters, and variably are given by licensed plumbers and electricians, Energy Safe Victoria, fire authorities, and accredited energy efficiency assessors.

These compliance and safety certificates must be in place before an occupancy certificate or certificate of final inspection can be provided, which brings us to the next step.

[38]The BAB is discussed in Section 6.2.6 (Dispute Management) below.
[39]For a list of permits and consents see the Moreland City Council website - https://www.moreland.vic.gov.au/building-and-business/planning-and-building/building/building-permits/.
[40] Building Act, Part 10.

4.5.2.5 OCCUPANCY CERTIFICATE/CERTIFICATE OF FINAL INSPECTION

The final step is for the building surveyor to issue an occupancy certificate if required by the building permit; or if an occupancy certificate is not required, a certificate of final inspection.

A certificate means that the building is fit for occupation.

It does not confirm that the building work complies with the Building Act and Regulations.

It is the builder who is responsible for ensuring that the building work complies with all legislative requirements.

A refusal to issue a certificate can be appealed to the BAB.

4.5.2.6 DISPUTE MANAGEMENT

There are several dispute management processes available to persons dissatisfied with decisions made in the process.

As noted above, an appeal may be made to the BAB against the refusal or deemed refusal of: a building permit or occupancy certificate; the imposition of a condition on a permit or certificate; the amendment or cancellation of a permit; or the failure to decide an application within the prescribed time (or if no time is prescribed, within a reasonable time).

An appeal also goes to the BAB with respect to a referral authority report, or lack thereof.[40] The BAB is an independent statutory body established under the Building Act to hear and determine appeals, disputes and requests for modifications to the regulations for a particular building project.

The BAB's authority also includes the power to make certain modifications to the Building Regulations, and to assess whether a design or element of a building complies with the Building Act. The BAB's decisions are final and can only be appealed at the Supreme Court on a point of law.

Complaints can also be brought to the VBA (as the building industry regulator), and to local councils, Energy Safe Victoria, and fire authorities with respect to matters within their jurisdiction.

Disputes involving domestic buildings can be brought to Domestic Building Dispute Resolution Victoria (DBDRV). The DBDRV is an independent government agency established to resolve domestic building disputes without the cost and time often associated with courts and tribunals.[41]

Finally, certain matters can be brought to VCAT, although in the case of matters within the jurisdiction of the DBDRV, only after the matter has progressed through it first, or is a matter of urgency requiring injunctive relief.

4.5.3 REGULATORY OVERSIGHT

It has already been observed that the building surveyor performs the core regulatory functions involved in all steps of the building process.

The statutory role of the building surveyor includes issuing building permits, approving any amendments, undertaking inspections, issuing of occupancy certificates, and monitoring and enforcing compliance.

It also has been observed that the VBA has core responsibility for regulating Victoria's building industry, and that it and local councils, Energy Safe Victoria, and fire authorities perform monitoring, compliance and enforcement roles with respect to matters within their jurisdictions.

[40] Building Act, Part 10.
[41] See its website - https://www.dbdrv.vic.gov.au/.
[42] Building Regulations 2018 (Vic), Part 15.
[43] Building Act, s 3. Interestingly, 'demolition' is not defined in the Act or Regulations. 'Demolition' generally is given a broad interpretation consistent with the Act's purpose and is taken to include any work involving permanently removing part of an existing building (see VBA, Demolition of Building, Practice Note 43-2018) (Issued June 2018)).

4.6 OCCUPANCY REGULATORY SPACE (VICTORIA)

Once building works are complete, the building owner becomes responsible for ongoing maintenance and repair of the building.

In situations where the use or development of the land involves common property, an owners corporation normally assumes management of that property in accordance with the *Owners Corporations Act 2006* (Vic).

This is common with respect to National Construction Code Class 2 building (i.e., a multi-unit residential building). The role of the owners corporation is to repair and maintain the common property and the equipment and services in a building.

The occupancy certificate supplied by the building surveyor will contain a determination and schedule of Essential Safety Measures (ESMs) that the building owner (or owners corporation) is obliged to maintain.42 There are 32 ESMs set out in Schedule 8 to the Building Regulations dealing with:

- building fire integrity;
- means of egress;
- signs;
- lighting;
- Fire-fighting services and equipment; and
- air handling systems.

The building owner (or owners corporation) must ensure that the ESMs are maintained and regularly tested in accordance with applicable standards.

There is a requirement under regulation 224 of the *Building Regulations 2018* for an Annual Essential Safety Measures Report (AEMSR) to be prepared each year.

The AEMSR demonstrates that the owner has taken all reasonable steps to ensure that each ESM is operating at the required level of performance and has been maintained as required.

The AESMR must be made available to the building surveyor and relevant council officers to inspect on request.

4.6.1 RENOVATION / REFURBISHMENT

Any additional building work required may be subject to the same approval processes as applied during the planning and building stages.

4.7 DEMOLITION REGULATORY SPACE (VICTORIA)

The Victorian demolition regulatory space map is shown in Figure 19: Victorian Demolition Regulatory Space Map. The *Building Act* defines 'building work' to include demolition.[43] Therefore, demolition work may require a building permit under the Act.

In addition, if a heritage overlay applies to the building or if it appears on the Victorian Heritage Register, then permits under the *Planning and Environment Act* and consents under the *Heritage Act 2017* (Vic) also may be required. In this section, we look at each of these requirements in turn.

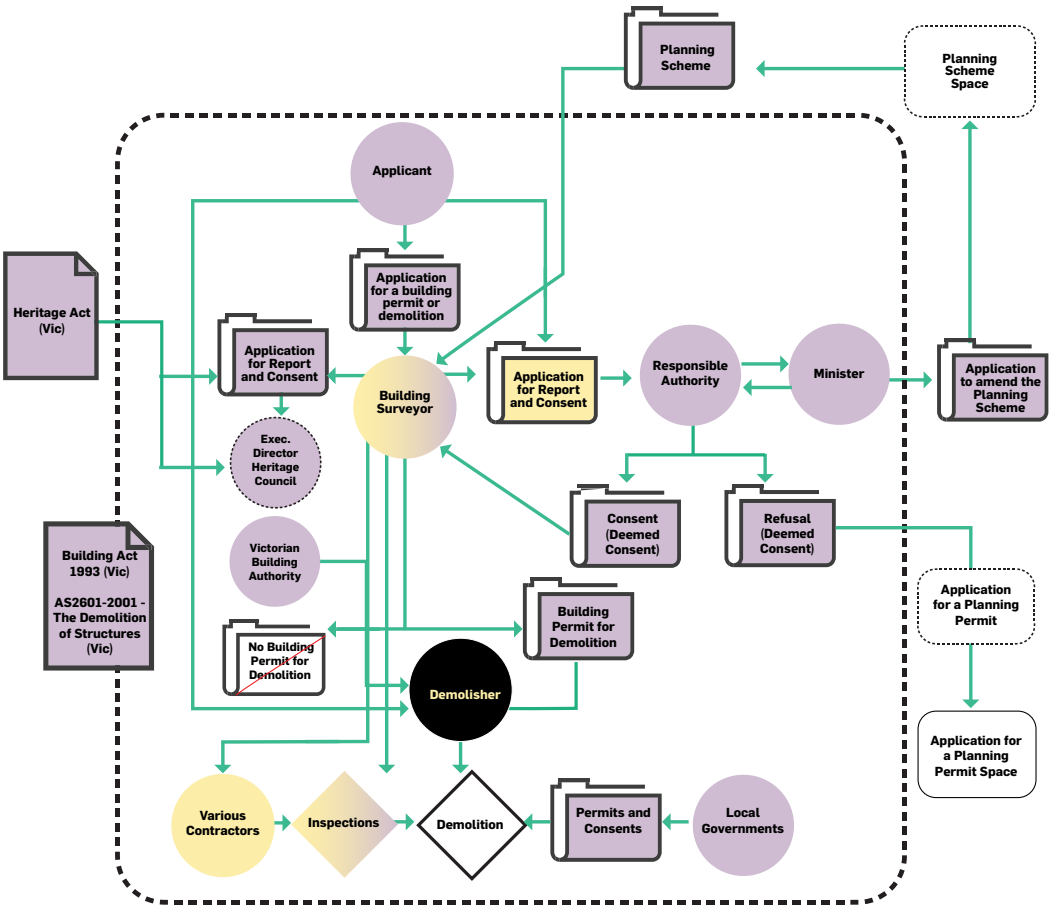


Figure 19: Victorian Demolition Regulatory Space Map

4.7.1 BUILDING PERMIT FOR DEMOLITION

As aforementioned, section 16 of the Building Act states that a person must not carry out building work unless a building permit in relation to the work has been issued and is in force. And as noted above, 'building work' is defined to include demolition.

Therefore, the same process and criteria for obtaining a building permit applies, save that the requirements set out in sections 29A and 29B of the Building Act in relation to the demolition of buildings also need to be considered.

Section 29A states that if the demolition satisfies the volume/façade test, then the report and consent of the responsible authority under the *Planning and Environment Act* for the planning scheme relating to that land must be obtained.

The volume/façade test states that the consent of the responsible authority is required if the demolition (and all other demolitions completed or permitted in respect of the building within the period of three years immediately preceding the date of the application) would, together, amount to the demolition of more than one half of the volume of the building as it existed at the date of the first building permit to be issued within that period for the demolition of any part of the building; or the demolition is of any part of the façade of a building that faces, or is visible from, the street.

4.7.2 PLANNING PERMIT

Section 24 of the Building Act states that a building permit must be refused if a required planning permit has not been obtained.

Further, section 29A of the Act states that the building surveyor must refuse its consent if a required planning permit has not been obtained.

Therefore, the building surveyor will need to establish whether a planning permit is required for demolition and instruct the owner or developer to apply for one if required.

A heritage overlay in the planning scheme generally states that a planning permit is required for demolition.

4.7.3 HERITAGE CONSENT

Section 28(4) of the Building Act requires that the report and consent of the Executive Director under the Heritage Act must be obtained for an application to demolish or alter a building that is on the Victorian Heritage Register.

Places that are on the Victorian Heritage Register also generally are included in a heritage overlay of the relevant planning scheme.

The Act seeks to minimise duplication by stating that a planning permit is not required under an overlay to develop a heritage place that is included on the Register if either a permit for the development has been granted under the Heritage Act or the development is exempt under section 92 of the Heritage Act.

However, a planning permit may still be needed under other provisions of the planning scheme (e.g., if required by a zone requirement or other overlay), assuming they apply to a demolition.

4.7.4 SUSPENSION OF BUILDING DEMOLITION PERMIT PENDING PLANNING SCHEME AMENDMENT

Section 29B of the Building Act enables the building surveyor to suspend the application for a demolition permit if the Minister for Planning is asked to amend the planning scheme (or the notice requirements attached to the scheme), to the effect that the relevant building may not be demolished or externally altered except in accordance with a permit under the planning scheme.

In this case, the responsible authority must refuse consent to the application, and a building permit for demolition may not be issued until such time as the planning permit is issued and the report and consent of the responsible authority is obtained.

Section 29B is most commonly invoked in situations where a reporting authority (usually local council) considers a building proposed for demolition has heritage value but has not yet been assessed or registered.

Section 29B allows the council to request the Minister's approval on an interim heritage overlay and for the demolition permit application to be suspended until the council completes the heritage study and, if appropriate, applies for an ongoing heritage overlay.

4.8 NEW SOUTH WALES: COMPARATOR

The planning and building approval systems in Victoria and New South Wales (NSW) seek to achieve similar outcomes, i.e., to promote development that provides economic, social and environmental benefits whilst protecting the environment from development that is harmful to the health, safety and wellbeing of society[44].

There are, however, key differences in the way these objectives are achieved.

The Victorian planning system achieves consistency through a consolidated process, which involves the use of planning schemes drawn from the VPP. Alternatively, the NSW planning system provides a complex but more tailored process designed to streamline development applications.

4.8.1 PLANNING PROCESSES

The NSW planning assessment system centres on a complex, multi-layered regulatory and policy framework under which sits a range of local development controls.

The system is underpinned by a strategic planning framework that aligns the planning priorities identified at state, regional and district levels, and incorporates environmental, social and economic objectives.

Where the Victorian planning system uses planning schemes to achieve the policy objectives and facilitate development, the NSW system uses a series of environmental planning instruments.

At the state level, a series of State Environment Planning Policies (SEPPs) provide the overall development controls for NSW. At local government level, a series of Local Environment Plans (LEPs) provide the framework for land usage by establishing land use zones and imposing standards to control development.

LEPs are drawn from the local strategic planning statements (LSPS) – a document required under the *Environmental Assessment and Planning Act 1979* that draws together and summarises planning priorities identified through state, regional, district and local strategic plans.

All 128 councils in NSW have an LSPS and LEP in place to guide planning decision-making. Where an SEPP and LEP overlap, the SEPP overrides the LEP.

Regional Plans and District Plans sit in between SEPPs and LEPs and provide a link between the strategic direction outlined in state strategic plans and the detailed planning controls for local areas.

NSW is covered by ten regional plans, and a further five district plans sit under the Greater Sydney Region Plan. Development Control Plans (DCPs) provide another layer of non-statutory planning controls for land zoning and development allowed under a SEPP or LEP.

The planning approvals system in NSW is designed around eight planning approval pathways.

The appropriate development pathway for a proposal is determined by the size and scale of the development. The eight pathways are:

- Exempt Development;
- Complying Development;
- Local Development;
- Regional Development;
- State Significant Development;
- State Significant Infrastructure;
- Development Without Consent; and
- Designated Fishing Activities,

For the purposes of this comparison, we are using National Construction Code Class 2 building as our case study, focusing on the Complying Development and the Local Development pathways.

4.8.1.1 COMPLYING DEVELOPMENT PATHWAY

The complying development pathway is a fast-track approvals process that applies to routine works for homes, businesses and industry that comply with the relevant development standards in the State Policy.

Figure 20: NSW Complying Development Pathway Regulatory Space Map maps the actors, instruments and process for gaining a complying development certificate prescribed in section 4.2(5) of the Environmental Assessment and Planning Act.

The process comprises the following steps.

[44] The objects of the NSW planning system are set out in section 1.3 of the *Environmental Assessment and Planning Act* 1979 (NSW).

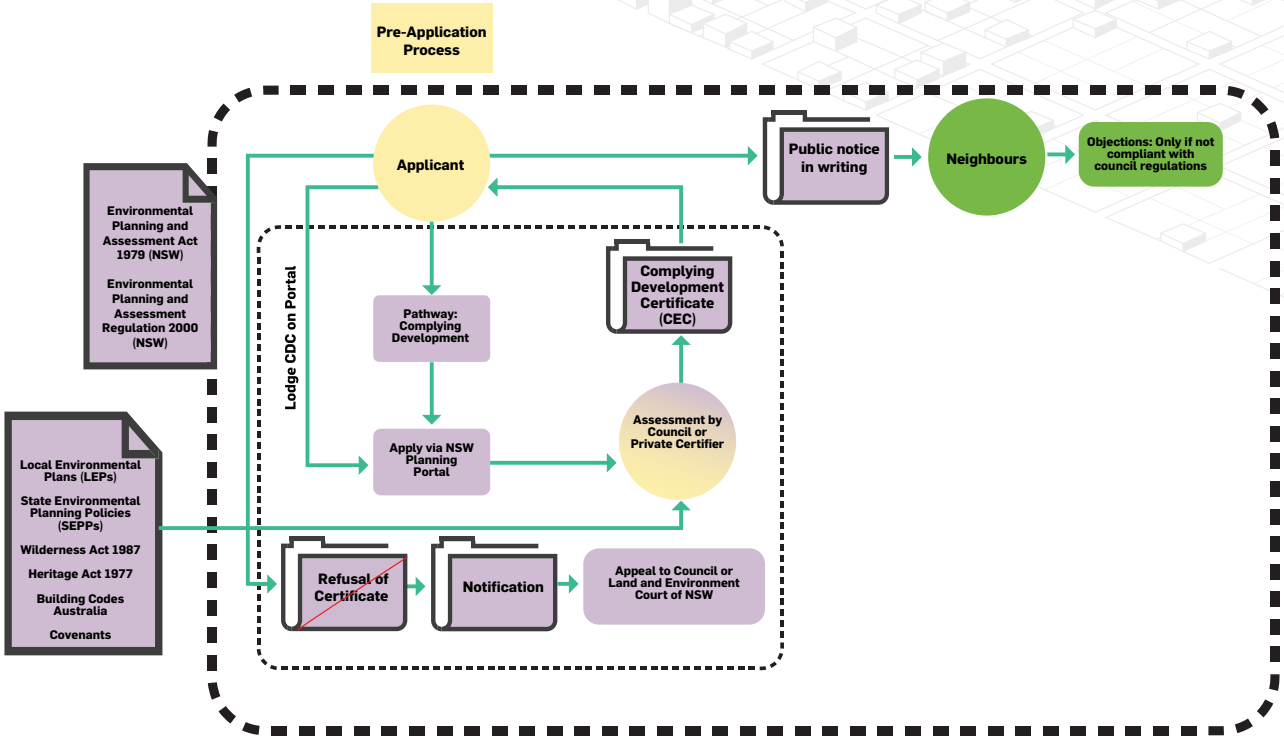


Figure 20: NSW Complying Development Pathway Regulatory Space Map

4.8.1.1.1 Preparation and Lodgement

To ensure that the proposal meets the specific development standards required for a complying development, the applicant must apply for a Complying Development Certificate (CDC). The application for a CDC must be lodged through the NSW Planning Portal.

4.8.1.1.2 Public Notification and Objections

The Environmental Assessment and Planning Regulation 2000 (NSW) requires that the public be notified of CDC applications via online publication on the NSW Planning Portal, or the relevant council's website. Public objections are only permitted if the proposal is not compliant with council regulations.

4.8.1.1.3 Assessment

The CDC application is assessed by a certifying authority – either the council in which the proposed development lies, or a registered certifier accredited by the NSW Building Professionals Board.

The application for a CDC is assessed against the development standards detailed in the State Policy, State Environmental Planning Policy (Exempt and Complying Development Codes) 2088, and the Environmental Planning and Assessment Regulation.

4.8.1.1.4 Appeals by Applicant: Refusal of certificate

If a CDC is not granted, or the applicant is dissatisfied with the conditions attached to the certificate, there are two pathways for appeal.

The applicant may request the council to conduct an internal review of the determination. Alternatively, the applicant may commence an appeal to the Land and Environment Court of NSW.

4.8.1.2 LOCAL DEVELOPMENT PATHWAY

Local development falls into three categories: development that does not need consent, development that needs consent, and prohibited development. A development that needs consent (but is not regionally significant or state significant development) is then further categorised depending on the potential environmental impact predicted to occur throughout the construction and life of the development.

These categories include designated development, integrated development and advertised development; categories that can, at times, overlap.

The category into which a development falls determines the level of environmental assessment required, the notification requirements, and the appeal rights for that development.

Figure 21: NSW Local Development Pathway Regulatory Space Map maps the actors, instruments and process for gaining a local development approval.

4.8.1.2 1 Preparation and Lodgement

Designated development refers to development that is likely to have a high impact on the environment, and is categorised as such – either according to a specific LEP or SEPP, or the Environmental Planning and Assessment Regulation.

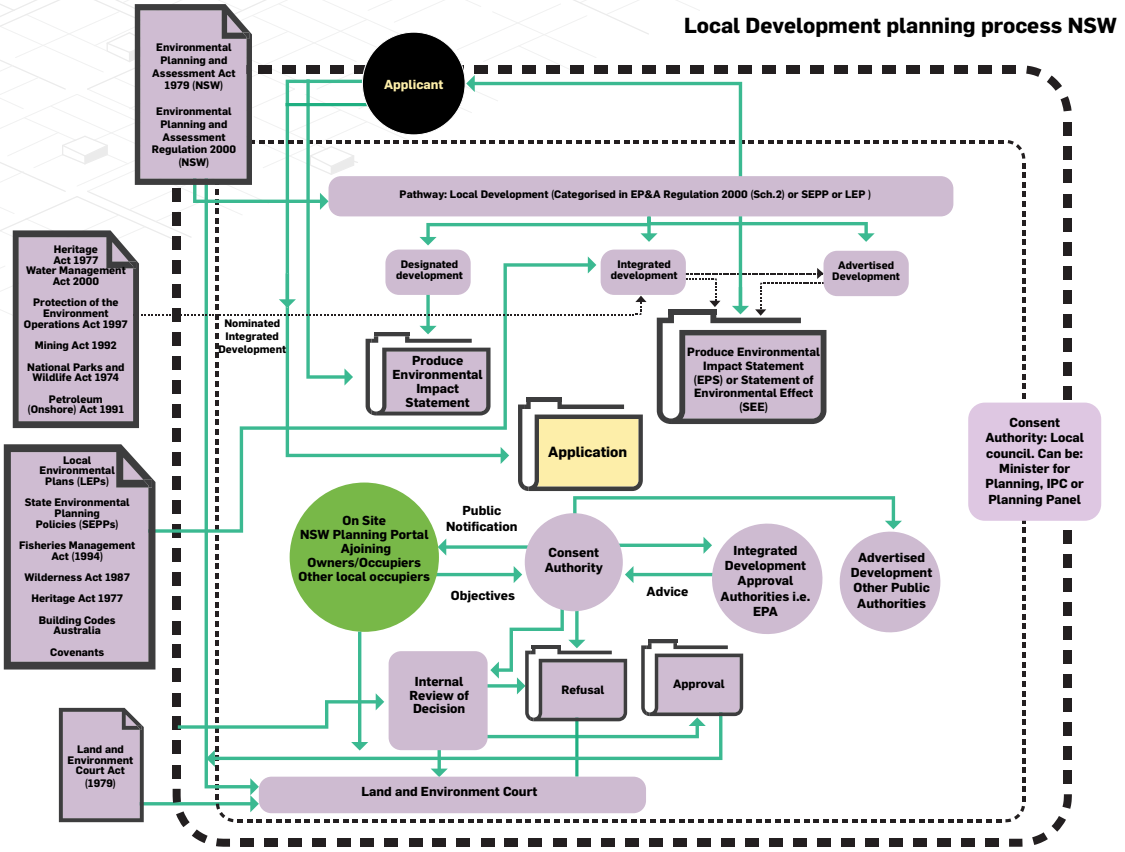


Figure 21: NSW Local Development Pathway Regulatory Space Map

The development application must be lodged with the local council and include an environmental impact statement (EIS), which must be prepared according to the Planning Secretary's Environmental Assessment Requirements (SEARs).

Integrated development is a development that requires approvals from one or more NSW State Government agencies.[45] If a public authority refuses to grant approval, the consent authority must refuse the development consent. The development application requires an EIS and must be lodged with the local council.

Nominated Integrated development is an integrated development that requires approval under provisions of the following: *Heritage Act 1977*; *Water Management Act 2000*; and *Protection of the Environment Operations Act 1997*.

For this reason, a nominated integrated development also falls under advertised development for the purpose of public notification.

Advertised development can include integrated development and complying development, and has more additional requirements for public notification than designated development. The application must be lodged with the local council.

4.8.1.2.2 Public notification, referrals and objections

The consent authority is responsible for notifying the public of the development application for all local development.

The development application and any accompanying information must be placed on public exhibition for at least 30 days, be published through the NSW Planning Portal, and notice of the development application must be placed on the land to which the application relates.

Written notice also must be given to relevant public authorities, owners and occupiers of adjoining land, and any people who own or occupy land that may be detrimentally affected by the development.

For *designated developments*, objectors can appeal the decision to grant a development application in the Land and Environment Court of NSW on the merits of the decision, unless the decision has been made by the Independent Planning Commission after conducting a public hearing.

For *integrated development* and *advertised development*, there are no rights to appeal on the merits of a case. Objectors can appeal a decision on a point of law.

4.8.1.2.3 Assessment

The local council is generally the consent authority for local development, but in some circumstances, such as when the development is a state significant development or a state significant infrastructure, or when stipulated in the SEPP, then the Planning Minister or the Independent Planning Commission will be the consent authority.

4.8.1.2.4 Applicant appeals

For all local developments, if development approval is not granted, or the applicant is dissatisfied with the conditions attached to the approval, then there are two pathways for appeal.

The applicant may request that the council conduct an internal review of the determination, or, the applicant may commence an appeal to the Land and Environment Court of NSW.

[45] Permits that may be required are listed in the Environmental Planning and Assessment Act, section 91

4.8.2 BUILDING AND CONSTRUCTION PROCESS

Building and construction in NSW is regulated by the *Environmental Planning and Assessment Act*, the *Building Professionals Act 2005* (NSW) and the *Home Building Act 1979* (NSW), as well as a complex array of Building Codes, Standards and Regulations.

The National Construction Code (comprising the Building Code of Australia and the Plumbing Code of Australia) sets out the minimum requirements for the design and construction of new buildings, and work being conducted in existing buildings, including plumbing and drainage.

Figure 22: NSW Building and Construction Regulatory Space Map maps the actors, instruments and process for building and construction, from the application for a Construction Certificate, through to the construction process and then applying for an Occupation Certificate.

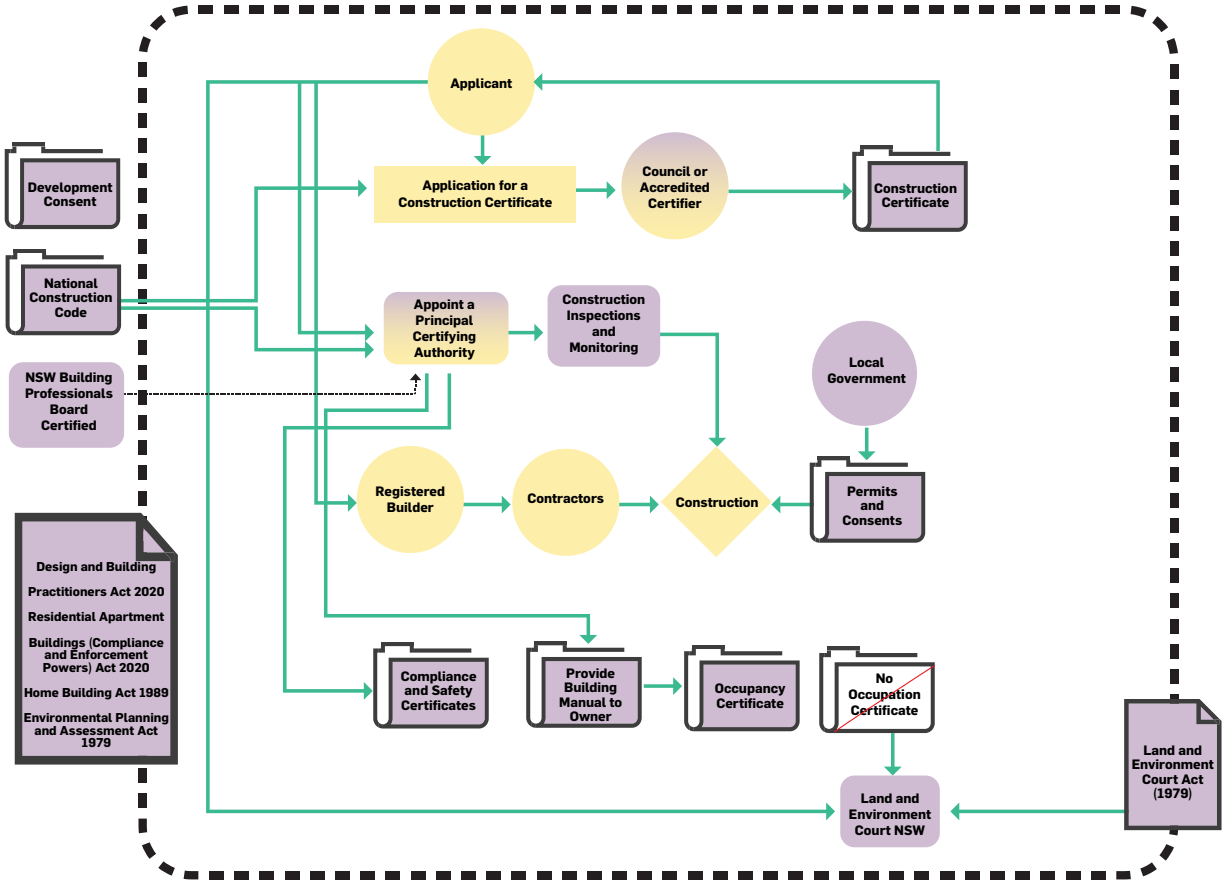


Figure 22: NSW Building and Construction Regulatory Space Map

4.8.2.1 THE CONSTRUCTION CERTIFICATE

Once development approval or a CDC has been granted, the applicant must apply for a Construction Certificate.

A Construction Certificate can be provided by the local council or a private certifier who is accredited by the NSW Building Professionals Board.

The certificate confirms that the construction plans and development specifications are consistent with the development consent and comply with the Building Code of Australia, and any other requirements of the local council.

4.8.2.2 THE PRINCIPAL CERTIFYING AUTHORITY

The principal certifying authority is responsible for conducting a final inspection once the building work is completed, and issuing the Occupation Certificate if all requirements have been met.

For certain developments, such as those that are completed in stages, an Interim Occupation Certificate can be given, allowing the completed part of the building to be occupied.

4.8.2.2 THE PRINCIPAL CERTIFYING AUTHORITY

The applicant must appoint a Principal Certifying Authority, who is accredited by the NSW Building Professionals Board, to monitor construction and conduct mandatory inspections at six critical stages of the development, to ensure building standards are met.

4.8.2.3 OCCUPATION CERTIFICATE

The principal certifying authority is responsible for conducting a final inspection once the building work is completed, and issuing the Occupation Certificate if all requirements have been met.

For certain developments, such as those that are completed in stages, an Interim Occupation Certificate can be given, allowing the completed part of the building to be occupied.

4.8.2.4 CERTIFICATE APPEALS

If to the issuing of a construction certificate, occupation certificate, subdivision works certificate, or subdivision certificate is rejected, or if the applicant is dissatisfied with the conditions attached to a certificate, the applicant can appeal the decision or conditions to the Land and Environment Court of NSW.[46]

4.9 COMPLEXITY AND COST

This mapping exercise has demonstrated the complexity of Victoria's (and NSW's) planning and building regulatory system and the regulatory regimes that comprise it.

The regimes comprise multiple Acts, regulations, schemes, directions, permits and certificates, as well as a host of quasi-regulatory codes and standards.

These regulatory instruments prescribe detailed and complex rules and processes that are administered and enforced by a plethora of government agencies, as well as building surveyors, many of whom are private actors to whom the state has delegated key regulatory roles.

This complexity has increased over the past 20 years as cumulative amendments to address new circumstances have led to increasingly longer and more complex planning schemes.

This has resulted in complexity, duplication, delays and uncertainty. Previous studies have concluded that some of this complexity is unnecessary.[47]

For example, Better Regulation Victoria's Discussion Paper on planning and building approvals processes found that many of the causes of delay were systematic in nature and included:

- disproportionate and inconsistent requirements for users to meet at each stage of the process;
- more decision points or decision-makers than are necessary to support the intent of the regulations;
- unnecessary process steps or steps that could be better coordinated;
- complicated, overlapping and sometimes contradictory policy settings;
- unclear information for users about what they need to do to meet those requirements;
- insufficient resources and skills for those administering the system;
- a lack of user-focused culture in organisations administering the system;
- limited adoption of best practice processes and technology to manage internal processes or provide users with access to information; and
- too little transparency in monitoring and accountability for performance.[48]

Importantly, these same studies have concluded that these complexities contribute to delays and costs that impact economic efficiency, particularly in the construction industry and on housing affordability and employment.

[46] Environmental Planning and Assessment Act 1979 - Sect 8.16

[47] See e.g., Department of Sustainability and Environment, *Better decisions faster: opportunities to improve the planning system in Victoria: a discussion paper* (State of Victoria 2003); Victorian Competition and Efficiency Commission, *Housing regulation in Victoria: Building Better Outcomes - A draft report for further consultation and input* (State of Victoria, 2005); Department of Sustainability and Environment, Cutting Red Tape in Planning (State of Victoria, 2006); *Victorian Planning System Ministerial Advisory Committee: Initial Report* (December 2011); Victorian Auditor-General's Office, *Compliance with Building Permits* (December 2011); Victorian Auditor-General's Office, Victoria's Consumer Protection Framework for Building Construction (May 2015); Victorian Auditor-General's Office, Managing Land Use and Development (March 2017); Department of Environment, Land, Water & Planning, *Reforming the Victoria Planning Provisions: A Discussion Paper* (State of Victoria, October 2017); Peter Shergold and Bronwyn Weir, *Building Confidence: Improving the effectiveness of compliance and enforcement systems for the building and construction industry across Australia* (Report for the Building Ministers' Forum, February 2018); Better Regulation Victoria, *Planning and Building Approvals Process Review: Discussion Paper* (State of Victoria, 2019)

[48] Better Regulation Victoria, *Planning and Building Approvals Process Review: Discussion Paper* (State of Victoria, 2019) 20.

For example, Better Regulation Victoria's Discussion Paper, referencing a March 2016 paper prepared SGS Economics and Planning, found that:

- the estimated costs to industry from the planning and building systems' complexity and associated delays range from $400 million to $600 million per year;
- the cost of a day's delay could be as high as $50,000 per day for a single high-rise commercial development, and for residential developments can range from approximately $70 per dwelling per day for low-rise dwellings, to approximately $180 per dwelling per day for high-rise, high quality developments; and
- Planning Permit Activity Reporting System (PPARS) data suggests that of all residential permits for new dwellings in Victoria in 2017-18, almost two-thirds took more than two months to assess, a quarter took more than six months to assess, and nearly one in ten took more than ten months to assess.

While the introduction of a digital platform of the type under consideration will not, alone, remove or address all the complexities and costs identified above, the streamlining of the processes and increased transparency and accountability that it will facilitate will mitigate many of them, thereby delivering a significant benefit to industry, consumers and society more broadly.

A review conducted by PricewaterhouseCoopers (PwC) for Better Regulation Victoria concluded that the following could generate benefits of up to $100 million per year[49]:

- engaging earlier with referral authorities through pre-application processes;
- sending referrals and requests for information concurrently;
- better coordinating and managing internal referrals and assessment;
- adopting best practice delegations; and
- processing applications online with a system that applicants can view.

4.10 CHANGE AND REFORM

Change is a constant. Some of this change is brought on by changes in industry practice, some by events and crises, some by technology, and some by government policy.

Industry is constantly looking at ways to improve how it can do things more effectively and efficiently. Industry innovation can be hampered by a regulatory regime that is static and incapable of evolving with change.

For example, the current planning and permit approval process is based on a traditional stage-based model of project delivery.

It is not readily adaptable to integrated project delivery models that seek to integrate the planning and building stages. and that manifest themselves in change to the design after the building permit is obtained and construction has commenced.[50]

As such, the current regulatory frameworks might be impeding innovation.

Reviews into these (and other) issues have identified inadequacies in the regulatory regime as factors that contribute to the problems.[51]

A review of the adequacy or 'fit-for-purpose' of the existing regulatory regimes was not within scope, other than to observe the extent to which these issues related to matters that improved information flows, and that regulatory oversight and decision-making could address.

This project does also have the potential to address the root causes of some of these problems.

The mapping exercise has shown the building process involves a range of actors exchanging information at different stages.

The opportunities this provides for digitisation of both the information and its flows are already being explored and exploited to various degrees by government and industry.

Building Information Modelling (BIM) and digital collaborative platforms are already being used to facilitate planning and building permits in several jurisdictions. This trend is only expected to accelerate.[52]

Several government reviews are underway – in many cases, in response to the above trends.

4.11 CONCLUSION

This mapping exercise has shown that the planning and building regulatory space is ***crowded, contested, complex, costly and changeable.*** This is reflected in the planning and building regulatory regimes.

Crowded: The planning and building regulatory space is very crowded. It is occupied by:

(1) a variety of state (public) and non-state (private) actors extending beyond those directly involved with the preparation and assessment of planning and building approval applications; (2) a variety of formal legal instruments giving effect to diverse legal, economic and social objectives; and (3) a variety of different decisions, permits, approvals, certificates and consents made under those legal instruments.

Also important is what is not shown on the maps – namely, the market forces, contractual arrangements, and business and societal norms that operate upon the actors in the space, both state and non-state.

Contested: The actors occupying the regulatory space have different interests and values, and different objectives that they would like to see a building and planning system deliver.

These interests, values and objectives can differ economically, socially and environmentally.

Even within government there are agencies with different missions and regulatory roles, and with multiple and potentially competing policy objectives in areas as diverse as economic development, environmental protection, urban renewal, neighbourhood amenity, and consumer protection.

Complex: The actors occupying the regulatory space possess resources (information; institutional credibility; money; people) relevant to the governments' regulation of the area.

The regulatory regime seeks to bring these actors together in a coordinated and synergetic manner that respects each actor's proprietary, legal and civic rights.

The end result, however, is generally perceived as being complex and cumbersome.

The system is also technical and nuanced, sometimes with fine distinctions that can lead to significant consequences.

Moreover, this complexity is exacerbated by the different legislative and regulatory frameworks employed by states and territories.

Costly: The complexity in the regime translates into increased costs for industry and government (and therefore consumers and society).

These costs have been estimated to be in the order of $400 to $600 million a year.

Changeable: The sector operates in a dynamic and changeable environment. Some of this change is brought about by changes in industry practice; some by technological change and disruption; some by events and crises; and some by government policy.

The complexity and cost of the system itself is driving calls for reform, to which governments are responding with proposed changes to policy, regulation and law.

4.11.1 IMPLICATIONS

That the regulatory space is crowded, contested, complex, costly and changeable has implications for the development of a digital platform, the subject of this report. These include the following:

- developing a 'one-stop' digital platform that covers the whole of building lifecycle is a difficult and challenging exercise;
- developing the platform by prioritising the development of components and ensuring those components are interoperable;
- developing the platform in close partnership with industry to ensure its needs are properly understood and reflected in the final design;
- ensuring the platform is capable of expanding to cover all construction types and other jurisdictions;
- future-proofing the platform – ensuring the platform is capable of evolving with changes and developments within industry, technology and government policy;
- future-proofing regulation – ensuring the regulation is sufficiently agile to adapt to rapid and transformative changes in both industry and technology;
- ensuring the platform is accessible to all who may have a need to use it. This includes the public (and potential objectors) and those charged with resolving disputes that might arise (e.g., VCAT), in addition to those directly involved with the preparation and assessment of planning and building permit applications and
- supporting the roll-out of the platform with a transition plan that leverages the drivers for change and overcomes (or at least mitigates) the barriers to change.

The issue of future-proofing is important. Buildings can have a long lifespan. The period from planning permit application to demolition of a building can be very long, and longer than the lifespan of the technology existing at the time that its design and construction were approved.

This makes it important to 'future-proof the data"; that is, ensuring the information relied upon to grant those approvals is archived and capable of being retrieved and used in the future, should the need arise – for example, when renovating or demolishing the building, or when government is considering additional regulatory overlays to it.

It also means the data (and its accessibility) should survive organisational and institutional change within government at both the state and local levels.

4.11.2 FUTURE RESEARCH DIRECTIONS

This mapping exercise has identified several possible future research directions with the aim of exploring how the regulatory space and regimes might be better configured to developing better governance and regulatory frameworks and models, though which to achieve government policy objectives.

This would involve moving beyond acknowledging the complexity of the regulatory space towards:

- developing an understanding of the opportunities presented within this complexity to better promote and synergise the multiple competing policy objectives;
- identifying those elements that may support and enable innovation, and those which may hinder and impede innovation; and
- examining regulatory and institutional arrangements in more jurisdictions to identify best (better) practice.

5. TECHNOLOGICAL EVALUATION AND REQUIRED CHANGES

This section focuses on technical aspects of the development process.

5.1 CONCEPTUAL FRAMEWORK

This section aims to identify the gaps in the current Australian planning and building process and approval, and certification, system through a benchmarking process, and to provide recommendations to move from the current status to the future status according to the best practices and latest developments.

The recommendations will lay the foundation for the eP&eA roadmap.

The technical evaluation initially reviews the results of assessing the current status of the Victorian and NSW system using data, innovation, and standards pathways defined in the Framework for Effective Land Administration (FELA), endorsed by the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM), UN-GGIM acts as an overarching policy guide and provides a reference when developing, renewing, reforming, strengthening, modernising, or monitoring land information systems (UN-GGIM, 2019).

The general goals and requirements of data, innovation and standards pathways are:

1. **Data:** the goal is to attain reliable data and service quality and it is recommended that data be maintained, secured and not duplicated;
2. **Innovation:** this pathway's goal is to encourage responsible and innovation-oriented systems to be designed and developed. It is recommended that the systems and approaches be upgradeable; and
3. **Standards:** the general goal is supporting interoperability and integration, and it is recommended that the internationally agreed standards be considered.

Given that land data property information provides the fundamental requirements for any development type, including all rights, responsibilities and restrictions (Tambuwala et al., 2012), it is important to adopt the FELA standards for planning and building information systems.

In addition, Australian state governments including Victoria and NSW have already started implementing online land administration systems, (e.g., ePlan), as well as investigating three-dimensional (3D) visualisation and validation, the findings of which will support achievement of the objectives in this study's research (Shojaei et al., 2012).

The description of data, innovation, and standards for an effective planning and building development assessment are provided in the following subsections.

5.1.1 DATA

Land and building data is core to development assessment and building lifecycle. It also supports the day-to-day activities of people and their interaction with built and natural environments.

This linking role between people and planet only increases with the growing use of ICT and web technologies.

To support the creation and maintenance of planning, building, and land data framework, it is important to consider enablement of data custodianship, acquisition, management, supply chain, curation, and delivery strategies and mechanisms.

Recognition of land and building tenure, use, value, and development data – including elements relating to environment, social, economic, demographic, conflict, safety, and disaster – are fundamental geospatial data themes within any jurisdiction, as well as provision that those data be integrated with other fundamental themes.

Theories, concepts and standards, including past experiences in spatial data infrastructures (SDI), can support the development of these data frameworks.

Similar to the Land Administration Domain Model (LADM ISO 19152), it is important that a Planning Application Domain Model (PADM) be developed. In the building domain, the Industry Foundation Classes (IFC) data model provides standard guidelines for design, building, and construction industry data.

[49] Better Regulation Victoria, Planning and Building Approvals Process Review: Discussion Paper (State of Victoria, 2019) 14.
[50] RMIT University, School of Property, Construction and Project Management, *Building Process Mapping: The Regulatory System and Potential for Digital Information Capture* (Final Report, April 2020) 9-10.
[51] See reports at n. 44 above.
[52] RMIT University, School of Property, Construction and Project Management, *Building Process Mapping: The Regulatory System and Potential for Digital Information Capture* (Final Report, April 2020) 11-12.

5.1.2 INNOVATION

We argue that innovations in digital modernisation of planning and building approval processes can be driven by societal pull on the one hand, and technological push on the other (Sabri, 2021).

We consider the social shaping of technology (SST) conceptualisation (Williams and Edge, 1996) in defining the forces of "social", "economic", and "technical" to encourage process improvement, technical advancement, and the promotion of creativity and innovation.

As such, the innovation process should be citizen-centric and engage the community. Emerging technologies including cloud computing, online 3D data models, validation, and visualisation tools, artificial intelligence (including machine learning and deep learning), automated feature extraction, change detection mechanism, Big Data analytics, the Internet of Things (IoT), crowdsourced data, and blockchain, all of which will continue to provide opportunity, and disruption.

In all cases, each development requires assessment for the jurisdiction context at hand.

5.1.3 STANDARDS

This project aims to act as a voluntary standard at an international level, while highlighting the existence and value of standards at regional, national, and state levels.

Significant contributions have emerged in digital building and modern land information systems with regards to standards, particularly through initiatives of the BuildingSmart, International Federation of Surveyors (FIG), UN-Habitat, UN-ECE, World Bank, ISO and OGC, all at the global level.

The National ePlanning Strategy for eDevelopment Assessment (eDA) (Figure 23) is recognised by the Planning Institute of Australia (PIA), National Construction Code (NCC) Australia, BuildingSmart Australasia, and Cadastre 2014, which provides a historical example of a strategic-level standard garnering significant uptake across national contexts.

The document comprised of six visionary statements and was translated into over 20 languages, and greatly influences the development of modern land information systems.

Further on, the Principles for Spatially Enabled Digital Twins in Built and Natural Environment developed by ANZLIC, (2019) and Cadastre 2034 Strategy developed in Australia and New Zealand, lead the way towards developing a modern digital modernisation process.

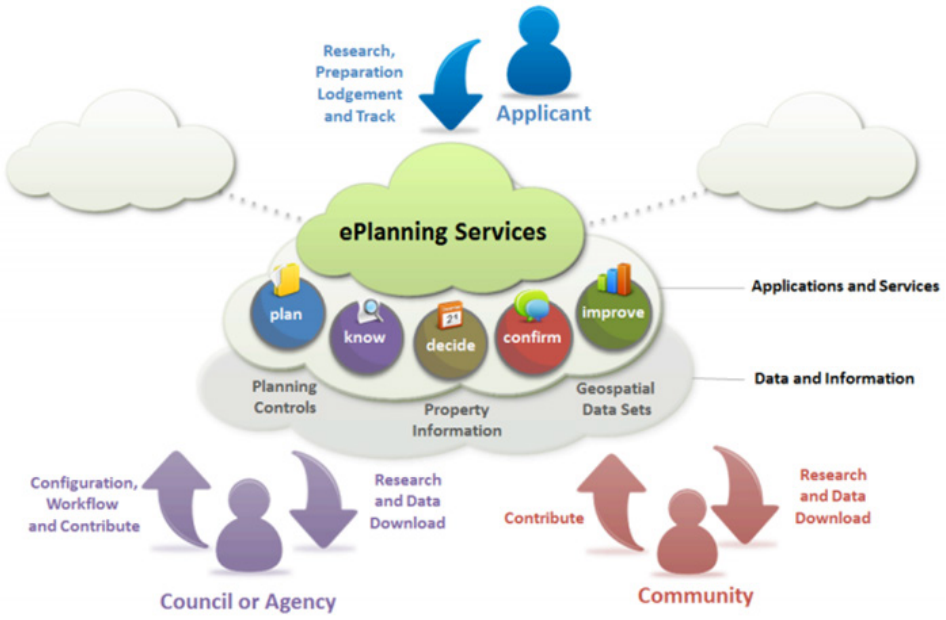


Figure 23: Future state of ePlanning proposed by National ePlanning Strategy. Source: National eDA Steering Committee, (2011).

5.1.4 TERMINOLOGY OF E-APPROVALS INFRASTRUCTURE

It is possible to create a plethora of applications to help with planning tasks, ranging from collaborative design to automated assessment. Although not an exhaustive list, some of the key applications are as follows:

DIGITAL TWINS: "A digital twin is a virtual representation of real-world entities and processes, synchronised at a specified frequency and fidelity. Digital twin systems transform business by accelerating holistic understanding, optimal decision-making, and effective action.

Digital twins use real-time and historical data to represent the past and present and simulate predicted futures. Digital twins are motivated by outcomes, tailored to use cases, powered by integration, built on data, guided by domain knowledge, and implemented in IT/OT systems" (Olcott and Mullen, 2020).

COLLABORATIVE DESIGN PLATFORMS: based on user input, interactive programs provide highly detailed visualisation and assessment of potential planning scenarios.[53]

DIGITAL PUBLIC CONSULTATION: digital applications that enable widespread and targeted feedback on planning policies and proposals, including issue identification and consensus building through the use of digital tools.

The government consults citizens on a regular basis about potential government policies, programs, new public infrastructure, and services. Depending on the goals, the tools and techniques used to deliver consultations vary.[54]

ASSISTED ASSESSMENT SYSTEMS (AAS): a coordinated set of documented policies and procedures (including assessment materials and tools) that ensure assessments are consistent and based on the Principles of Assessment and the Rules of Evidence (Australian Government, 2015).

These systems will aid planners in the evaluation of development applications by automating the tedious checks and flagging issues that need to be addressed.

MONITORING AND EVALUATION ANALYTICS: Development and other data are combined to provide critical insight into how a city is changing and growing, which is useful for everything from small business location decisions to the ability to protect land for critical infrastructure.

PLANNING ADVICE SYSTEMS: These applications will also use planning rules written in computer code to provide community members with accessible and accurate planning advice based on their location.[55]

APPLICATION PROGRAMMING INTERFACES: API is an operating system feature that allows an application to request services from the operating system, enabling the automated exchange of data and instructions linked to a single verified source, thereby making services and information easily accessible within and across organisations.

PLATFORM: The platform can be thought of as four elements, each of which can be delivered in digital, interoperable, and machine-readable formats for immediate use in software applications.[56]

CONTENT: A wide range of contextual information is available, including strategies, policy documents, web articles, images, and videos.

DATA: The platform requires data generated by planners, such as zoning information and spatial layers, development approvals data including digital building models, and infrastructure contributions information.

Data generated elsewhere, but consumed by planners, includes a diverse set of the demographic, economic, sensor, and environmental information.

TRANSACTIONS: Transactions include the payment of application fees and the issuance of development permits.

RULES: Regulations and planning codes are examples of rules. Planning rules can be represented in computer code, allowing for automated or streamlined assessment of a wide range of planning issues, a concept known as 'rules as code'.

[53] There are many options for team collaboration tools: Flowdock, GoToMeeting, Trello, ProofHub, Redbooth,...
[54] https://www.vic.gov.au/set-public-consultation
[55] For instance, the City of Casey's Plan Advice System https://www.casey.vic.gov.au/planning-advice
[56] https://www.planning.org.au/documents/item/10768

5.2 TECHNOLOGICAL CONSIDERATIONS IN VICTORIA

The construction industry in Victoria has grown over the past decade.

Income from the industry increased from around $106,000 million AUD in 2017-18 to nearly $121,000 million AUD in 2019-20 (The Australian Bureau of Statistics, 2021).

At the national level, this industry produces around 9% of GDP, and a 2.4% growth rate is expected in the next five years (Australian Industry and Skills Committee, 2021).

The industry is heavily controlled in many subsectors with stringent regulations. A building permit is a means of controlling compliance in building design and construction with regulations in place prior to building works commencing.

In Victoria, the Building Act 1993 and Building Regulations 2018 provide a legal framework, requirements, and standards for controlling building work, building codes, building and occupancy approval, and building maintenance and operation. In 2020, around 113,000 building permits were issued (Victorian Building Authority, 2019).

5.2.1 SYSTEMS FOR PLANNING APPROVAL PROCESS IN VICTORIA

The electronic submission and delivery of all planning and subdivision permit applications in Victoria is serviced by the Surveying and Planning through Electronic Applications and Referrals (SPEAR) online system.

This service enables applicants to lodge and manage their applications while tracking their progress, as well as permitting councils to receive, manage, refer, and approve applications.

Also, Digital Twin Victoria, which is an innovative new digital program led by Land Use Victoria (a subsidiary of the Department of Environment, Land, Water, and Planning (DELWP)), provides an opportunity for the future of the planning and building approval process.

Victoria's digital twin proof-of-concept developed by The University of Melbourne at Fishermans Bend, for example, demonstrated how innovative technology can help solve the interconnected challenges of urbanisation.

The current method presents old processes and lacks useful functionality, such as workflow capabilities, template management, access to council data, integration of statutory clock management, and document management with the council Data Management System (DMS).

There is also a long response time for changing requirements or rules. In addition, and as aforementioned, content published and produced in public planning processes may not be easily readable by computers (machine-readable).

SMART PLANNING PROGRAMME

Smart Planning is a programme that: aims to make the planning policy framework clear and accessible, and has enhanced the system by simplifying existing provisions, making information and processing available online, implementing plain English provisions, and expanding the VicSmart programme.

The Planning and Environment Amendment (VicSmart Planning Assessment) Bill 2012 was introduced into Parliament by the Planning Minister in 2012. The *Planning and Environment Act 1987* (the Act) enables the planning scheme to set out different procedures for particular classes of applications for permits[57]

Smart Planning was established in 2016 with $26 million in funding for two years and then in 2018-19 was allocated another $15.5 million in funding over three years.

The VicSmart permit process is a specific procedure for evaluating straightforward applications that are consistent with the area's policy objectives and land zoning.

The VicSmart process involves a more tightly focused planning assessment and shorter statutory timeframes than the regular permit process. The decision on a VicSmart permit application is made by the council's Chief Executive Officer (Department of Planning and Community Development, 2007, p63).

Some stakeholders argue that many of the permits they are currently applying for are for low-risk work that could be incorporated into VicSmart or be exempted entirely.

A need has also been identified for a new code assessment pathway for permit applications that are too complex for VicSmart but are simple enough not to necessitate the entire 60-day assessment process.

The Smart Planning programme is working to create this pathway – VicSmart Plus – in which appropriate permit applications would be assessed within 30 days.

Concurrently, the Department of Planning and Community Development issued a fact sheet that explained the proposed new planning permit stream.

According to the fact sheet, the new scheme may apply to a variety of building/work and subdivision applications, such as realigning a common boundary between two lots, subdividing existing buildings, building a fence within three metres of a street, managing vegetation in urban areas, and erecting small advertising signs more than 30 metres from land in a residential zone.

The fact sheet also stated that the processing time for applications submitted through VicSmart will be reduced (derived from Planning and Environment Amendment (VicSmart Planning Assessment) Bill 2012 by State of Victoria).

[57] https://vicsmartguide.com.au/the-complete-vicsmart-guide-blog/the-evolution-of-vicsmart

The following are key aspects of the VicSmart permit process:

- The planning scheme specifies the classes of application to which the process applies.
- The responsible authority is expected to evaluate an application within 10 business days of receipt.
- Section 52 of the Act exempts applications from the notice requirements.
- Sections 60 and 84B of the Act exempt applications from certain decision-making considerations.
- The application is only evaluated in light of specific decision guidelines outlined in the planning scheme.
- The application is the responsibility of the council's Chief Executive Officer (CEO).

VicSmart applications are classified into two types: state VicSmart applications and local VicSmart applications. The Minister establishes state VicSmart applications, which apply to all planning schemes. The council implements local VicSmart applications for its planning scheme, which may differ from scheme to scheme.

The following are some significant differences between VicSmart and the regular permit process:

- The VicSmart process consists of fewer steps than the regular permit process.
- The VicSmart entails a more narrowly focused planning assessment.
- Different statutory deadlines for requesting additional information and making a decision on an application apply.
- For VicSmart applications, the CEO of the council is the responsible authority, whereas the council is typically the responsible authority for regular applications.

Figure 24: The VicSmart and regular permit processes (Source: Department of Planning and Community Development, 2007, p63) depicts the VicSmart and regular permit processes.

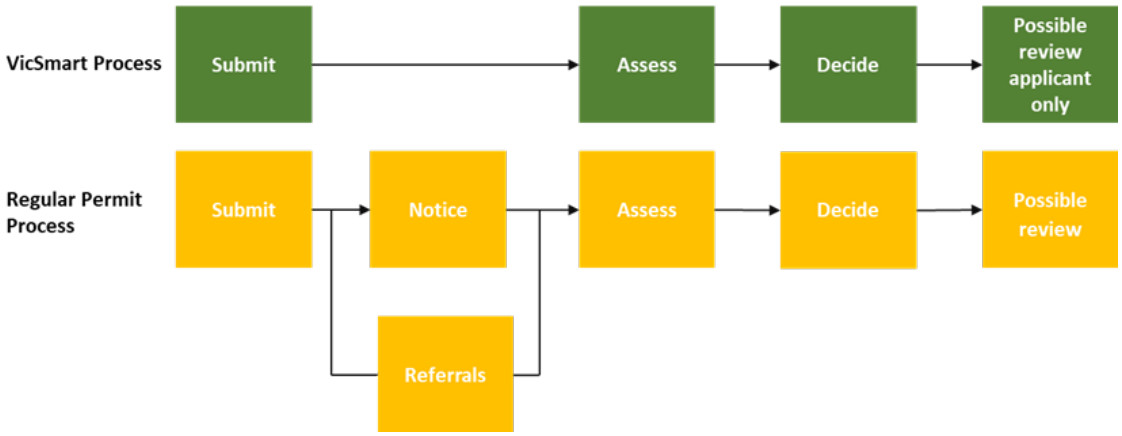


Figure 24: The VicSmart and regular permit processes (Source: Department of Planning and Community Development, 2007, p63)

5.2.1.1 DIGITAL SYSTEM FOR SUPPORTING PLANNING APPROVAL PROCESS BY CITY COUNCILS

Digital technology has the potential to significantly improve planning assessment processes, increase transparency to users, and improve public access to information.

There is currently no state-wide ePlanning platform in Victoria, and councils' use of digital platforms varies greatly.

The Smart Planning programme recently reached a watershed moment, with all councils' planning schemes now online and accessible through a single portal.

However, more steps are needed to make this a truly integrated online planning scheme that is fully searchable.

Currently, many councils do not allow for electronic application submission; instead, they process applications manually. The cost of developing new digital systems is a major barrier to adoption for some councils.

The most recent capability overview occurred three years ago, when the MAV surveyed all councils to obtain a snapshot of their digital planning processing capabilities.

According to the feedback, fewer than ten councils had digital planning platforms with public access, such as electronic filing of planning applications or objections.

The councils that did have digital functionality used a diverse set of software tools and products from various developers.

Approximately half of the councils surveyed were in the process of converting to digital planning or had committed to future transitions, implying that the current situation is more advanced.

While other councils have digital platforms that could be used in their planning processes, the capabilities and compatibility of these platforms vary. According to the findings of the consultation, councils use various digital platforms for a variety of functions such as customer service, approvals, data storage, and payments (Better Regulation Victoria, 2019).

5.2.1.2 DIGITAL SYSTEM FOR SUPPORTING PLANNING APPROVAL PROCESS BY CITY COUNCILS

While larger, better-resourced councils can prioritise their operations in order to invest in digital technology, some regional and rural councils struggle to do so.

The Rural Councils Transformation Program (RCTP) can help to break down this barrier.

The RCTP has provided funding to regional councils to develop common systems, technologies, and processes to maximise the use of digital solutions in service delivery, resulting in economies of scale and improved collaboration, including planning.

The City of Ballarat, for example, has received funding to provide a shared IT platform to support finance, payroll, records, safety, fleet management, building, environmental health, planning, waste, and community services.

Digital planning portals allow for real-time tracking of the status of planning permit applications.

They can also provide visible dashboards for all parties involved in the process, such as referral authorities and the community, to input responses or objections, and councils to publish decisions and reports.

Fully digitised planning portals would also allow for better monitoring and reporting.

The digital management of planning permits should also be linked to the SPEAR system, which is used for subdivisions and digital permit handling, to provide a complete, trackable, end-to-end record of a development cycle, including enforcement matters (Better Regulation Victoria, 2019).

5.2.2 TECHNOLOGICAL CONSIDERATIONS OF BUILDING APPROVAL PROCESS IN VICTORIA

5.2.2.1 SYSTEMS FOR BUILDING APPROVAL PROCESS

In Victoria, the relevant building surveyors approve building permits based on manual review and assessment of applications.

According to the Australian Institute of Building Surveyors, there has been a shortage of building surveyors nationwide since 2015 (Better Regulation Victoria, 2019).

It has caused heavy workloads to the profession, and resulted in the increase of delay and costs in the building approval.

VBA and local councils have introduced an online platform to facilitate an efficient building approval process, focusing mainly on preparing and applying for the permit.

Local councils serve as a central repository for all records related to building and occupancy permits, notice and orders, and certificates of final inspections.

The public records are managed separately, and no central database, systems, or platforms have been introduced for its comprehensive and systematic management state-wide.

5.2.2.1.1 Building Activity Management System (BAMS) by VBA

In 2019, the BAMS platform was introduced by the VBA to manage BPNs. It is intended to provide a basis for a central building records database. This system aims to process levy payments and issue Building Permit Numbers. It also allows managing records of active or completed permits under the user account:

- *Active permits:* checking the status of building permits, amending/cancelling permit records, reporting prescribed events for building permit records.
- *Completed permits:* viewing completed permit records.

The VBA provides an online levy calculator on its website. When the levy payment is made, BAMS creates the BPN, ready for the building permit to be issued. This system requires 34 fields of information regarding building permits for BPN application. The information can be reported to the system via a CSV file or manual input within the system.

The BAMS system is designed to enable building surveyors to directly lodge permit records electronically, and to enable unlimited access records held in it.

Once the required software and infrastructure are in place through BAMS, local councils can seek assistance with migrating existing digitised records to BAMS, and digitising and lodging their remaining hard copy building information.

5.2.2.1.2 Digital system for supporting building approval process by city councils

In Victoria, there are no state-wide central systems for supporting the application, lodgement, and management of building permits and their records.

Each council has established its own system for providing public services with its authority, including building permit application, private building surveyor notification, building permit lodgement, and report and consent application.

To facilitate an efficient and effective process, some councils have introduced a digital platform supporting the services. However, many councils still rely on email communication, or still use post.

ONLINE SYSTEM FOR BUILDING PERMIT APPLICATION

When owners or developers want to appoint municipal building surveyors as RBSs, they need to apply for their building permit to their relevant city council.

Northern Grampians Shire Council has developed and operates an online platform for the building permit application. However, this platform is only for submission; the council still notifies, communicates, and informs

applicants by email. Owners therefore cannot review their applications and track application status.

Many councils, including City of Boroondara, City of Stonnington, and Moonee Valley City Council, still accept application in electronic format via email, or in hard copy by post to the council office.

ONLINE SYSTEM FOR PRIVATE BUILDING SURVEYOR NOTIFICATION

The Building Act Section 80 requires private building surveyors, who accept the appointment as RBS, to notify the relevant council in writing of their appointment. City of Yarra and City of Greater Geelong have introduced online channels to digitally lodge the notification.

This is an online notification form, which is only for submission. All information relevant to the notification is also sent to the building surveyors by email.

ONLINE SYSTEM FOR REPORT AND CONSENT

According to the Building Act Section 29, a Report and Consent from reporting authorities and relevant council must be granted.

A Report and Consent is the process for consulting with, and obtaining the approval of, reporting authorities when building work may affect assets, infrastructure, or amenity of the community.

Several councils, including City of Yarra, have provided online services to apply for the report and consent, and to pay fees.

The services of these councils are offered only for application submission; applicants cannot review, monitor, or get notification on the systems. Email is used as the primary delivery and communication channel. Hard copies of the application form are also accepted via mail or in person at the council office.

ONLINE SYSTEM FOR BUILDING PERMIT LODGEMENT

According to the Building Act Section 30, private building surveyors must lodge the issued building permit to the relevant council within seven days of issues.

Some councils, like Manningham Council and Brimbank City Council, have set up a facility that allows lodging new building permits and all relevant documents online, and paying the lodgement fee.

Manningham Council's system receives only PDF format documents, and is only to be used for new or Stage 1 building permits. Stage 2 permits, amended documents, and certificates of final/occupancy permits can be lodged via email to the council office.

Like building permit applications, a considerable number of councils receive issued building permits and plan documents as electronic files or hard copies by email or post.

This creates an inconsistent format of building permit records, and a limitation in direct access to them, which lead to challenges in establishing a central repository of building permit records.

5.2.2.2 INITIATIVES TOWARD DIGITAL BUILDING APPROVAL PROCESS

5.2.2.2.1 Victorian Digital Asset Strategy (VDAS)

In 2018, the Victorian government announced the Victorian Digital Asset Strategy (VDAS); an innovative way to improve the value and use of the state's assets via digital engineering across the asset lifecycle (Office of Projects Victoria, 2019).

It aims to deliver effective and efficient public services, innovate the public sectors' capabilities, and improve public infrastructure assets.

The VDAS employs digital engineering technologies, such as Building Information Modelling (BIM) and Geographic Information Systems (GIS), as a critical foundation for this whole-of-government innovation shift.

It emphasises that 3D information and information technologies realise connected information environments for asset management to achieve the aims.

The VDAS sets out innovative approaches to creating, capturing, and managing information of the state's physical assets in a digital environment.

It provides a collection of processes, frameworks, systems, standards, and technologies as enablers to improve the transfer and quality of information throughout the asset lifecycle.

Various information requirements, (e.g., asset information, information exchange), which define information hierarchies and classification for planning, building, and operating assets, are provided as standardised templates.

The VDAS is aligned with international standards, as well as national or state directives and technical standards (see Table 4: Standards and directives adopted by the VDAS).

The VDAS focuses on digital asset information practices. It is oriented around activities of planning, designing, constructing, and operating assets, where the information is created and used from the project side.

It shows a lack of direct linkage of asset information to public services and public domain syntax. In the VDAS, building permits play a role

as a sub-source, which builds the information sources for lifecycle asset management.

Use cases, workflow, stakeholders, and the templates suggested by the VDAS were implemented from a project-specific approach; the building approval process was not discussed and covered sufficiently. However, it provides detailed standards for the required documents for building permit application (drawings, specifications, schedules).

The alignment of the digitalisation of building approval processes with the VDAS needs to be considered.

It could ensure interoperability in using project information for building permit applications. In addition, this linkage would bridge the improved data value and effectiveness in information management by VDAS from private to public sectors.

	Standard and directives	Description
National standard	National BIM Guide and Specifications	BIM modelling guideline developed by NATSPEC
	National Construction Code and relevant Australian Standards	Australia's primary set of technical design and construction provisions for buildings
Victorian government standard	Information Management Governance Standard	Standard for common information management framework within the Victorian Government
	Virtual Building Information System	System-agnostic standard as a means of classifying asset data
	Geocentric Datum of Australia 2020	Coordinate reference frame for the project with the one adopted by the Victorian Government
	Victorian Protective Data Security Standards	Standard for data security and integrity established under the Privacy and Data Protection Act 2014
	Asset Management Accountability Framework	Mandatory asset management requirements (strategies, frameworks, standards, processes)
International standard	IFC 16739	International standard for Building Information Model (BIM) by ISO/TC 59/SC 13
	ISO 19100 series	International Standards for digital geographic information by ISO/TC 211
	ISO 19650 series	International standards that define the collaborative processes for the effective management of information when using BIM by ISO/TC 59/SC 13
	ISO 55000 series	International standards for asset management by ISO/TC 251
	ISO 12006	International standard for a framework for the development of built environment classification systems by ISO/TC 59/SC 13
Other	Uniclass 2015	Asset data classification and hierarchy
	LandXML	Data format for survey and titles

Table 4: Standards and directives adopted by the VDAS (Office of Projects Victoria, 2019)

5.3 TECHNOLOGICAL CONSIDERATIONS IN NEW SOUTH WALES (NSW)

5.3.1 SYSTEMS FOR PLANNING APPROVAL PROCESS IN NSW

From July 1, 2021, all Certificate applications have had to be submitted through the NSW Planning Portal.

This portal is a New South Wales Government initiative that was created to provide public access to a variety of planning services and information, including documents and other information in the NSW planning database established under the *Environmental Planning and Assessment Act 1979* (the EP&A Act).

The NSW planning database is an electronic repository of spatial datasets or other maps that are adopted or incorporated by reference by environmental planning instruments, plans, or other documents or information relating to the administration of the EP&A Act, and are required by the regulations to be published on the NSW Planning Portal.

The NSW planning database is to be compiled and maintained in accordance with the Secretary's instructions.

The Secretary has the authority to certify that the form of such documents or other information on the NSW Planning Portal is correct. The Secretary has not yet certified any content on the NSW Planning Portal.

An applicant applies for development consent by lodging a development application (DA) online, which they can then also track online through council processes.

This online portal is a single place for the planning process and transactions, including viewing and interacting with the Development Control Plans and Local Environment Plans.

The map viewer on the NSW Planning Portal provides access to spatial datasets for certain planning maps incorporated by reference in the EP&A Act environmental planning instruments. PDF versions of the official maps, adopted when the instruments are made, are available on the NSW legislation website via a map link index.

The portal's map viewer also provides access to spatial datasets for certain planning maps that may not be regulated by an EP&A Act-created environmental planning instrument.

The suffix 'non-EPI' appears on these layers. To obtain the most up-to-date information on this property, the appropriate local council should be contacted.

5.3.2 INITIATIVES TOWARD DIGITAL PLANNING APPROVAL PROCESS

Digital Twin of NSW: the NSW Government has commenced initiatives in Planning Reform, Planning Information Services, and developing a Digital Modernisation Roadmap.

NSW Spatial Digital Twin provides opportunity for future planning and building approval processes.

The Spatial Digital Twin aims to help the NSW Government and local councils plan for, manage, and maintain their assets, map real-time environmental data from new sensor networks, and support local planning processes.

The digital ecosystem, created in collaboration with CSIRO's Data61, includes 3D/4D foundation spatial data, a spatial collaboration portal for search and discovery, and an open-source visualisation service.

The NSW 'Digital Twin' is an upgrade from traditionally held 2D spatial data. The State Infrastructure Strategy 201858 recommended that NSW's spatial data be upgraded from 2D to real-time 3D and 4D, with the launch of this platform being the first step towards making that recommendation a reality.

Digital Planning Principles: Digital Planning Principles, developed by NSW and the National PlanTech working group at PIA, provides important insights on innovation for an open digital public infrastructure. It suggests a platform for a future digital planning system, whereby the platform is a prerequisite for further innovation, and must be provided as open digital public infrastructure in order to reap the full benefits of a digital planning system.

With a fully open platform in place, the possibilities for new application development by anyone inside or outside government are limitless.[60]

[57] https://www.nsw.gov.au/nsw-infrastructure-strategy-2018-2038

Figure 25: 4D Model showing the internal structure of a building in Penrith as at December 2018[59]

5.3.3 TECHNOLOGICAL CONSIDERATIONS OF BUILDING APPROVAL PROCESS IN NSW

The application should be submitted with building plans/engineering details and specifications. The plans will most likely contain a lot more information than the approved Development Application (DA) plans.

The building must be consistent with the submitted documents and the development consent. To obtain the CC, additional reports and pay refundable bonds, or development contributions to the council, must first be provided.

The NSW Building Professionals Board (BPB) accredits all certifiers who are not employed by the council. The Principal Certifying Authority (PCA) must be appointed by the owner.

The PCA works with the owner through the construction process and issues an Occupation Certificate (OC) when the work is completed. To issue the OC, the PCA inspects the construction of the building at various points in the construction stages and ultimately ensures that the building is safe and fit to occupy, in accordance with the development consent and CC.

The OC authorises the occupation and use of a new building or part of a building. For staged works, a Part OC may be issued, which allows occupying the completed part of the building.

Depending on the particular OC sought, the Principal Certifier must be satisfied the development meets various regulatory standards.

Issuing the OC for the whole of the development is the last step in the formal DA and construction process (although there could be ongoing 'operational' conditions such as maintaining appropriate noise levels or landscape maintenance). The building approval process, including CC and OC, is shown in Figure 26: Building approval process for NSW.

[59]https://www.digital.nsw.gov.au/article/twinning-spatial-services-has-created-digital-twin-nsw
[60]Digital Planning Principles, 2020, Available online: https://www.planning.org.au/policy/pia-digital-planning-principles

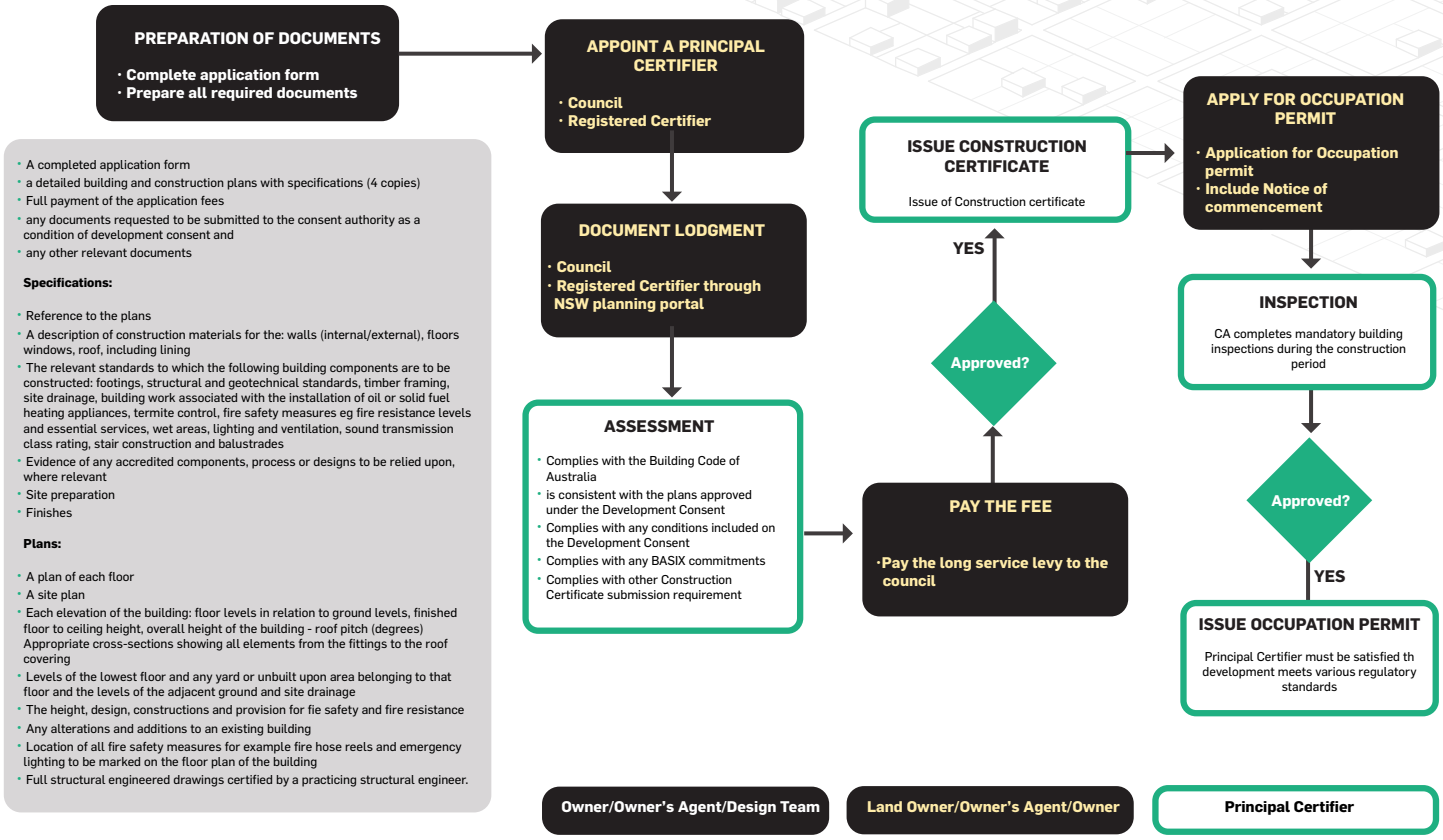


Figure 26: Building approval process for NSW

5.3.3.1 SYSTEMS FOR BUILDING APPROVAL PROCESS

From 1 July 2021, all Construction Certificate (CC) applications and Occupation Certificates (OCs) have had to be lodged to the council or a registered certifier through the NSW Planning Portal[61].

The portal is an industry-wide electronic platform. It captures declared regulatory information throughout a building's lifecycle, from planning approvals through to construction and, finally, occupation of the building.

The portal digitises the planning, development application, determination, certification, and compliance across the lifecycle of a development project, and holds all the relevant statutory, legal, planning, and spatial documents in a single place.

5.4 TECHNOLOGICAL INITIATIVES IN KEY OVERSEAS JURISDICTIONS

5.4.1 UNITED KINGDOM

5.4.1.1 SYSTEMS FOR PLANNING APPROVAL PROCESS IN UK

'Planning Portal' is a private digital infrastructure that, in 2002, started transforming the planning process across England and Wales.

It is a joint venture between the Ministry of Housing, Communities and Local Government and a private industry, to provide an entry point to online planning information and support planning applications.

In 2003, Planning Portal began with introducing the electronic planning application form using simple standards, and was voluntarily made available to any local planning authority.

In 2008, after twice redesigning the Portal to meet user requirements, it was able to reduce the number of form variations from around 12,000 to one.

The Planning Portal Blog was launched in 2009. This blog serves as a forum for users to participate in discussions about the latest developments on the Portal, and in the planning sector as a whole. In 2010, the Planning Portal 2.0 website was launched, which improved user experience. The new website also meets the government's goal of fostering public-private partnerships

[61] NSW Planning Portal: https://www.planningportal.nsw.gov.au/

and receives over 700,000 visits per month.

In 2011, more than half of all planning applications were submitted online through the Planning Portal. One million applications were submitted online in 2012 and 1.5 million applications were submitted online in 2013. In 2014, 80% of all planning applications in England and Wales were submitted online via the portal, which then became a private entity in 2015: PortalPlanQuest Ltd, a collaboration between the Ministry of Housing, Communities and Local Government and TerraQuest.

To meet user demand, the Planning Portal website was redesigned in 2016, and the 1App system was updated. The interactive House has been updated and the Planning Portal's online building control application service was launched. In 2017, the digital mapping service ReQuestaPlan was launched, and the 1App system was updated to meet user demand.

In 2018, the RTPI Directory of Planning Consultants was made available through the portal. Planning Portal then launched the Welsh Government's Planning Application Wales, and the Planning Portal streamlined the application process by launching an integrated payment system (FTS).

Since 2019 all Prior Approval applications can be submitted online. TerraQuest and Planning Portal were awarded the contract to deliver the Regional Planning IT system by the Department for Infrastructure Northern Ireland in 2020, as well as the launch of monthly Planning Market Insight Reports and the addition of a new investor to Planning Portal.

The portal can streamline the application process with an integrated payment system. However, the publicly available reports did not indicate if the new data types, including BIM, can be uploaded and used for development assessment in this portal.

In addition, an eDevelopment Planning compliance with the Data Protection Act was recently introduced in Scotland, to address the Digital Scotland requirements as one of its major initiatives.

Public consultation and wider stakeholder involvement are required for both plan development and decision-making on individual proposals. This involvement varies depending on the nature of the proposal, but the overall goal is the same.

In terms of BIM, the planning system serves as a gateway through which all developments, large and small, must pass. The system influences that development in a variety of ways, and proposals submitted for consideration must include certain information and be in a specific format.

Most applications, including the accompanying plans, are now submitted online. One reason for the increase in online submissions is the improvement of consultation with other public bodies (such as local authorities the Department of Transport, the Environment Agency, Historic England, and so on) and local communities, such as parish or town councils or individuals.

The consultation process seeks to ensure that a diverse range of perspectives are considered during the decision-making process, but it also aids in the coordination of development proposals among various bodies and in eliciting community and stakeholder involvement in design.

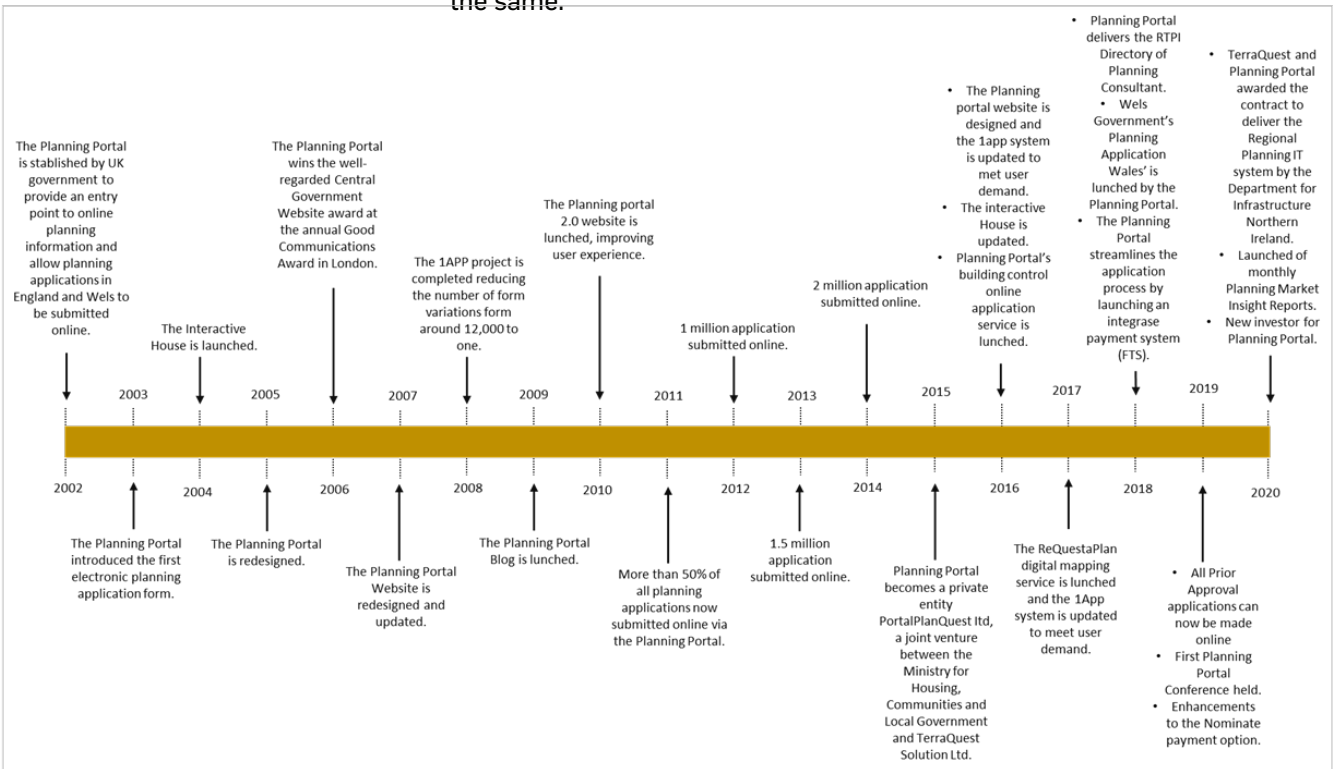


Figure 27: Timeline of Planning Portal Development in the UK (2002 – 2020)

5.4.1.2 SYSTEMS FOR BUILDING APPROVAL PROCESS IN UK

Since March 2012, Submit-a-Plan has changed, and is now a front end to a more comprehensive web product. Users now create their applications in the main application hub (DataSpace Live).

FileLive is DataSpace UK Ltd's online Document Management portal that allows users to securely manage physical, electronic or scanned documentation that is stored offsite at one of DataSpace UK Ltd's professional archive facilities.

The FileLive system seamlessly allows records managers to track, trace, manage, and view scanned documentation. Further, DataSpace's Image Viewer was developed to ensure compliance for the legal admissibility of electronic information (BS10008:2008).

Documents can be edited and amended; however, a full version history is maintained at all times. Each new version that is saved is time, date and user stamped.

FileLive Features:

- Request items to be delivered/ collected/scanned/destroyed.
- Track boxes/files on or offsite.
- Manage and generate new files.
- Edit data.
- View BS10008:2008 scanned images.
- Annotate and Redact images.
- Link to the scanned image of the file.
- Download images as TIFF or PDF file.
- All data hosted in a secure ISO/ IEC27001:2013 compliant image library environment.
- Upload Supporting Electronic File documentation pdf, xls pdf.
- Process the requests for physical and electronic data.
- Order related supplies – boxes, barcodes.
- Restricted User access rights and permissions.
- Secure IP specific usage.
- Dual bandwidth secure 256-bit encrypted leased lines.
- Upload scan data locally or through off-site bureau.

5.4.1.2 INITIATIVES TOWARD DIGITAL BUILDING APPROVAL PROCESS

5.4.1.2.1 NBS Pioneering Automated Checking of Building Regulations

In 2014, a pilot project to demonstrate the tools currently available to perform automated code compliance checking, using a BIM model, was completed in collaboration with Solibri and Butler & Young, the National Building Specification (NBS) (NBA, 2014).

This project demonstrated how existing tools could be used for automatic compliance checking to the Building Regulations in BIM data environments.

The team identified that clauses in the regulations are suitable for translation into code, then developed a system to verify that BIM data is compliant with parts of these clauses.

It was the first initiative in the UK to utilise existing software and technologies, including NBS's Create specification product, objects from the National BIM Library, IFC models, and Solibri Model Checker software.

This project identified what can be achieved by combining new methodologies and processes with existing software. The outcomes highlighted that providing consultants, designers, and contractors with a product that can tell them instantaneously whether the design will pass or fail would have huge benefits, both in terms of saving time and the potential for earlier checking.

This is another huge benefit that should speed up the adoption of BIM. In addition, it could be helpful for building regulations assessors, allowing them to automate a proportion of the routine checking work and concentrate on giving valuable advice in those areas that cannot be automatically checked.

5.4.1.2.2 Digitisation of Requirements, Regulations, and Compliance Checking Processes in the Built Environment

The Digitisation of Requirements, Regulations, and Compliance Checking Processes in the Built Environment (D-COM) network was formed to advance the digitisation of regulations, requirements, and compliance checking systems in the built environment (D-COM Network portal, 2020). In the UK, there has been no adoption of either the digitisation of regulations/requirements or a compliance system.

To motivate discussion in the area of digitisation of checking, the network proposed a conceptual process model as represented in Figure 28: Proposed conceptual model of the digitised building approval process. Source: (D-COM Network portal, 2020).

In this model, authors specify the regulations, requirements and standards against which a built environment asset is to be checked, using an authoring tool that creates digitised regulations.

An actor within the built environment domain will then work using a human-aided design package on a virtual model of the physical asset.

This design package utilises the compliance checking system to automate aspects of the design and ensure the actor's work meets the regulations, requirements and standards.

This is then formally checked against these regulations, requirements and standards. Once the model is submitted to a compliance checking

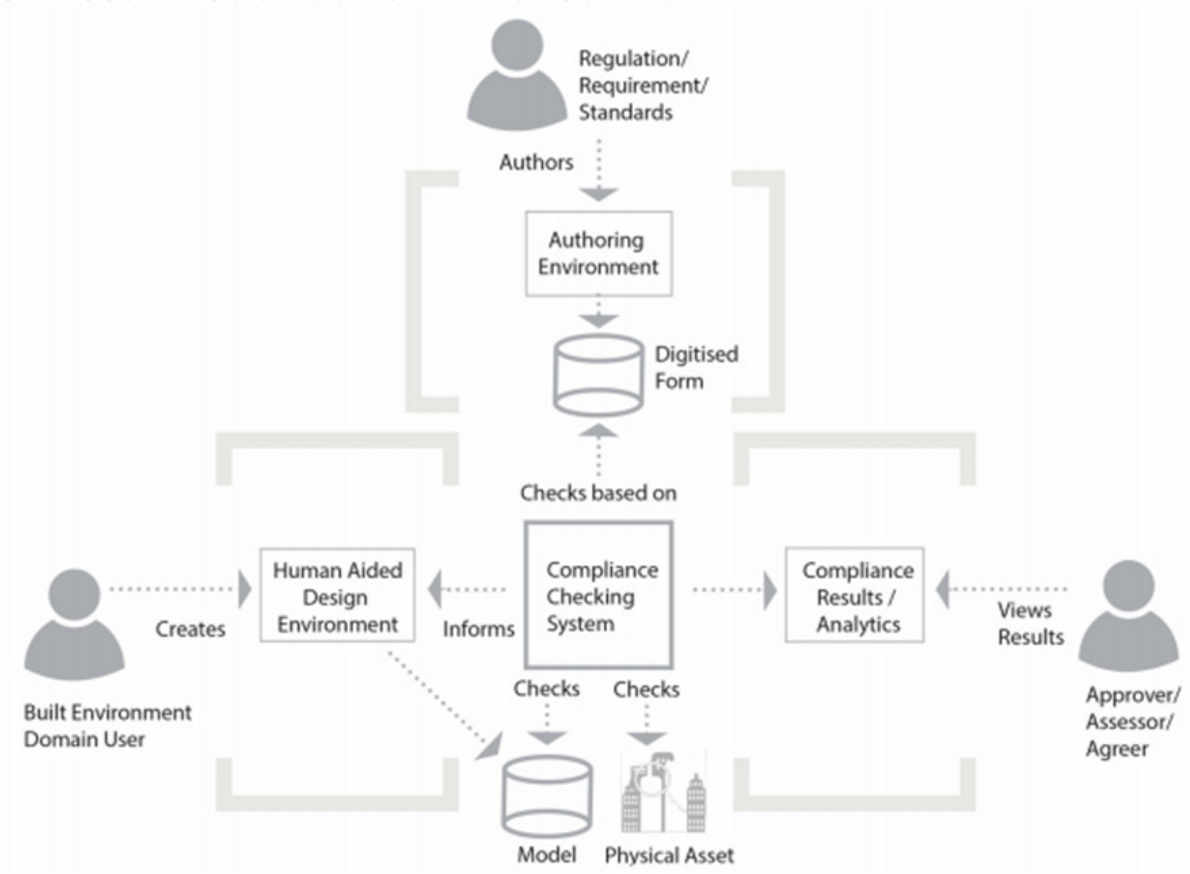


Figure 28: Proposed conceptual model of the digitised building approval process. Source: (D-COM Network portal, 2020)

system, the system (1) automatically provides a result, or (2) assists an approved regulator to come to a decision by assessing some elements automatically.

Additionally, the system can manage the overall checking process and guide an approved regulator through the process, even if all decision-making cannot be automated.

The final element is the ability to automatically check, based on data collected (e.g., from sensors), the physical asset against regulations or requirements.

This initiative consists of five research areas:

- digitising and subsequently managing requirements and regulations drawn from a variety of contexts and sources;
- automatic and semi-automatic compliance systems;
- underpinning data formats to store and subsequently analyse the result of regulatory compliance checking;
- use cases for compliance data at a district/city/national scale; and
- convergence of private and public requirement specification for automated design.

5.4.2 THE NETHERLANDS

5.4.2.1 SYSTEMS FOR BUILDING APPROVAL PROCESS IN THE NETHERLANDS

For several years, the ICT policy of the Dutch government has been geared to promoting and incorporating information and communication technology in public services, the idea being to improve accessibility and speed.

This, in turn, would cut down the paperwork and the administrative costs. In recent years, various action plans and initiatives have been devised specifically for this purpose. A lot of experience has been gained in the Netherlands in ICT applications through numerous pilot projects, and this has formed the basis for a few concrete steps that are defined 'upfront' in the Electronic Government Action Plan.

The aim of this Action Plan was to target the deployment of ICT in such a way that it gives a momentous boost to the quality and service (customer focus), efficiency (cost savings), and effectiveness (reaching the target group) of public services for private citizens and businesses.

Three explicit themes were identified, namely: good electronic accessibility; improved public services; and better management of internal government operations.

The Dutch Act 'Wabo' lays down the rules for granting an All-in-one Permit for Physical Aspects. The Act enables

members of the public and companies to use one transparent procedure, to apply to one competent authority for permits for activities that impact on the physical environment.

The Act replaced around 25 former separate permits for such matters as construction, spatial planning, listed buildings, and the environment, with a single one-stop-shop permit covering all activities.

The websites provide or refer to information on all aspects of the application procedure, such as the Building Decree, the terms and conditions, the municipal regulations, the various types of permit etc.

The Act has created one overarching procedure for granting permission for projects such as construction, alteration, or use of a house or building.

There is now one permit, one procedure, and one set of submittal requirements, followed by one legal remedies procedure and enforcement by one authority. Applications may be submitted electronically to the Online Portal OLO 24 hours a day. They are processed electronically as far as possible.

There is considerable freedom for applicants in arranging the process of requesting a permit. In principle, they may decide whether to apply in one go for a permit that covers all their activities, or first to apply for a permit for one activity or a few activities and, later, for the other activities.

Successive landowners can then request planning permits to build one or more houses, a retail building, company building, school, for example.

Besides the integrated permit procedure (i.e., one application for several activities), the Act regulates coordination.

Government authorities involved in the application are required to cooperate with each other to take one harmonised decision issued by one competent authority.

Applicants can apply digitally through their municipality's website or directly through the website. Before submitting an application, the applicant can first check the Online Portal regarding whether permission is required for the intended work and activities.

Applications can be made digitally or in writing. The application form is standardised nationwide and can be submitted together with attachments, like construction plans and drawings.

The application will automatically be routed to the relevant competent authority, which will then give information about the further procedure, decision-making and costs.

The server website provides background information and links to specific information on the site of the municipality and other information.

The application can be checked for completeness, and support can be obtained via a help function. The central server then sends the application to the municipality, who decides who has access to the file, and who then imports it into its own registration system.

The municipality then checks that the application is complete and starts the assessment. Authorised assessors can access (parts of) the file plans, other documents can be studied online, and measurements can be taken. The assessors can add 'layers' of commentary to the file. During the process, the applicant can track the progress of the application.

The decision is 'loaded' in the file and the applicant is automatically notified. The building inspector can, if they wish, consult the file on-site via an online connection and can add information/documents.

The Standard Applications and Notifications (STAM) and the associated information model (IMAM) help with the submission of a permit application or notification to authorities.

This is one of the standards for the Digital System Environment Act (DSO). The Standard Requests and Reports (STAM) is for (1) suppliers of systems who want to link with the DSO for license applications and notifications, and (2) anyone who wants to know how a request (or notification) is structured.

The standard also includes the Requests and Notifications Information Model (IMAM). This model lays the foundation for the interface. The standard and the information model also include XSDs. They describe the structure of XML documents.

5.4.2.2 INITIATIVES TOWARD DIGITAL BUILDING APPROVAL PROCESS THE NETHERLANDS

5.4.2.2.1 EuroSDR GeoBIM project

Stakeholders from many European countries participated in the EuroSDR GeoBIM project6 (2017-20), aiming at the development of a coherent approach to the integration of geoinformation with BIM. The automation of issuing building permits was one of the project's use cases (the other being on asset and facility management).

This project selected CityGML by the Open Geospatial Consortium (OGC), and the Industry Foundation Classes (IFC) by buildingSMART, to provide scalable and shareable methods and tools in line with international open standards that foster interoperability (see Figure 29: Initial implementation of GeoBIM for automating building permit issuing).

This project proposed a methodology for interpreting the specific text of the regulation and translating it to a formal language that would be able to be interpreted by machines. Automatic transforming of natural language of regulations to code-checking rules was not considered.

This is because, even for humans, the regulations' text can be open to several different interpretations, whereas an effective code should be absolutely unambiguous. submitted to a compliance checking

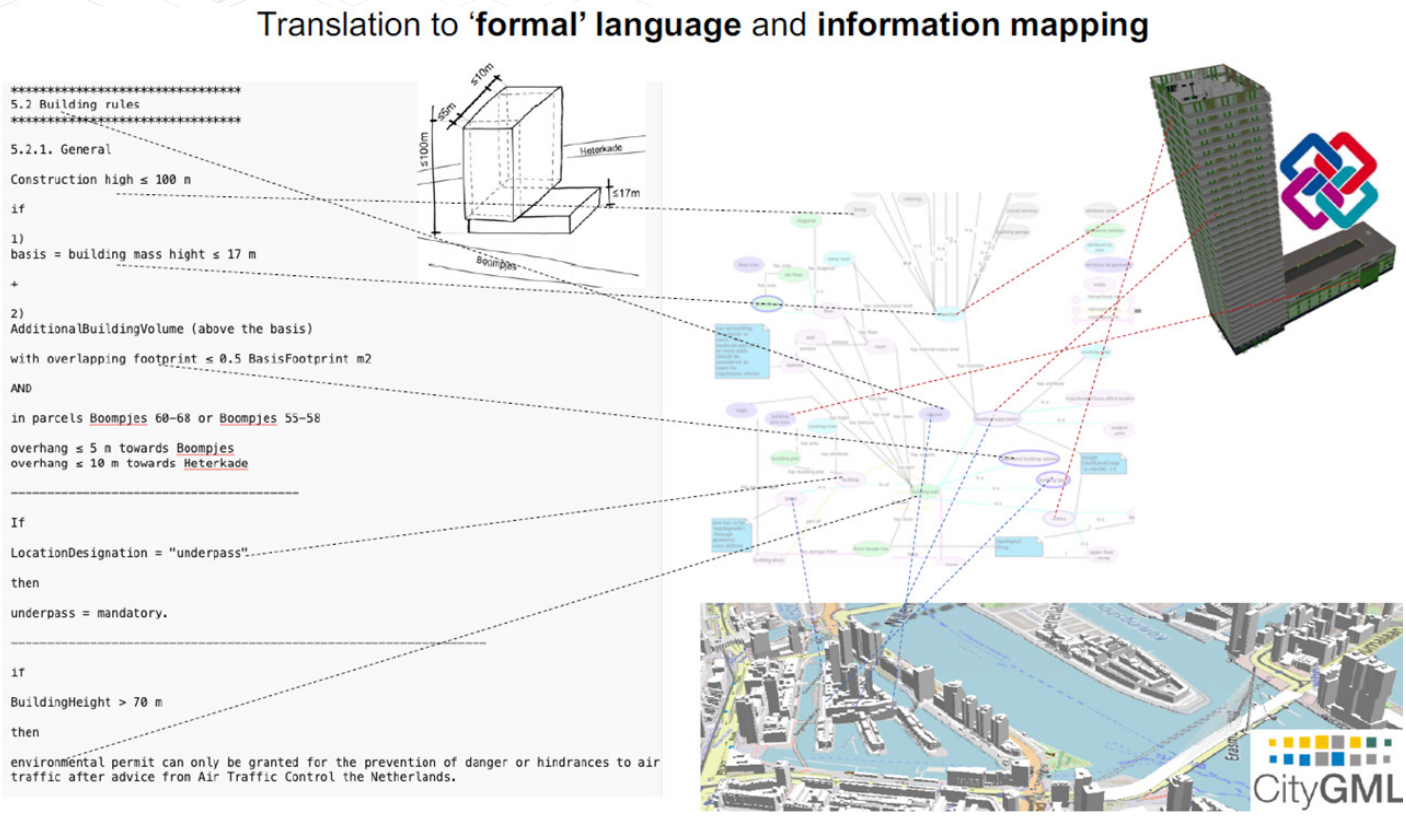


Figure 29: Initial implementation of GeoBIM for automating building permit issuing[65]

5.4.3 SINGAPORE

5.4.3.1 SYSTEMS FOR PLANNING APPROVAL PROCESS IN SINGAPORE

5.4.3.1.1 CORENET

CORENET (Construction and Real Estate NETwork) is a major IT initiative that was launched in 1995 by Singapore's Ministry of National Development, to "propel the construction and real estate sector into the new millennium" by re-engineering the business processes with state-of-the-art IT to achieve a quantum leap in turnaround time, productivity and quality.

It also aims to make it possible for parties in the construction and real estate industries to communicate and exchange information in a seamless and efficient manner.

Singapore's Building and Construction Authority is implementing it in collaboration with several other public and private organisations. CORENET is divided into three platforms: e-submission, e-PlanCheck, and e-Info. Currently, the e-submission platform is used for planning approval.

The CORENET e-Submission system is an internet-based G2B (Government to Business) system that allows industry professionals to submit project-related electronic plans and documents for approval to regulatory authorities.[62]

The system manages project-related documents throughout the project's lifecycle, including the processing of plans and documents related to the issuance of permits:

- Planning approvals
- Building plans approvals
- Structural plans approvals
- Temporary occupation permits
- Fire safety certificates
- Certificates of statutory completion

The public can use this system to submit electronic plans and documents to 16 different regulatory authorities. Furthermore, the public can track the submission status online at their leisure.[63]

CORENET is a virtual, transparent, one-stop, round-the-clock service "counter" for electronic project-related document submission.

It provides a one-stop convenience to both private and public sectors.

It provides a one-stop point for submission of plans from qualified persons to multiple approving authorities from anywhere, at any time.

It provides one-stop access for qualified persons to check submission status online.

It provides a one-stop billboard for approving authorities to post submission status online.[64]

Several regulatory authorities in Singapore are participating in the CORENET e-Submission

[62] https://www.aecbytes.com/feature/2005/CORENETePlanCheck.html
[63] https://www.ura.gov.sg/Corporate/Guidelines/Development-Control/Planning-Permission
[64] https://www.corenet.gov.sg/general/corenet-e-submission-system/corenet-e-submission-system-faqs.aspx
[65] https://3d.bk.tudelft.nl/projects/eurosdr-geobim/

system, including the Building and Construction Authority (BCA), Urban Redevelopment Authority (URA), Land Transport Authority (LTA), Public Utility Board (PUB), Singapore Power (SP), and Housing & Development Board (HDB), along with various industry associations including the Singapore Institute of Architects, the Institution of Engineers, Association of Consulting Engineers, Real Estate Developer's Association, and the Singapore Contractor Association.

Five types of application can be lodged in CORENET:

- Additions and alteration to land house;
- New erection of land house;
- Warehouse HBD (Housing Development Board) development;
- Agriculture uses and development; and
- Land and /or strata subdivision.

5.4.3.2 INITIATIVES TOWARD DIGITAL PLANNING APPROVAL PROCESS

Singapore has taken a long-term approach to land use planning. This is done to make the most of limited land and to ensure that people's current and future needs are met.

This long-term planning entails broad strategies, identifying land for various needs, and determining the overall development pace of Singapore. These then lead to the development of the necessary infrastructure and resources.

5.4.3.2.1 Data analytics and geospatial technologies

Data analytics and geospatial technologies are used by URA planners and architects to gain deeper insights and make more informed decisions about land use, amenities, and infrastructure.

Better services and outcomes can be delivered through digitisation to serve citizens and businesses, as well as meet Singapore's long-term planning needs. URA has created in-house digital planning tools to support a more data-driven work process. To follow are some examples:

With ePlanner, the geospatial urban planning analytics tool, planners can quickly construct queries and visualise, analyse, and overlay over 100 data layers.

It provides quantitative and qualitative insights into each area to planners across URA and other agencies, while complementing traditional sources of information such as site visits, groundwork, and community engagement.

One Tool supports planning workflows by bringing together government agencies to track infrastructure project implementation and map future land use scenarios.

Agencies can develop a more holistic picture to formulate plans and coordinate the implementation of infrastructure development with a common and integrated platform.

5.4.3.2.2 URA SPACE

URA SPACE is a one-stop geospatial platform and is designed to provide professionals, businesses, and the general public with a comprehensive array of up-to-date planning and real estate information on a digital map in an efficient manner.

The 'Popular map services' list can be used to quickly access information related to current and past Master Plans, as well as to check on site-specific planning information such as development charge rates, past development approvals, urban design guidelines, use of property, and private residential property transactions.

Aside from assisting in the streamlining of application processes, URA SPACE allows the public to purchase season parking at URA-managed carparks.[66]

5.4.3.3 SYSTEMS FOR BUILDING APPROVAL PROCESS IN SINGAPORE

5.4.3.3.1 CORENET

CORENET is a one-stop-shop for building professionals to make electronic submissions to BCA or any of the other government regulatory authorities.

It also provides the automated compliance check for building plan approval and digital information related to building and construction. CORENET aims to provide the necessary infrastructure for the exchange of information of buildings in a timely and seamless manner to all stakeholders, including regulatory authorities using IT.

The information services are organised into five major categories: planning, design, submission, construction/procurement, and facilities management.

Since its launch in 2001, CORENET has enabled the building industry to save more than S$30 million in printing and dispatch costs by 2013 (Building and Construction Authority, 2013).

According to the BCA, this pro-business initiative has transformed a time-consuming and complex building plan approval process into one that is highly efficient.

CORENET was introduced as a web-based submission system incorporating a system for checking technical irregularities in 2D plans with reference to the Regulations in 1995 (Preidel and Borrmann, 2015).

In 1998, it switched to operate on IFC 2x2 to cover building code checks on building plans and code compliance for building services (Eastman et al., 2009).

This was the world's first adoption of BIM in the building approval process. Currently, CORENET consists of three strands: e-Submission, e-PlanCheck, and e-Info (Refer Figure 30: CORENET Strands and their associated systems).

[66] https://www.ura.gov.sg/Corporate/Planning/Our-Planning-Process/Digitalisation

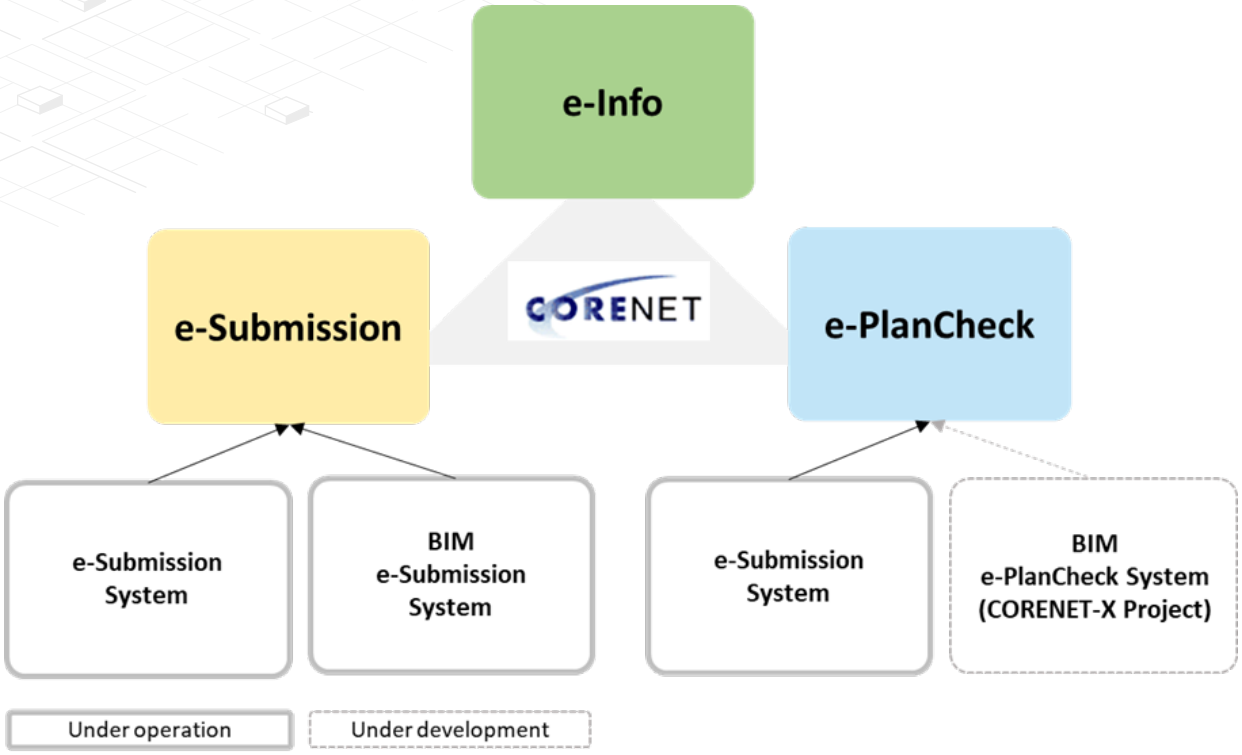


Figure 30: CORENET Strands and their associated systems

e-Submission

This has been running since 2002 and supports digital submission building plans approvals, TCP, and CSC.

This system allows applicants to submit and monitor the process of their application via the e-Submission server, which is available 24/7. It enhances the transparency of the approval process.

In addition, this system improves efficiency and customer experience by streamlining government processes (Building and Construction Authority, 2013). From 2015, BIM e-submissions of building plan approval have been required for all projects greater than 5,000 square meters.

From 2016, the BCA accepted voluntary BIM e-submissions in native BIM format for architectural plans (Building and Construction Authority, 2016a).

From 2017, the BCA started to receive civil and structural and MEP engineering plans in native BIM format. Together with this, the BCA launched the "Code of Practice for BIM e-Submission" to provide the minimum modelling standards and regulatory information required to be provided in the BIM model, moving away from lightweight file format submissions. BIM e-submissions requires the following documents: architectural BIM native file (Revit, ArchiCAD); civil and structural BIM native file (Revit, ArchiCAD); and mechanical, electrical and plumbing BIM native file (Revit, ArchiCAD).

e-PlanCheck

This is a system for digitally checking the submitted building plans against building codes, using machine-readable rules.

Mapping of the IFC schema for implementation of rule checking is a big issue for automatic building code checking. Currently, CORENET rules are hardcoded in computer programming language on top of FORNAX developed by NovaCITYNETS (see Figure 31) (Eastman et al., 2009).

FORNAX is a digital platform for code-checking; it extends the IFC model and builds rules that implement checking functions. FORNAX uses the Open CASCADE and ACIS solid kernels as geometry engines and services for retrieving and structuring required data from an IFC building model (Eastman et al., 2009).

Its schema contains objects that extend IFC information to provide that needed for checking certain building codes.

The FORNAX objects have been defined to capture specific rule semantics; each object has diverse functions to retrieve required properties from IFC data.

The objects and their functions retrieve attributes from the object, depending on the type of rules. e-PlanCheck has the FORNAX interface and checking module to define and check the extended properties for certain entities. It does not need algorithms for retrieving required information from IFC data by using the FORNAX objects.

Code-checking in this system has been simplified by adopting FORNAX objects and their member functions; a rule written in natural language can be interpreted to programming language methods and applied (Eastman et al., 2009; Hjelseth, 2015).

In e-PlanCheck, the code compliance checking is performed in three phases: (1) checking rules with current IFC information; (2) checking rules with property set extensions to IFC; and (3) checking rules with derived information from IFC. BCA has implemented the automatic

code compliance check against the following regulations and codes in architectural and building services domains:

- Building Control Regulations Barrier Free Access (Accessibility) codes
- Code of Practice for Fire Precautions in Building, Household and Storey Shelters Codes
- Building Control Regulations for Public Housin.
- Provision Of Parking Places and Parking Spaces
- Code of Practice on Environmental Health
- Fire Codes for Building Services Systems
- Code of Practice for Manufactured Gas Pipe Installation
- Code of Practice on Surface Water Drainage, Code of Practice for Water Services, Code of Practice on Sewerage and Sanitary Works

e-Info

The e-Info system has provided a central repository for building codes, regulations, and circulars published by the various building and construction regulatory agencies in Singapore since 2002.

As an integrated information channel, this system offers easy access to advisory information for various construction-related departments. Supported by 13 regulatory organisations, it stores, manages and distributes information on codes, regulations, standards, guidelines, product catalogues, contractor performance, events and circulars.

e-Info has been implemented in XML, so all information is generated in a machine-readable format.

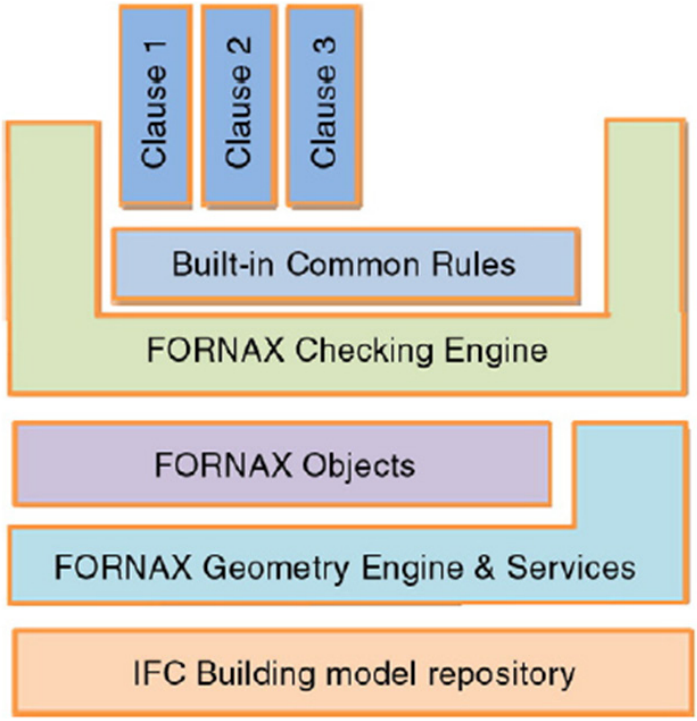


Figure 31: The system architecture of FORNAX (Eastman et al., 2009)

5.4.3.4 INITIATIVES TOWARD DIGITAL BUILDING APPROVAL PROCESS

5.4.3.4.1 CORENET-X project by BCA

In 2016, BCA invited tenders to develop rule-based code compliance checking for BIM models, to fully harness the capability of BIM and improve overall construction productivity under the iGrant innovation project (Building and Construction Authority, 2016b).

In 2020, BCA had an active tender for the CORENET-X project as an iGrant innovation project. BCA awarded that project to novaCITYNETS, to develop a BIM Model Checking System.

The ongoing project aims to fully harness the capability of BIM in the building plan approval process and improve overall productivity, especially focusing on solutions on automated code compliance checking in BIM on e-PlanCheck.

This project aims to develop a robust checking engine for BIM e-PlanCheck that has full capacity for rule-based checking and identifying areas of non-compliance with the stipulated regulatory requirements.

This development also includes the integrity check on the BIM model to ensure it meets the prerequisite for the functions of code compliance checking.

In addition, the developed system will provide a pre-checking module for designers that supports design check before applying for building plan approval, to reduce design errors, omissions, and oversights.

This module provides error reporting for users and customisation to the parameters of the rules sets created on the e-PlanCheck platform.

It will contribute to reducing time and cost to retrospectively correct design or even construction if left undetected.

5.4.4 SOUTH KOREA

6.4.4.1 SYSTEMS FOR PLANNING APPROVAL PROCESS IN SOUTH KOREA

6.4.4.1 .1 Seoul Committee Integrated Management System (Seoul Metropolitan Council)

Since 2020, an integrated platform to support deliberation of the planning and building committee has been developed and applied to the actual practice of deliberation. The integrated information source of planning and building deliberation is as follows:

- All information about the application (planning and building design review) is managed and shared with commission members and Seoul Metropolitan council officials.
- All procedures of planning and architecture design review have been defined as an integrated database:
  - » Support record management of the previous review; and
  - » Share status of review progress to applicants.

This system also offers information relevant to planning and building permits to the public, such as guidelines, reports and statistical summaries.

This system is linked to an assessment platform for building deliberation, called Virtual Seoul (Digital Twin of Seoul City). It provides various assessment functions to review architecture design ahead of examination for issuing a building permit, including:

- Landscape analysis;
- Wind path analysis;
- Daylight analysis; and
- Transportation impact analysis.

The assessment functions have been extended. When applied for the deliberation, applicants submit 3DS file (.3ds) created from 3D Max or SketchUp; it is uploaded to the digital twin as target of analysis.

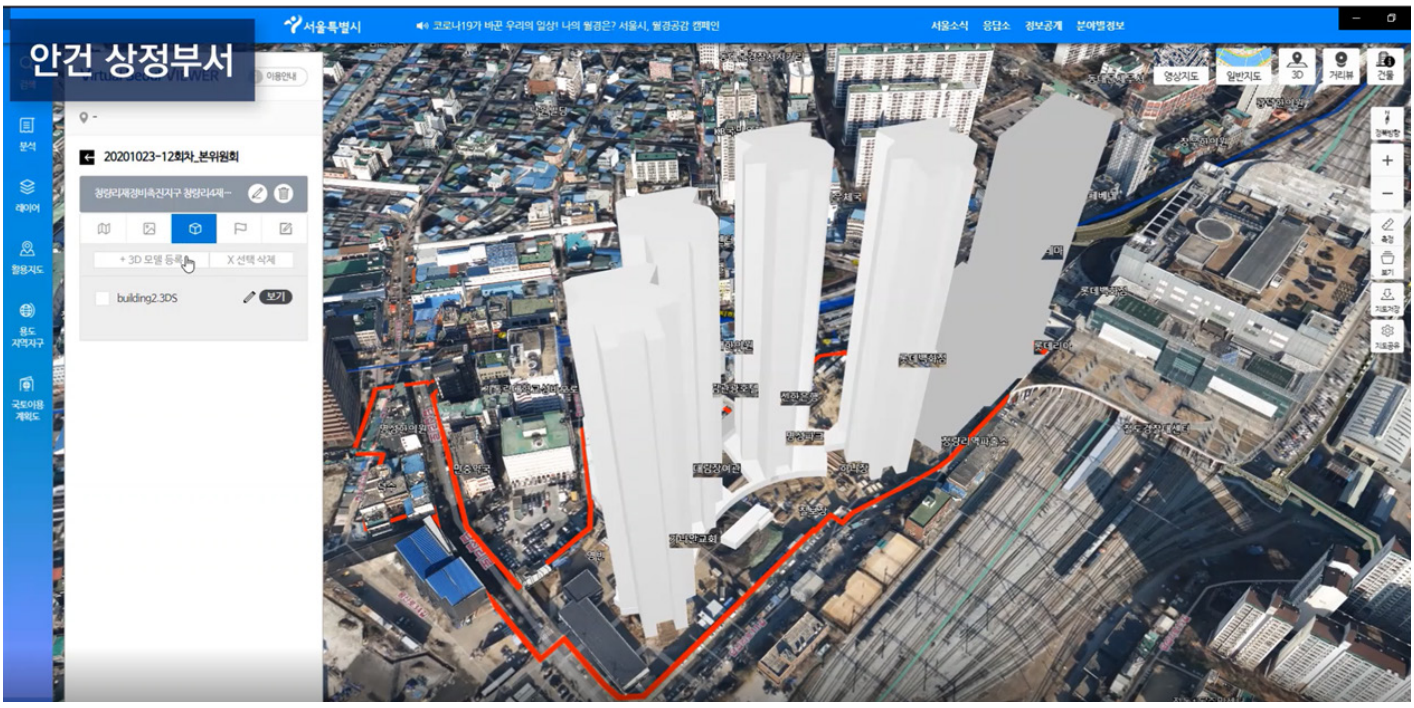


Figure 32: Interface of Virtual Seoul linked to Commission Integrated Management System[67]

[67] https://virtual.seoul.go.kr/sbmc/?user_id=MDEwNTA0MDAwODQ=&user_nm=7KCE7ISg7Zic&mode=dmlldw==

Figure 33: Image of Smart Commission Meeting Room[68]

6.4.4.1 .2 Smart Committee Meeting Room (Seoul Metropolitan Council)

Since 2020, the Planning & Building deliberation of Seoul Metropolitan Council employs a smart meeting system in their review.

The system is designed to improve efficiency in communicating information regarding site, landscape, transportation analysis, and environment of land use and development or building works.

The developed system in the smart meeting room employed the Virtual Seoul and Virtual Reality (VR) system:

- Virtual Seoul: daylight analysis, wind path analysis, transportation impact analysis; and
- Virtual Seoul with VR system: landscape analysis, site review.

5.4.4.2 SYSTEMS FOR BUILDING APPROVAL PROCESS IN SOUTH KOREA

Seumter is an integrated system to digitise construction administration services, generate a nation-wide central database of construction administration information, and build collaboration with relevant authorities. Under the strategy of the Korean Ministry of Land, Infrastructure, and Transport (MOLIT), the system development was initiated in 1998 and was distributed to operate in several local councils in 2008.

It aligned with the eGovernment initiative and Seumter has been established based on an open standardised framework, eGovFrame, like all other systems supporting administrative services (Korean Ministry of the Interior and Safety, 2020).

It facilitates the sharing of information with various government departments. From 2012, all local and city councils have had to provide public services related to construction administration via Seumter.

The services digitally offered by Seumter are summarised in Table 5: Main services provided by Seumter.

As one of its services, Seumter digitises building permit applications as well as planning permits.

It allows applicants to: (1) apply for building permits online; (2) monitor application progress status; and (3) receive notices and requests regarding building information.

In addition, this system supports issuing or applying for other required documents for building permits, such as certificates of title or subdivision plan (see Figure 34: The system architecture of Seumter).

Seumter consists of Web portal (access channel for applicants) and Intranet for officials in charge and examiners in MOLIT and city/ local councils. It is linked to the external system of other government authorities for information sharing.

Once the building permit application is summited to the Web portal, council officials access and manage it to proceed with the approval process. They conduct the consultation with the relevant departments, or other authorities, by requesting consent or

[68]https://opengov.seoul.go.kr/press/21128632

Field	Main supporting services
Building	Planning permit, Building permit, Building report, Commencement of building work, Deliberation, occupancy permit, permit for temporary building/structure
Housing	Planning permit for housing, Construction start notice, Occupancy permit, Development activity permit
Building Register	Management of building register (create, update, register, cancel, issue, access)
Redevelopment	Approval of redevelopment association establishment, Issues of authorisation for project implementation, Approval for management and disposal plan, Construction start notice, Occupancy permit
Statics	Statistics of building permit, Statistics of building start, Statics of building
Code Checking	Pre-code checking

Table 5: Main services provided by Seumter

advice using an online collaboration system in Seumter.

Seumter enhances connection among relevant departments and authorities, and manages all application documents in the one channel.

Pre-code Compliance Checking System

Since 2011, Seumter has provided a service for pre-code compliance checking with the Building Regulations. It supports applicants' preparation of building plans and application assessment by council officers.

This module supports automatic code-checking of 731 provisions of relevant Acts for building permits (including Building Act), and 4495 provisions of relevant Acts for planning permits on the CAD environment.

For applications, Seumter has distributed a CAD plugin for the pre-code checking; it allows architects to check accurately and efficiently whether their design complies with the requirements, while developing the design.

In the Intranet, Seumter provides the pre-code checking function for council officials. It produces compliance reports to support their decision-making on issuing building and planning permits, based on machine-readable rules of the provisions that apply to a CAD file of building drawings.

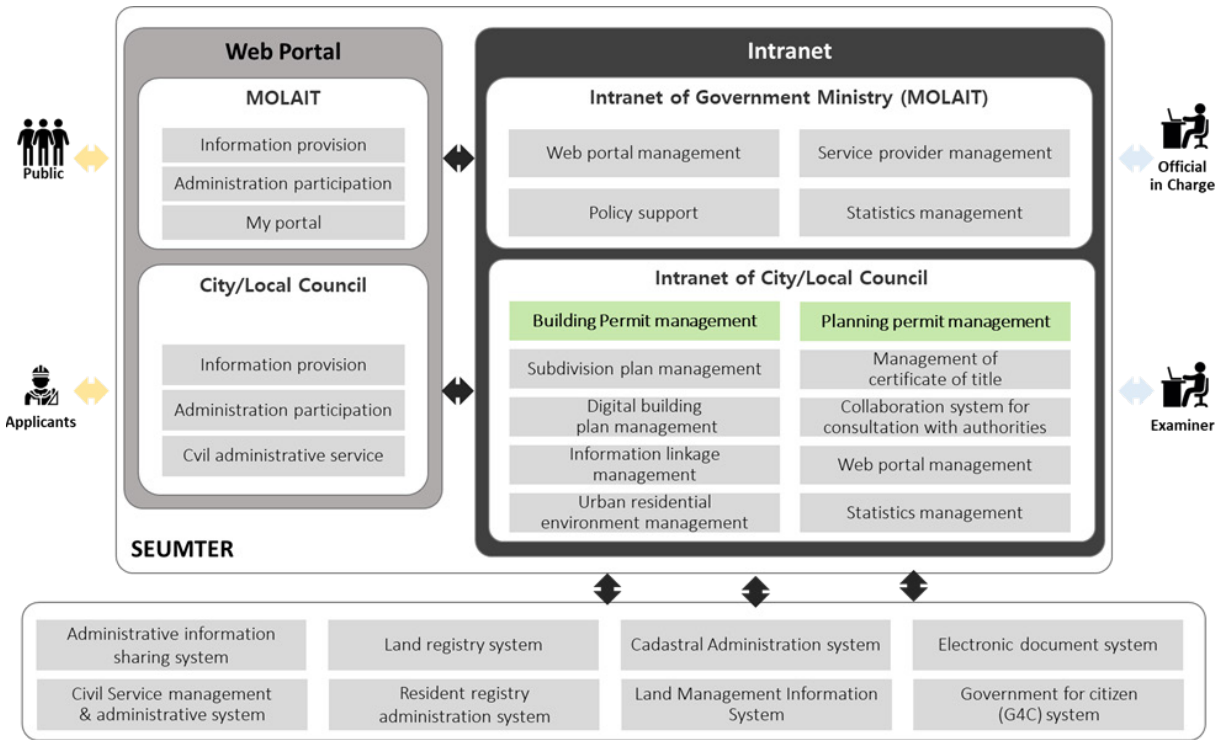


Figure 34: The system architecture of Seumter[69]

[69]Korean Ministry of Land, Infrastructure and Transport Affairs, 2014, Information Master Planning for Architecture Service Industry Information System.

5.4.4.3 INITIATIVES TOWARD DIGITAL BUILDING APPROVAL PROCESS

5.4.4.3.1 KBIM Project - Open BIM Technology Environment for Design Quality Innovation

Korean Ministry of Land, Infrastructure, and Transport released the Construction Industry BIM 2030 Roadmap in December 2020. In this roadmap, the ministry announced its plan to initiate a BIM-based building approval process from 2024.

BIM-based systems for building permit application and assessment will be incorporated into Seumter and its operations.

In 2013 the Korean government launched an ongoing project, Open BIM Technology Environment for Design Quality Innovation, to develop a framework for the BIM-based building approval process.

The framework focuses on the construction project process, from building design to the issue of building permits.

It consists of eight systems to automate and digitise the design and permit application tasks of architects, as well as permit assessment and issue tasks of council officials.

The development of the prototype system was completed in 2016 and has been refined and tested through conducting the test operation in the Seumter environment, in collaboration with several city councils.

The developed systems are as follows:

- *KBim Collaboration:* a BIM-based collaboration support system among architects and engineers.
- *KBim Logic:* a BIM-based code-checking rule set management module.
- *KBim Assess–Lite:* a BIM-based pre-code checking system for assessing design quality during the design development process.
- *KBim Energy:* a BIM-based energy performance assessment system to produce energy reports required by Korean legislation.
- *KBim D-Generator:* a BIM-based 2D drawing generation system from BIM data to support various construction administrative services from other authorities.
- *KBim Veri:* a BIM-based data quality verification system to check data validity before submitting building permit applications.
- *KBim Submission:* a BIM-based system to support BIM-based building permit application and check input requirements.
- *KBim Assess:* a BIM-based system for assessing building plans and approving building permits.

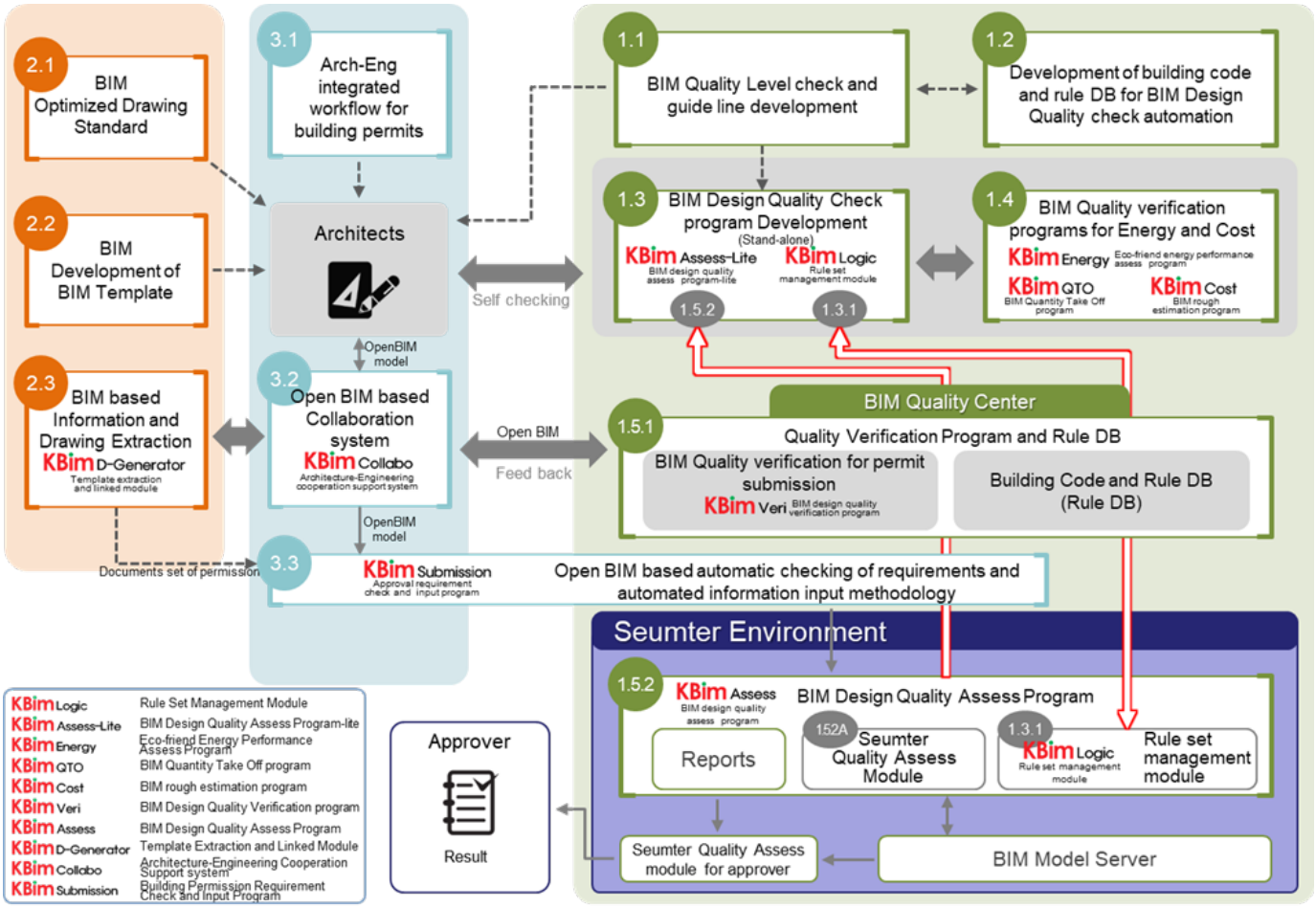


Figure 35: Relationship of developed systems in KBIM project[70]

[70]https://opengov.seoul.go.kr/press/21128632

5.4.5 HONG KONG

5.4.5.1 SYSTEMS FOR BUILDING APPROVAL PROCESS IN HONG KONG

As part of the Government's "Be the Smart Regulator"[71] Programme, which aims to streamline licensing processes and reduce compliance costs for business, a One-Stop Centre (OSC) for Warehouse Construction Permits was established in December 2008.

OSC provides a centralised office for receiving first submissions of plans and related applications, as well as coordinating joint inspections for two-storey warehouses. OSC is an alternative arrangement to existing processes.

Applicants, if they prefer, can opt for the existing procedures of submitting applications and applying for inspections with individual departments.

Relevant departments have implemented various regulatory reforms and streamlined the associated procedures.

Further, the Development Bureau has set up a steering group to explore how best to consolidate and rationalise the standards and definitions adopted by different government departments (namely the Planning Department, the Lands Department (LandsD) and the Buildings Department (BD)), in vetting and approving development projects, with a view to streamlining the vetting and approval procedures.

The BD is leading the development of the Electronic Submission Hub (ESH) as a centralised digital portal for receiving and processing building plans and applications submitted under the Buildings Ordinance.

The contract for setting up the ESH was awarded in May 2020. The BD aims to launch the first phase of ESH in the first quarter of 2022 and shall continue to maintain close liaison with relevant government departments, organisations and the building industry.

The framework of the EHS system is shown in Figure 36: EHS framework.

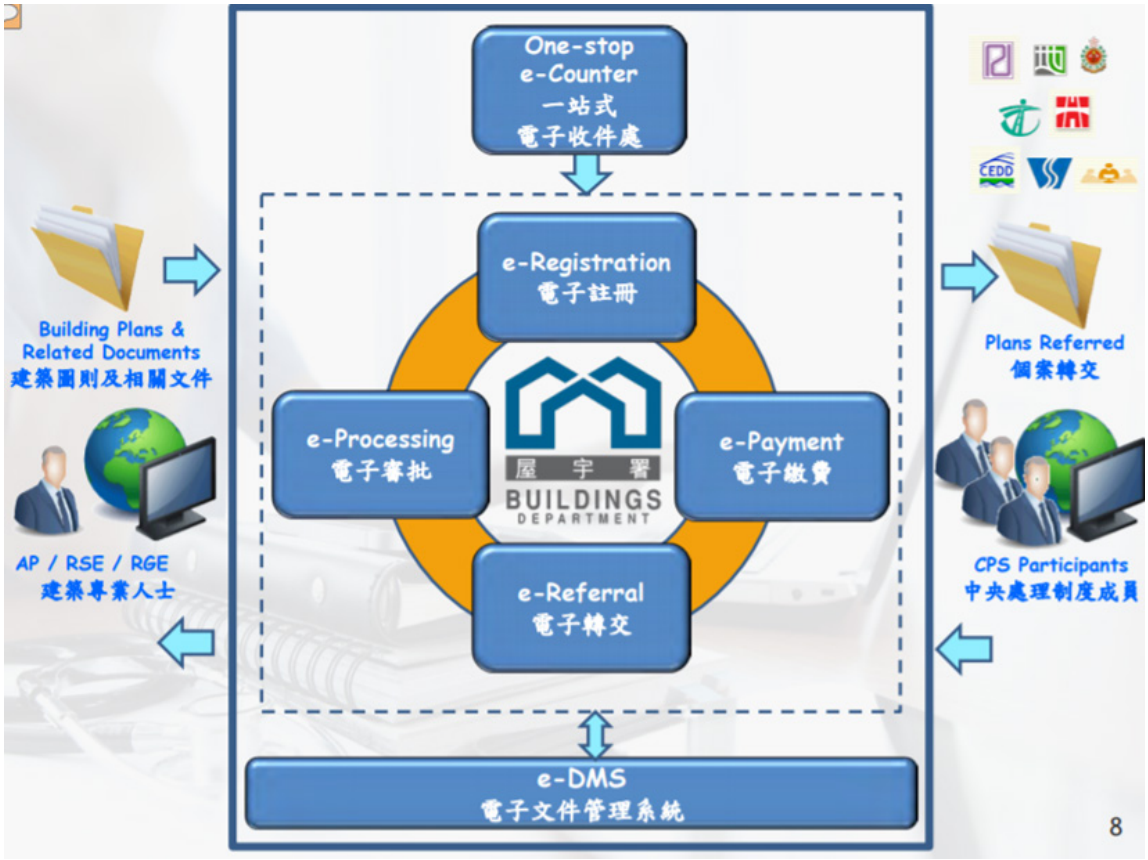


Figure 36: EHS framework (Office of the Government Chief Information Officer, 2021)

[71] Be the Smart Regulator: http://www.gov.hk/en/theme/bf/smart/

5.4.6 SCOTLAND

eDevelopment is a Scottish service that allows users to apply online to their local and planning authority for planning permission, building warrants, appeals, and a variety of other forms.

The Scottish Government manages it in collaboration with all Scottish local and planning authorities. Since its inception in 2016, eDevelopment has received over 1,000,000 submissions.

For planning permission, 'ePlanning Portal' enables applicants to complete and submit planning applications, notice of reviews, appeals, and other permissions under planning law online, all from the comfort of their own home or office.

Applicants can also upload documentation to support their application, purchase and mark up a location plan, and make an online payment for their application through the council's payment engine.

The benefit of this portal is that the applicant frequently manages a collection of proposals with a group of colleagues, or anyone else who wants to view the application, and they frequently do so on behalf of clients. ePlanning Scotland has advanced features to help manage those tasks.

Users can share access with one another so that each can contribute to the completion of an application and can create an organisation for their business, which allows all users within the organisation to share access, and view and edit each user's proposal.

As they can email and process them more quickly, decisions can be made more rapidly; another benefit to this portal.

Scotland's Digital Strategy for Planning sets out proposals for the Digital Transformation of the planning system, in particular changes in the planning permission. This document states that next generation Planning Scotland Gateway online portal will provide easy access, in one place, to all information about planning, including real-time tracking and notifications, and a more consistent and coordinated planning process.

5.4.7 SPAIN (BARCELONA)

Barcelona's priority is to go beyond the concept of smart city and fully capitalise on the opportunities created by highly transformative data-driven technologies.

Barcelona aspires to be a leader in the transition to technological sovereignty, allowing both the government and citizens to decide on and articulate, their own priorities in the use of technological innovations to generate public benefits.

The City of Barcelona's government set in motion an ambitious plan for digital transformation in three main parts, including: technology for a better Government; Urban Technology; and City Data Commons.

Barcelona City Council has taken another step forward in the Administration's digital transformation by adapting to the needs of digital citizenship.

In November 2020, the 'eObres Portal' project went live, allowing for the online processing of permits for major works.

This new service streamlines the administrative steps involved, which contributes to the City Council's public transparency.

The new process has the advantage of requiring more information in permit applications and allowing them to be checked at all stages of their validity.

The eObres portal also provides a wide range of online procedures related to permit applications for major works, with this new process including more information set out in the permit applications, and the option of checking them at all stages during their validity.

It provides better comprehension, greater speed for checking and enquiring about the status of an application, and improved access to data.

This process simplifies and streamlines the relationship between citizens and the City Council, allowing greater control of the time the procedure takes, and a significant reduction in the use of paper.

Another benefit is that the applicant will liaise with a single point of contact who will be in charge of managing reports with other departments, and informing the applicant of any requirements.

5.5 REVIEW AND IDENTIFICATION OF THE TECHNOLOGIES AND RELEVANT STANDARDS

5.5.1 PLANNING APPROVAL PROCESS

5.5.1.1 DIGITAL MODERNISATION IN VICTORIA

The Victorian Government has begun initiatives in Planning Reform, Planning Information Services and developing a Digital Modernisation Roadmap.

Digital Twin Victoria, which is an innovative new digital program led by Land Use Victoria (DELWP), provides an opportunity for a future planning and building approval process. Victoria's digital twin proof of concept, developed by The University of Melbourne, demonstrated how innovative technology can help solve the interconnected challenges of urbanisation.[72]

The vision of Digital Twin Victoria is to recreate Victoria online so that government, industry, and the community can collaborate to improve real-world outcomes using shared open data, technology, and algorithms. Digital twins organise and visualise massive amounts of data in a single virtual location to create a 3D digital version of the world.

The Digital Twin Victoria programme will bring together rich 3D and 4D spatial data, artificial intelligence, and sensor data from across the state to virtually visualise and model places before investments are made. Data, platforms, skills, analytics, governance, and community engagement are the six core capabilities of the Digital Twin Victoria programme.

The goal of a digital twin is to improve decision-making about how to plan, design, and manage current and future infrastructure.

Rather than being motivated by high resolution, feature-rich data, the motivation should be focused on the insights gained, which allow for better decision-making about how to manage current and future infrastructures.

The Victorian government's $45 million investment in the Digital Cadastre Modernisation is supplemented by Digital Twin Victoria. It also builds on the success of Fishermans Bend, Victoria's first digital twin, which debuted in 2019.

In addition, The eComply project, for example, uses advanced algorithms and artificial intelligence to support faster, more robust regulatory assessments and compliance monitoring.

Digital Cadastre Modernisation (DCM):[73] The DCM project has now digitised land parcels from 33 Victorian municipalities, with a further 12 municipalities expected to be completed by the end of 2021.

The DCM project has already added significant value by demonstrating that it will improve the accuracy of Vicmap, the State's authoritative suite of spatial data products that serves as the foundation for all mapping in Victoria. Vicmap is open data and is used by over 6,000 customers over 100 million times per year.

Fishermans Bend Digital Twin:[74] Victoria's digital twin proof of concept demonstrates how cutting-edge technology can aid in the resolution of the interconnected challenges of urbanisation.

Fishermans Bend was chosen as the location for a Digital Twin technology pilot so that the findings could support decision-making within the plans for a development already underway.

The project developed a realistic, high-accuracy model that enables virtual and augmented reality, as well as the incorporation of real-time data and artificial intelligence-generated data. 4D modelling of the design and condition of a physical asset (above and underground) includes precise location and legal boundaries.

The eComply project:[75] eComply is a pilot project investigating ways to make the housing approvals process faster, easier, and less expensive.

Development Victoria, Brimbank City Council, the Office of Projects Victoria, and the Victorian Building Authority collaborated on the pilot project. It assesses the compliance of digital building designs with the Small Lot Housing Code using digital twin technology, spatial intelligence, and machine learning.

This pilot project, which is part of Digital Twin Victoria, demonstrates the value that digital twin technology can provide in terms of reducing regulatory red tape.

Figure 37: Snapshot of eComply submission with a compliance report depicts an example of an eComply submission with a compliance report.

Digital Twin Victoria's platform:[76] Digital Twin Victoria's platform was created with the help of TerriaJS technology from CSIRO's data and digital arm, Data61. It will allow access to thousands of Victorian and national 2D, 3D, and live datasets in one place, as well as the ability to visualise and interpret built and natural environments using datasets, upload data and easily share spatial datasets with communities and stakeholders, and support the presentation of tailored location-based information.[77]

[72] https://www.spear.land.vic.gov.au
[73] https://www.land.vic.gov.au/maps-and-spatial/maps-and-spatial-news/digitisation-of-victorias-land-parcels-approached-2-million
[74] https://www.land.vic.gov.au/maps-and-spatial/projects-and-programs/digital-twin-victoria/fishermans-bend-digital-twin
[75] https://www.land.vic.gov.au/maps-and-spatial/projects-and-programs/digital-twin-victoria/ecomply
[76] https://www.land.vic.gov.au/maps-and-spatial/projects-and-programs/digital-twin-victoria
[77] Thousands of open datasets from Australia, Victoria, and local government agencies are already available on the platform, and more will be added in the future. The platform is expected to be widely available by late 2021.

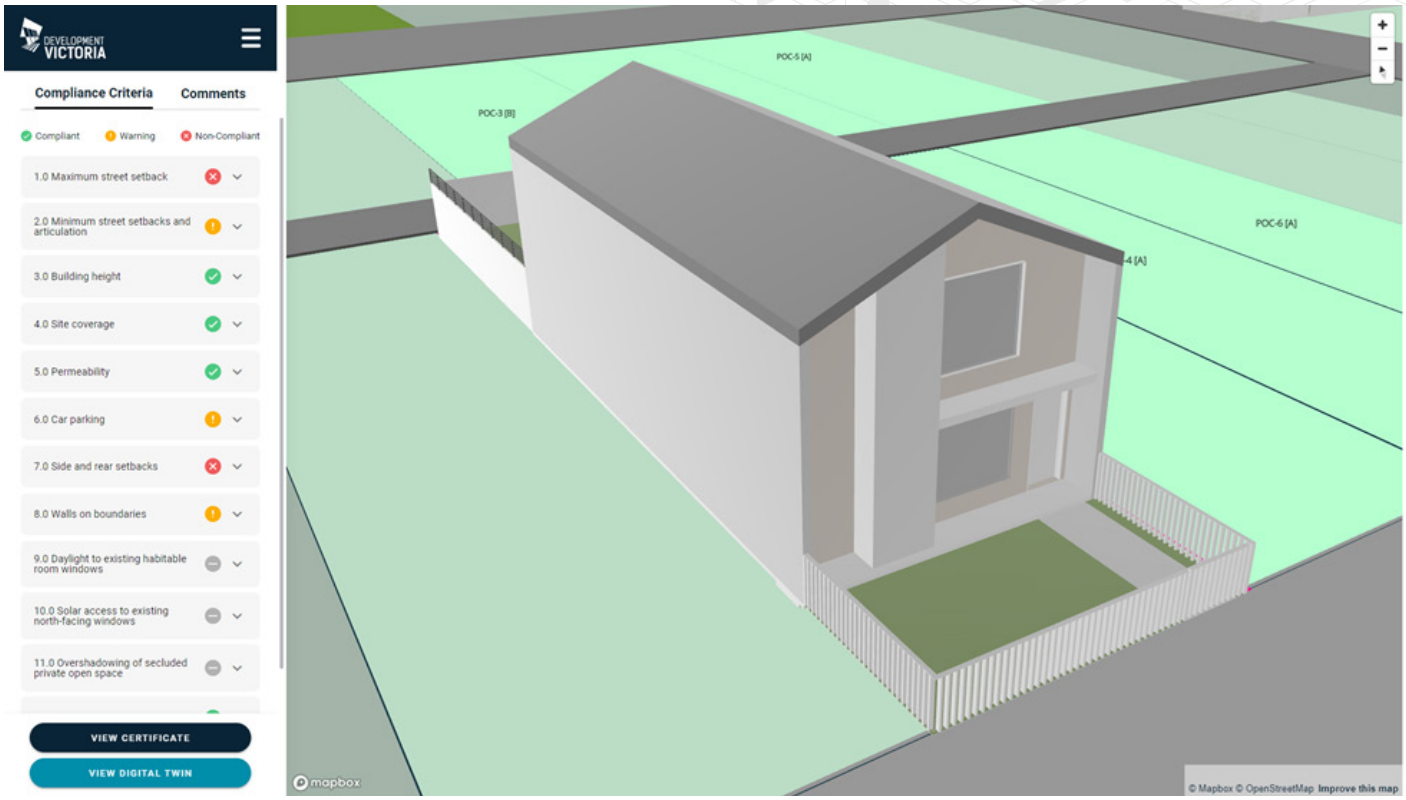


Figure 37: Snapshot of eComply submission with a compliance report[78]

The SPEAR:[79] The electronic submission and delivery of all planning and subdivision permit applications in Victoria is serviced by the Surveying and Planning through Electronic Applications and Referrals (SPEAR) service.

This service enables applicants to lodge and manage their applications while tracking their progress, and councils to receive, manage, refer, and approve applications. SPEAR includes complete end-to-end workflows that allow applications to be lodged online with Land Use Victoria for registration.

The Planning Referral Authority Directory, which allows a user to identify the referral authorities that may be relevant within a specific local government area, is one of the SPEAR service's additions.

The service identifies the key contact information for each referral authority and groups them by council.

SPEAR is available to all users at no cost. SPEAR can be used in various capacities by all parties involved in the planning and subdivision processes:

SPEAR supports subdivision, as well as other plan-based applications submitted to the Responsible Authority, managed, referred to statutory and non-statutory referral authorities, approved, electronically lodged to Land Use Victoria, and tracked online. SPEAR can be used in various capacities by all parties involved in the subdivision and planning processes.

The SPEAR system sends email notifications to the appropriate SPEAR parties when new actions must be completed, or new information is added to the application.

Figure 38: Workflow in SPEAR[79]

[78]https://www.land.vic.gov.au/maps-and-spatial/projects-and-programs/digital-twin-victoria/ecomply
[79]https://www.spear.land.vic.gov.au/spear/pages/about/what-is-spear/overview.shtml

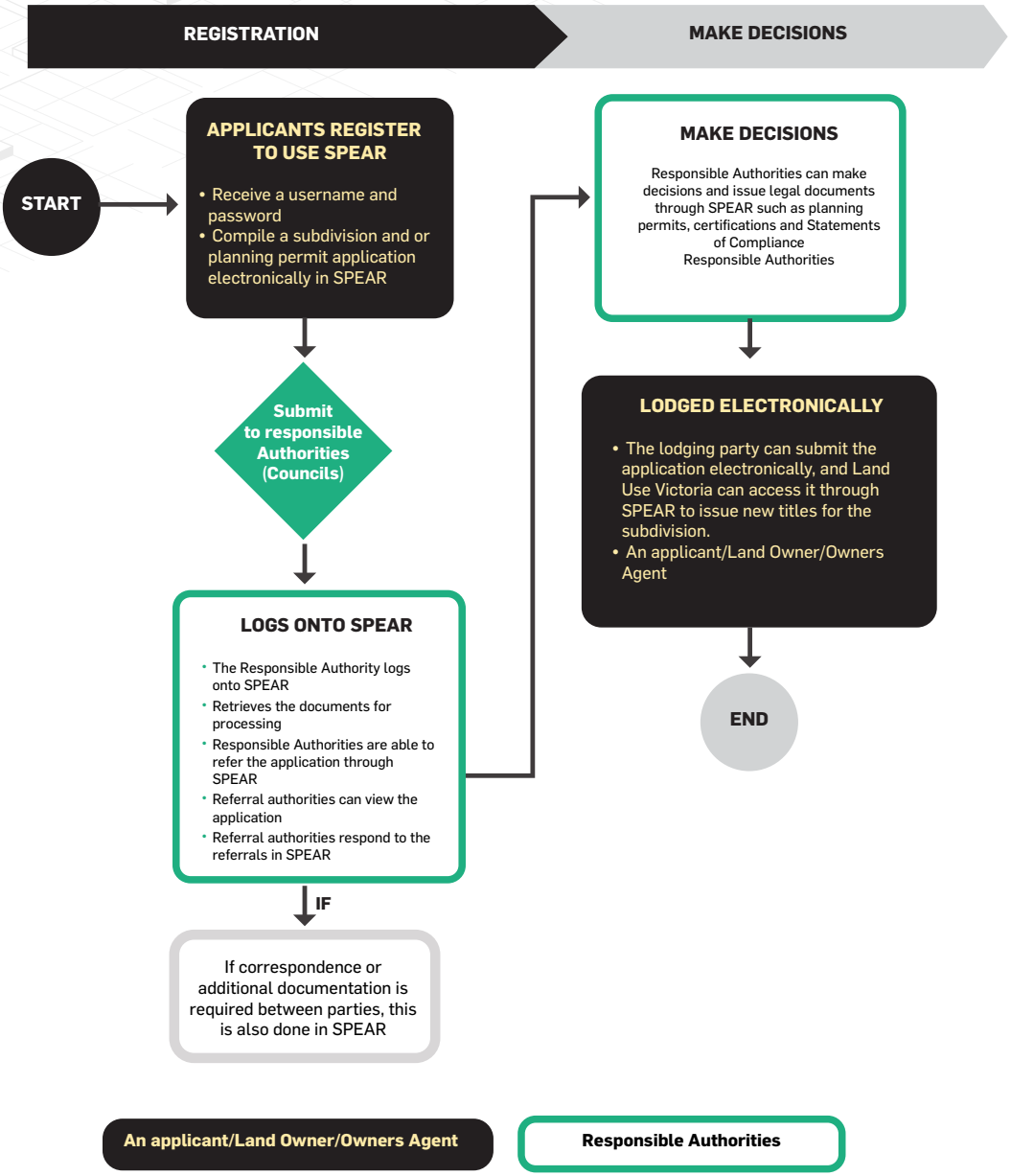


Figure 39: Simplified application process in SPEAR

Figure 39: Simplified application process in SPEAR depicts the application process in SPEAR.

The SPEAR service provided by the Victorian Government has several significant advantages, including the fact that it is currently free to use and manages the majority of participant interactions throughout the process (such as the applicant, referrals, and councils); provides faster turnaround time; and lower copying, collating, and postage costs.

It also provides a single consistent interface for all participants across the state; it can be updated once on behalf of all participating organisations in one location; and it complies with current legislative requirements, providing increased transparency, thus leading to fewer inquiries about the status of an application.

It is a single interface to all councils for applicants, referral authorities, VCAT, and members of the public.

SPEAR is used by stakeholders such as applicants (surveyors and planning organisations), Responsible Authorities (councils), Referral authorities, the public, guests (invited by applicants), objectors, consenting parties, lodging parties, and Land Use Victoria.

The benefit of SPEAR is significant for the current list of SPEAR-registered organisations (Applicants, Responsible Authorities, referral authorities, and lodging parties), as follows.

Applicants: Among the benefits available to applicants are:

- The ability to check the status of all applications across all councils at any time.
- The ability to compile applications over time.
- Due to digital signing, there is no longer any need to physically sign each page of a document.
- When new documents, changes to documents, or application decisions are made, users will receive immediate email notifications.

Responsible Authority: The advantages of being a Responsible Authority include: submissions that are more consistent and complete; electronic document loading into

council systems without scanning; Certification and Statement of Compliance signed and delivered immediately; and same-time electronic signing of all application documents for endorsement.

Referral Authority: Improved access to all application documents; fewer calls responding to application status; automatic overdue response reminders; and automatic notification of application updates are Referral Authority benefits by using SPEAR.

Lodging party: Some of the advantages of a Lodging Party are:

- Improved access to application documents and Land Use Victoria requisition details.
- Application forms that can be completed and validated electronically.
- There is no need to visit Land Use Victoria in person to file applications.
- Upon registration, users will receive immediate notification of new title allocations.

The current version of SPEAR contains older processes and lacks some useful functionality, such as workflow capabilities, template management, and access to council data, integration of statutory clock management, and document management with the council Document Management System (DMS)[80].

It also has a long response time to changing requirements or rules. This current technology faces with machine-readable digital content. Content published and produced in public planning processes may not be easily readable by computers (machine-readable).

5.5.1.2 DIGITAL MODERNISATION IN VICTORIAN COUNCILS

There are no state-wide central systems in Victoria to assist with the application, lodgment, and management of planning permits and their records.

Each council has established its own system for providing public services with its authority, such as preparing and submitting the Planning Application.

Some councils have implemented a digital platform to support services to make the process more efficient and effective. However, a significant number of council services rely on email communication, or still use postal mail.

Among Victoria's councils, Wyndham City Council and the City of Whittlesea have gone beyond the application submission stage and use the digital platform for decision-making and referrals to officials.

Whittlesea City Council: In 2021, the Whittlesea City Council developed and rolled out an online system for planning process applications. This digital system is built on Salesforce infrastructure, and connected to other

Victorian systems including SPEAR for land title and subdivision. The online system has created a matrix to facilitate a faster pre-application process for submission. However, the development assessment remains in 2D and PDF form.

Wyndham City Council: Wyndham City Council has developed and launched an online platform for the planning permit application. This platform is for submission, registration, allocation, assessment, and decision-making.

5.5.1.3 INNOVATION AND TECHNOLOGIES

5.5.1.3.1 The Planning Permit Activity Reporting System (PPARS)

PPARS is an online system that automates the collection of standardised permit activity data from 80 Victorian responsible authorities on a monthly basis.[81]

DELWP already maintains a database of council-reported performance in approving permit applications, known as PPARS, which is used to generate public quarterly reports, and Local Government Victoria (LGV) maintains the Know Your Council website, which is based on PPARS data.

DELWP has also recently implemented the Amendment Tracking System (ATS) as part of a Smart Planning initiative to assess the performance of authorising, assessing, and approving planning scheme amendments.

The Surveying and Planning through Electronic Applications and Referrals (SPEAR) system, which is used for subdivision approvals, also includes tracking and monitoring features (Better Regulation Victoria, 2019).

Based on the purpose of the data in the application process, the planning permit activity data identified in this data dictionary has been classified into the following categories (Planning Permit Activity Reporting, 2016):

- *Application details* (information pertaining to the application and derived primarily from the application form) including

[80] A document management system (DMS) is a system for receiving, tracking, managing, and storing documents in order to reduce paper usage.
[81] https://www.planning.vic.gov.au/resource-library/planning-permit-activity-in-victoria

Victorian Planning Scheme code, application identifier, new or amended application, property location, fees, VicSmart, pre-application meeting, estimated cost of works, applicant details.

- *Processing details* (information pertaining to the management of the application's processing within the Responsible Authority) including date application received, estimated assessment effort, further information requested, public notice, Referral issued, objections, 60-day timeframe, Cultural Heritage Management Plans.
- *Application outcome* (information pertaining to the Responsible Authority's and, if applicable, VCAT's decision) including Responsible Authority outcome, date of Responsible Authority outcome, VCAT reference number, VCAT lodgement date, VCAT grounds for appeal, VCAT outcome, VCAT outcome date, final Outcome, final outcome date.

5.5.1.3.2 Geospatial Data Services

Vicmap data is the state of Victoria's authoritative spatial data. It serves as the basis for Victoria's primary mapping and geographic information systems.

The 2D-based data can be used for a variety of purposes, including land management, location decisions, marketing, planning, procurement, and mapping calls/clients/delivery routes, among others.

According to the DataVic Access policy, most DELWP spatial data is free to use.

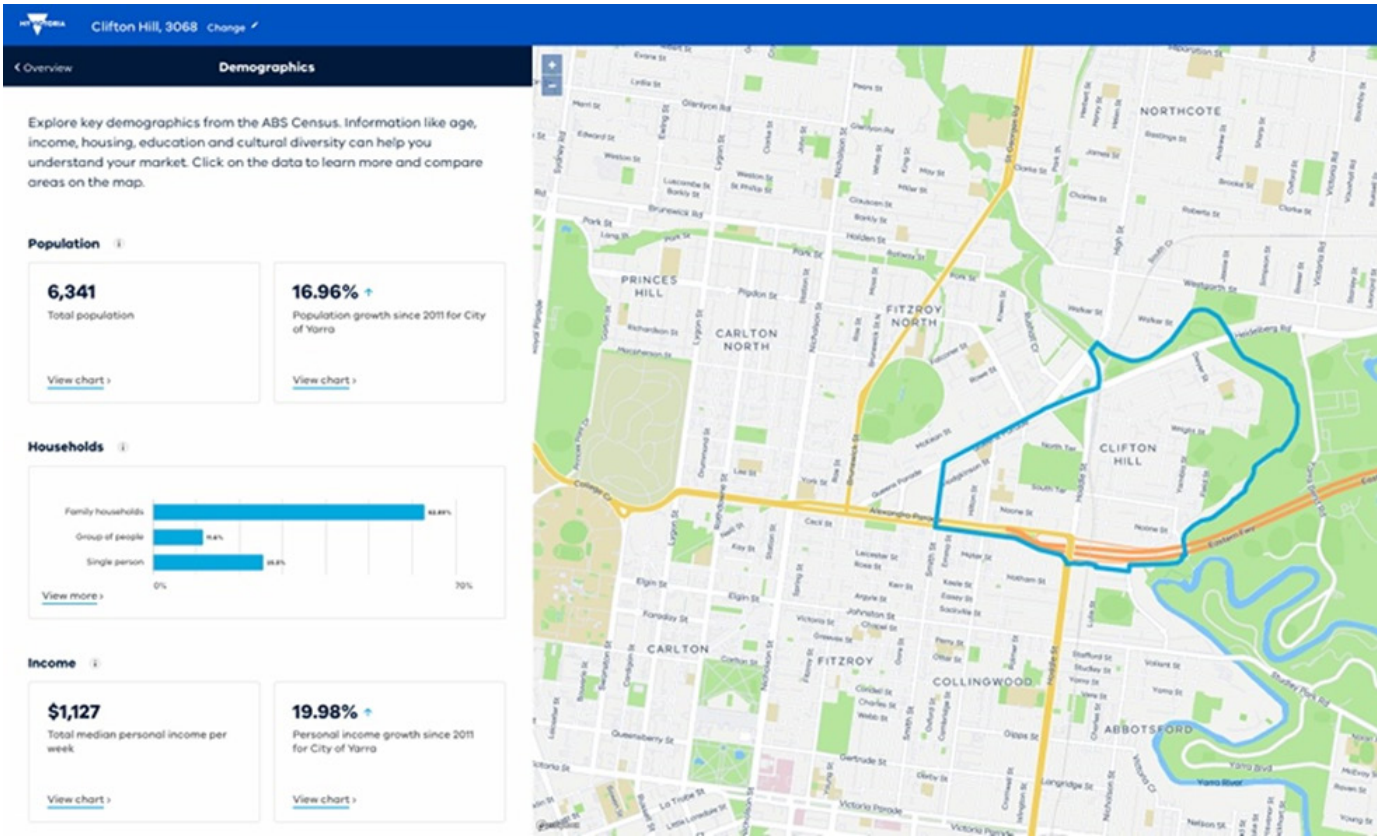


Figure 40: Spatial Datamart Victoria[82]

5.5.1.3.3 Spatially enabled digital twins

Digital twins will allow for more effective data use to understand place-based policy and planning issues, test potential interventions, and deliver more sustainable planning and development, thereby improving decision-making efficiency and effectiveness in social, economic, and environmental outcomes.

To provide holistic information on the built and natural environments, digital twins will layer data such as digital engineering models, Internet of Things (IoT) sensor data, and environmental data.

This will be supported by spatial (location) data, which will provide the necessary elements to position digital twins relative to each other in order to reflect the real world.

To achieve spatially enabled digital twins, modernised 3D and 4D (temporal) spatial data, particularly land parcel and property (cadastral) data and land use data, will be required (ANZLIC, 2019).

Spatially-enabled digital twins can provide useful location-based insights, assisting users in understanding place-based policy and planning issues, testing potential interventions, and delivering more sustainable planning and development.

The Principles of Spatially Enabled Digital Twins for Natural and Built Environment developed by

[82]https://services.land.vic.gov.au/SpatialDatamart/

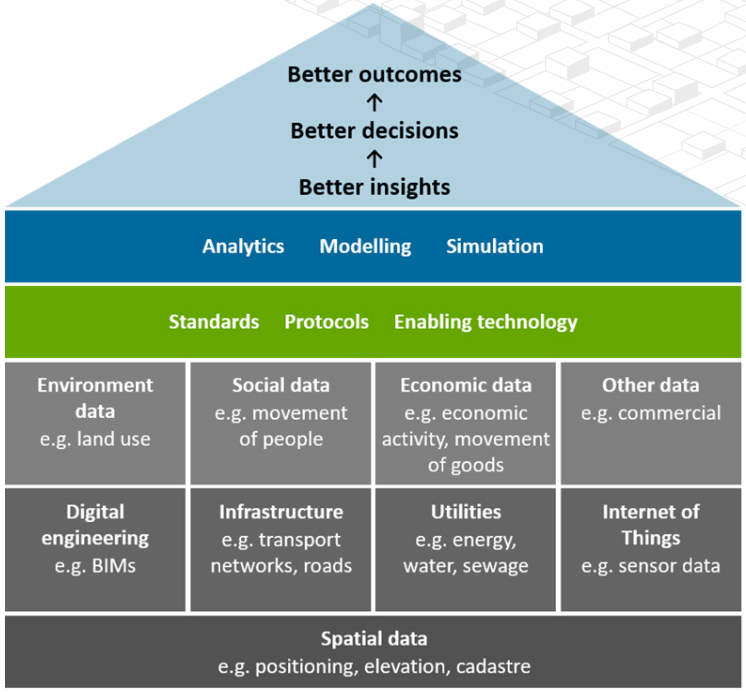


Figure 41: Spatially enabled digital twins integrate multiple data types and sources to allow for advanced analytics and better insight[83]

ANZLIC (2019) provides insights on building blocks and maturity levels of Digital Infrastructures (See Figure 41: Spatially enabled digital twins integrate multiple data types and sources to allow for advanced analytics and better insight).

5.5.1.3.4 Digital Planning Principles

Across 2019 and 2020, the Digital Planning Principles were developed by the NSW and National PlanTech working group at PIA, providing important insights on innovation for an open digital public infrastructure. Digital Planning Principles suggest a platform for a future digital planning system.

This platform is a prerequisite for further innovation, and it must be provided as open digital public infrastructure to reap the full benefits of a digital planning system.

With a fully open platform in place, the possibilities for new application development by anyone inside or outside government are limitless.[84] See Figure 42: Digital planning platform (Office of Projects Victoria, 2019).

5.5.1.3.5 Victorian Digital Asset Strategy (VDAS)

In 2018, the Victorian Digital Asset Strategy (VDAS) directed an innovative approach to improving the value and use of state assets through digital

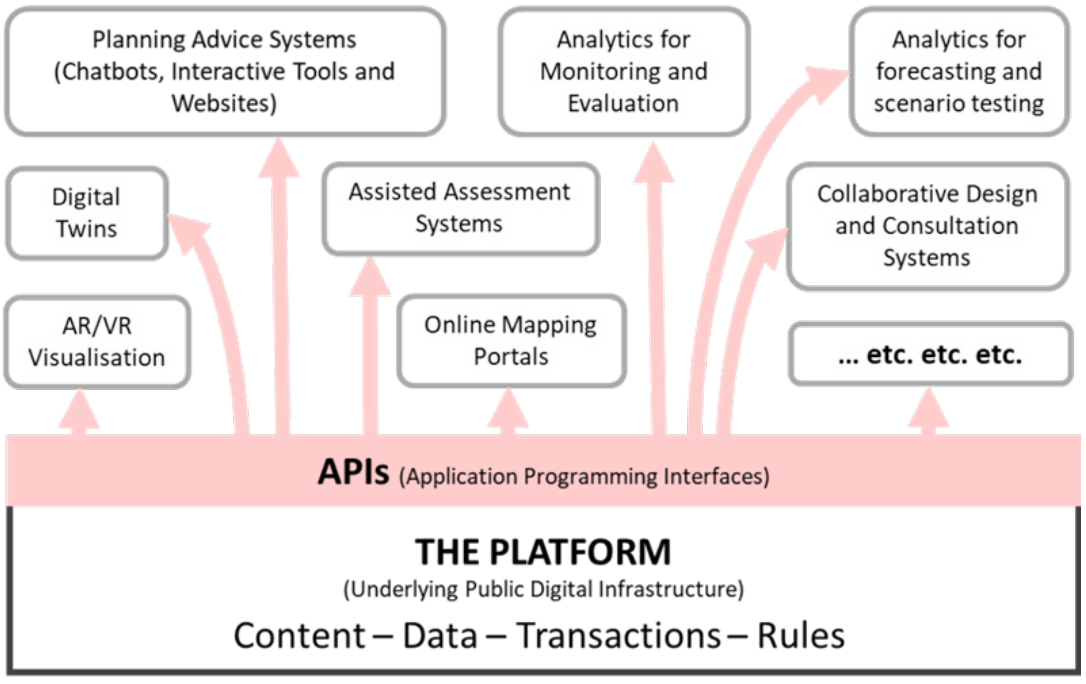


Figure 42: Digital planning platform (Victorian Digital Asset Strategy Guidance, 2019)

[83] https://www.anzlic.gov.au/resources/principles-spatially-enabled-digital-twins-built-and-natural-environment-australia
[84] Digital Planning Principles, 2020, Available online: https://www.planning.org.au/policy/pia-digital-planning-principles

engineering throughout the asset lifecycle.

A common data environment (CDE) supports this work by aligning digital information systems such as drafting, geospatial information systems (GIS), building information modelling (BIM), electronic document management systems (EDMS), project controls (time, cost, risks, and so on), asset data, and other related systems.

It emphasises the importance of 3D information and information technologies in realising connected information environments for asset management to achieve the objectives.

In particular, it recognises the importance of preserving the valuable data generated at each stage of an asset's lifecycle, and that this data can and should be used for the public good.

The VDAS operates in a digital environment, in which systems interact and information, data, and documentation are stored. Individuals spend less time searching for information and more time making effective decisions as a result.

By preserving this data, future cities will be able to improve their data value and information management (Victorian Digital Asset Strategy Guidance, 2019).

It will also allow for the creation of a "Virtual Victoria" – a digital twin that will aid in integrated planning and the development of smart cities. Through innovative approaches, VDAS will improve the outcomes of Victoria's infrastructure.

5.5.1.3.6 Digital Cadastre Modernisation

The Victorian Government is investing $45 millionAUD to digitise the authoritative map of Victoria's property boundaries, ensuring that one of the state's most important

Figure 43: Virtual Victoria by VDAS (Victorian Digital Asset Strategy Guidance, 2019)

datasets is accurate, up to date, and easily accessible. Vicmap is the authoritative suite of spatial data products provided by the state that serves as the foundation for all mapping in Victoria.

It is open data and is accessed by over 6,000 customers over 100 million times per year. Digital Cadastre Modernisation will take place in four interconnected stages, with extensive stakeholder participation:

- Stage 1 Digitisation: Involves converting accurate data from each plan into a digital record;
- Stage 2 Adjustment: To improve spatial accuracy, data from plans is joined and mathematically adjusted;
- Stage 3 Integration: The updated data is made public and changes in location are propagated through Vicmap layers; and
- Stage 4 Automation: Creation of automated processes to keep the digital cadastre and other Vicmap layers current and spatially accurate.

5.5.1.3.7 3D city model

A 3D city model is a digital representation of an urban area and provides a fundamental building block for digital twins that includes terrain surfaces, sites, buildings, vegetation, infrastructure, and landscape elements in three dimensions, as well as related objects (e.g., city furniture). Their constituents are described and represented by 2D and 3D spatial data, as well as geo-referenced data.

3D city models aid in presentation, exploration, analysis, and management tasks across a wide range of application domains. In particular, they enable "visually integrating heterogeneous geoinformation within a single framework and, thus, creating and managing complex urban information spaces." (Dollner et al., 2006).

The 3D city model has been identified as an appropriate digital process and data model for innovating the eApproval process. The Planning group employs digital 3D modelling to assist government departments

and agencies in visualising and testing development proposals for places, buildings, and infrastructure in three dimensions. 3D modelling has the potential to[85]:

- Test alternative scenarios for strategic sites, significant places, and urban renewal areas;
- Visualise and evaluate the impact of a development proposal on its surroundings;
- Represent planning scheme overlays in three dimensions;
- Analyse a location to identify potential built form envelopes; and
- And analyse the impact of a development proposal, taking into account bulk, height, view lines, and shadows.

5.5.1.4 STANDARDS

Identifying the current standards in the planning approval process is critical for the implementation of the ePlanning and eApprovals process. The following sections detail some of the status data and standards.

5.5.1.4.1 Open Geospatial Consortium (OGC)

The Open Geospatial Consortium (OGC) is an international consortium of companies, government agencies, and universities participating in a consensus process to develop publicly available geospatial and location-based services.

Interfaces and protocols defined by OpenGIS specifications support interoperability and seek to integrate geospatial technologies with wireless and location-based services.[86]

OGC standards are developed to make location information and services FAIR – Findable, Accessible, Interoperable and Reusable. They are used by software developers to build open interfaces and encodings into their products and services.

OGC's main "products" are standards, which have been developed by the membership to address specific interoperability challenges, such as publishing map content on the web, exchanging critical location data during disaster response and recovery, and enabling the fusion of information from diverse Internet of Things (IoT) devices.[87]

To follow, the OGC standards related to the planning approval are described:

Community Standards[88]

A Community standard is an official position of the OGC endorsing a specification or standard developed external to the OGC.

The most important consideration for a Community standard is strong evidence of implementation.

The OGC does not take over the work's maintenance; rather, a Community standard is a "snapshot" of a mature standard for which the originator has either shared the Intellectual Property Rights with the OGC, or granted all implementers unlimited free use of the Intellectual Property. Community standards can be used for two purposes:

1. To establish de facto standards from the larger geospatial community as a stable reference point, which governments and other organisations can use as a normative reference; and
2. To introduce new, but implemented, standards to the OGC to serve as the foundation for further refinement and development of interoperability between other OGC standards.

City Geography Markup Language (CityGML)[89]

CityGML is a geospatial information model and XML-based encoding standard for representing, storing, and exchanging virtual 3D cities and landscapes, adding more value to sustainable information sharing and semantics for representing volumetric urban objects.

It is defined as a GML 3.1.1[90] application schema, and its geometric models are based on ISO 19107.[91]

[85] Available online: https://www.planning.vic.gov.au/policy-and-strategy/urban-design/3d-built-form-modelling
[86] Available online: https://support.esri.com/en/other-resources/gis-dictionary/term/9320efda-972f-4273-b7bb-7c6e7bf5df26
[87] https://www.ogc.org/standards
[88] Available online: https://www.ogc.org/standards/community
[89] OGC, OGC CityGML Encoding Standard, Document No. 12-019, 2012. Available online: http://www. opengeospatial.org/standards/citygml
[90] OGC, OGC GML, Document No. 07-036, 2007. Available online: http://www.opengeospatial.org/ standards/gml
[91] ISO/TC211, Geographic Information—Spatial Schema; ISO 19107:2003; ISO: Geneva, Switzerland, 2003.

The goal of CityGML development is to achieve a common definition of the basic entities, attributes, and relationships of a 3D city model.

This is especially important in terms of cost-effective, long-term maintenance of 3D city models, allowing for the reuse of the same data across multiple application fields.[92]

Recent CityGML developments have a wide range of implications for urban planning tasks, particularly environmental sustainability and energy modelling (Sabri et al., 2015).

IndoorGML

OGC published IndoorGML as a standard data model and XML-based exchange format to support interoperability between indoor spatial information services.

While previous standards, such as CityGML, KML, and IFC deal with interior space of buildings from geometric, cartographic, and semantic viewpoints, the goal of IndoorGML is to establish a standard foundation for the indoor space model (for navigation purposes).

Because IndoorGML defines a minimum data model for indoor space, more effort is required to discover its potential aspects that are not explicitly described in the standard document (Kang & Li, 2017).

LandXML[93]

LandXML is a non-proprietary XML (eXtensible Mark-up Language) data file format that contains civil engineering and survey measurement data used in the land development and transportation industries.

The LandXML user community includes over 650 organisations and 750 members from more than 40 countries, and the standard is supported by more than 70 registered software products.

LandXML data is valuable to the larger geospatial data community, but it is not currently integrated with any of the OGC or ISO geospatial standards. Integrated access to the two types of information would benefit both the land and infrastructure user domain and the geospatial technology user domain.

ISO Standards

There are many ISO standards that cover the requirements in the digital environment, such as ISO 37120, ISO 19107, ISO 6709, ISO 19115, ISO 19118, and ISO 19136.

ISO 37120, Sustainable development and resilience of communities: Indicators for city services and quality of life:

ISO 37120 specifies methodologies for the collection of such indicators, which are organised into 17 themes centered on social, economic, and environmental development.
The goal of these interdisciplinary indicators is to guide and measure cities' performances in terms of service delivery and quality of life.

As a result, urban planners and land administration organisations have a great opportunity to adopt interdisciplinary urban quality of life indicators for comparable and verifiable decision-making.

The ISO 37120 indicators, which include two key features, can act as drivers for the adoption of a smart city planning approach (Sabri et al., 2015):

1. The development and communication of data required for the majority of the ISO 37120 indicators necessitates the use of geospatial data as smart technology; and
2. To achieve these indicators, innovative tools that enable the integration of geospatial data and ICT-driven data are required.

ISO 19107:2019 Geographic information — Spatial schema:[94]

ISO 19107:2019 defines conceptual schemas for describing the spatial properties of geographic entities, as well as a set of spatial operations that adhere to these schemas. It is concerned with "vector" geometry and topology.

It specifies standard spatial operations for accessing, querying, managing, processing, and exchanging geographic data for spatial (geometric and topological) objects.

Because of the nature of geographic data, these geometric coordinated spaces will typically have up to three spatial dimensions, one temporal dimension, and any number of other spatially dependent parameters as required by the applications.

In general, the topological dimension of geometric object spatial projections will be no more than three.

ISO 6709:2008 Standard representation of geographic point location by coordinates:[95]

The interchange of coordinates describing geographic point location is covered by ISO 6709:2008. It defines the coordinate representation, including latitude and longitude, to be used in data interchange.

It also specifies how to represent horizontal point locations using coordinate types other than latitude and longitude, as well as specifying the height and depth representations that can be associated with horizontal coordinates. Units of measurement and coordinate order are included in the representation.

ISO 6709:2008 allows for the representation of point locations using the eXtensible Markup Language (XML) and, to maintain compatibility with the previous version of this International Standard, ISO 6709:1983 allows for the use of a single alpha-numeric string to describe point locations.

[92]https://www.ogc.org/standards/citygml
[93]OGC, LandXML, buildingSMART, LandInfraSWG, post date, 2 September 2014. Available online: https://www.ogc.org/blog/2098
[94]Available online: https://www.iso.org/standard/66175.html
[95]Available online: https://www.iso.org/standard/39242.html

ISO 19115: Geographic information – Metadata[96]*:*

The schema required for describing geographic information and services is defined in ISO 19115:2003.

It describes the identification, scope, and quality of digital geographic data, as well as its spatial and temporal schema, spatial reference, and distribution.

Its principles can be applied to a wide range of other types of geographic data, including maps, charts, and textual documents, as well as non-geographic data.

ISO 19118:2011: Geographic information — Encoding:[97]

ISO 19118:2011 specifies the requirements for defining encoding rules for use in the interchange of data that conform to geographic information in the ISO 19100 series of International Standards.

It specifies the requirements for developing encoding rules based on UML schemas, as well as the requirements for developing encoding services and XML-based encoding rules for data neutral interchange.

ISO 19136 -1:2020 Geographic information — Geography Markup Language (GML) — Part 1: Fundamentals:[98]

The Geography Markup Language (GML) is an ISO 19118 XML encoding for the transport and storage of geographic information that is modeled in accordance with the conceptual modeling framework, used in the ISO 19100 series of International Standards, and includes both spatial and non-spatial properties of geographic features.

6.5.2 BUILDING APPROVAL PROCESS

6.5.2.1 DATA

Building data is the core of the building approval process. The data about various aspects of buildings, including architectural, structural, and fire safety, is assessed, monitored, and managed by examining authorised relevant regulations.

The required data for building approval varies between jurisdictions and legislation; it is generally addressed in documents, including a statement of the construction overview, building drawings and specification, structural/mechanical/electrical drawings and calculations, site plans, and certificate of title.

Some of the data is geospatial data in a spatial context, while others are in semantic. The data is generated based on the collaboration of multidisciplinary experts, such as architects, land surveyors, structural engineers, mechanical engineers, electrical engineers, plumbing engineers, and contractors.

All the data are interdependent to each other to construct a building working as one system. The building approval requires an integrated evaluation of the data.

The digitisation of building approval requires the data to be captured and delivered in a digital environment as a subject of assessment. For this, the following are required:

Digital Data Requirements:

In the eApprovals process, all required data of buildings must be structured as digital data and available to the right people at the right time.

In this context, clear data and information requirements for the building approval process is necessary to assist stakeholders in defining and delivering the data.

The standardised data structure and digital engineering process to support data production for building approval needs to be provided.

It should consider the data requirements of relevant authorities for the report and consent in the process, which can facilitate an efficient building permit application as well as management building information across the jurisdiction. In addition, it should consider the FAIR data principle: Findable, Accessible, Interoperable, and Reusable.

Exchange Information Requirements:

Together with data requirement, the identification of the relevant stakeholders and their roles are the Exchange Information Requirements.

It defines data supply chains for creating, organising, exchanging, integrating, managing, maintaining, and reusing the data relevant to building approval.

The requirements clearly inform who, what, how, and when to execute the data chain from building planning to post-construction phases that link to building approval.

Centralised Database Architecture:

Information acquired from building approval is the basis of establishing a strategic plan for national or state-wide asset management and supporting government administration.

[96] Available online: https://www.iso.org/standard/26020.html
[97] Available online: https://www.iso.org/standard/44212.html
[98] Available online: https://www.iso.org/standard/75676.html

The building permits and relevant documents need to be managed in a central repository to acquire, archive, and manage the data across local councils under the same data structure.

It stores all records related to building and occupancy permits, notice and orders, and certificates of final inspections.

This database should be developed in line with existing national fundamental data themes and digital government frameworks; it allows its integration with standardised fundamental data to support government initiatives and overarching policies.

6.5.2.2 INNOVATION

Since 1990, there has been a wide range of research on leveraging digital and information technologies to modernise building approval processes.

In addition to this, initiatives have been launched to develop required technologies and solutions that enable its digitised practices.

Digital innovation in the building approval process provides enhanced efficiency by automating or semi-automating current manual procedures and improved accuracy, by automatic compliance assessment of each application against the regulations. Some of the crucial technologies, which can be enablers of the eApprovals process, are identified.

6.5.2.2 BIM

BIM indicates a digital representation of the physical and functional characteristics of a facility; it also means a process of generating, using, and managing building data in a common data format throughout the facility lifecycle (NBIMS, 2015).

It is a new approach to describe and define integrated information of buildings, as a shared knowledge information resource and reliable basis for decisions during the design, construction, and management stages.

BIM allows generating a computer-interpretable data model of buildings for various analyses and evaluations and the automated checking of designs after they are generated (Eastman et al., 2011).

Existing research and initiatives have identified that building approval against regulations requires an integrated approach to building design and construction, digital engineering, and the legal field (Hjelseth, 2013).

In addition to this, information required for building approval covers multidisciplinary aspects of buildings.

BIM is regarded as a suitable digital process and data model for innovating the eAproal process, which can interface the three fields and incorporate diverse data into a single operating environment (Greenwood et al., 2010; I. Kim et al., 2020; Narayanaswamy, 2019).

Many countries, including Singapore, South Korea, the UK, and the Netherlands, have been operating

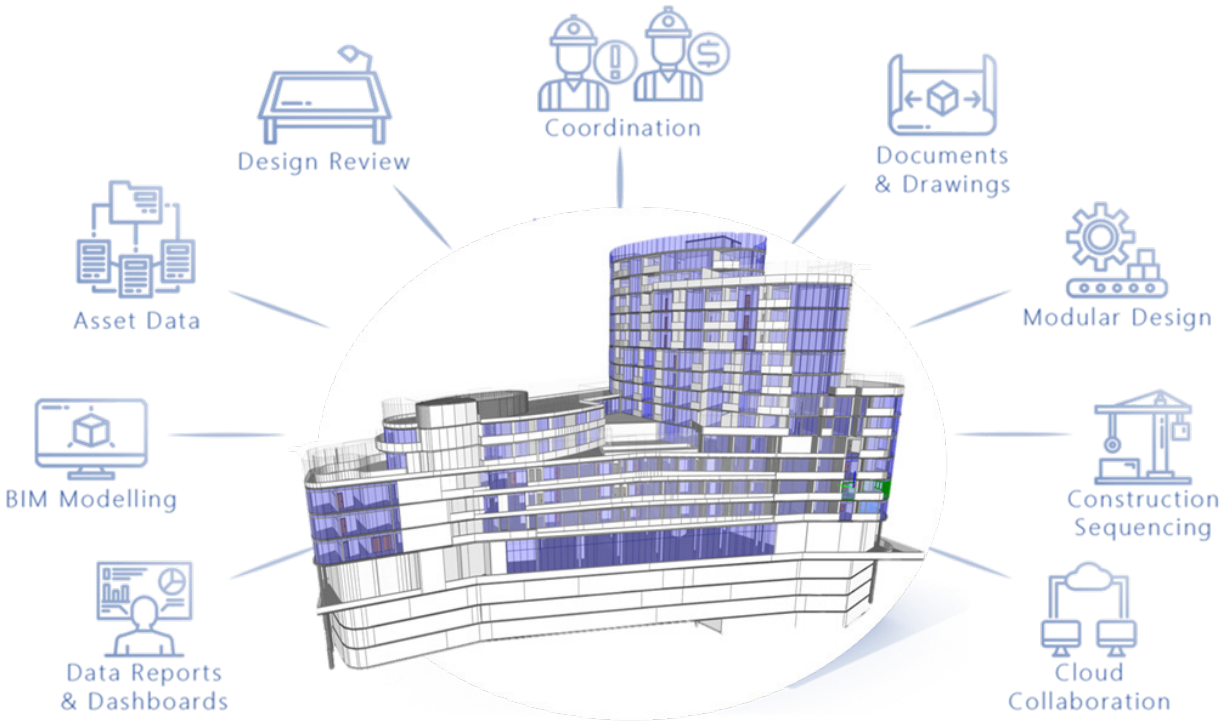


Figure 44: BIM and some scenarios of its usage

initiatives for the digital transformation of their building approval process.

These initiatives indicate the great value of BIM in the building planning and approval process, allowing the digital transformation of building/asset management in private and public sectors throughout their lifecycle from planning to demolition.

However, so far there has been no meaningful adoption of BIM-based automatic compliance checking, except for Singapore. This is because this transformation requires a BIM-based workflow and the increased maturity of BIM data during planning and design stages.

It demonstrates that it is essential to enhance the construction industry's maturity level in generating, using, exchanging, and managing BIM data.

In this context, the development of standards and systems that contribute to industry capacity improvements is ongoing in many countries as parts of the initiatives: a national BIM library; BIM modelling guidelines; BIM data quality verification systems; and BIM-based collaborative design platforms.

6.5.2.3 Integration of BIM and GIS

GIS refers to systems used to create, capture, manage, analyse, and map spatial and geographical data related to positions on the Earth's surface, their attributes, and interrelations (Song et al., 2017).

CityGML is an open standard data model to store and exchange the digital model of cities and landscapes, issued by the Open Geospatial Consortium (OGC) and the ISO TC211.

As strong urban management support, the integration of GIS and BIM has been actively discussed in recent decades; BIM delivers rich geometric and semantic information of buildings, while GIS covers geo-visualisation-based decision making and geospatial modelling (Kalantari, 2017; Liu et al., 2017; Volk et al., 2014).

The integration of building and city modelling has been developed and applied in various fields in construction supply chain management and urban planning, analysis, and management.

There are initiatives and research on leveraging BIM-GIS integration to digitise the building approval process (Guler and Yomralioglu, 2021; Noardo et al., 2020; Olsson et al., 2018). They highlight the need to incorporate geoinformation with BIM to:

1. confirm whether proposed building works comply with the regulations, focusing on the relationship between building and its surrounding environment (e.g., roads, other buildings, natural environment); and
2. extend three interrelated fields: building permit procedure, 3D property registration, and updating the 3D city model.

The integration allows the generation of a data model for physical, georeferenced, and ownership of facilities required for building approval, as well as urban asset management.

5.5.2.3 DIGITAL REPRESENTATION OF BUILDING REGULATIONS

In the building approval process, the regulations serve as sole standards of judgment on the adequacy of the proposed building works.

It means that the context and contents of building regulations should be represented in logical and machine-readable formats to automate code compliance checking in the building approval process.

Existing research has been developed to formally represent and reason for the regulations by adopting information technologies (Garrett Jr et al., 2014).

The infrastructure, process, and ideal form for digital representation of regulations, need to be developed to support translating the semantic structure of the legal requirements into rules, language-based representation, computer codes, or parametric tables (Lee, 2011; Macit İlal and Günaydın, 2017; Shih et al., 2013).

The translated regulations should have no room for misinterpretation and discretionary use.

Several countries, including Singapore and South Korea, have launched an ongoing project to develop a rule-based mechanism for translating building regulations into a computable format in the BIM data environment (Lee et al., 2016; Preidel and Borrmann, 2015).

These rules play essential roles in automated code compliance checking in the building approval process.

5.5.2.3.1 Automated Compliance Checking

The current manual compliance checking in the building approval process requires significant effort and time, but it is error-prone since there is uncertainty and inconsistency in the assessment based on individual knowledge and experience (Eastman et al., 2009; Narayanaswamy, 2019). This has led to delays in issuing building permits and increased expense to applicants. The automated compliance checking against digitally represented building regulations makes the process more efficient and effective.

The introduction of an automatic compliance checking system has the potential to improve communication among building permit issuers, building authorities, and project stakeholders.

It facilitates the transparency and predictability of building approval by officers in the authorities, with enhanced accuracy of checking results based on the digitised regulation.

In addition, it can also be used by project practitioners to check whether their design complies with the regulations, as design development proceeds before building permit application.

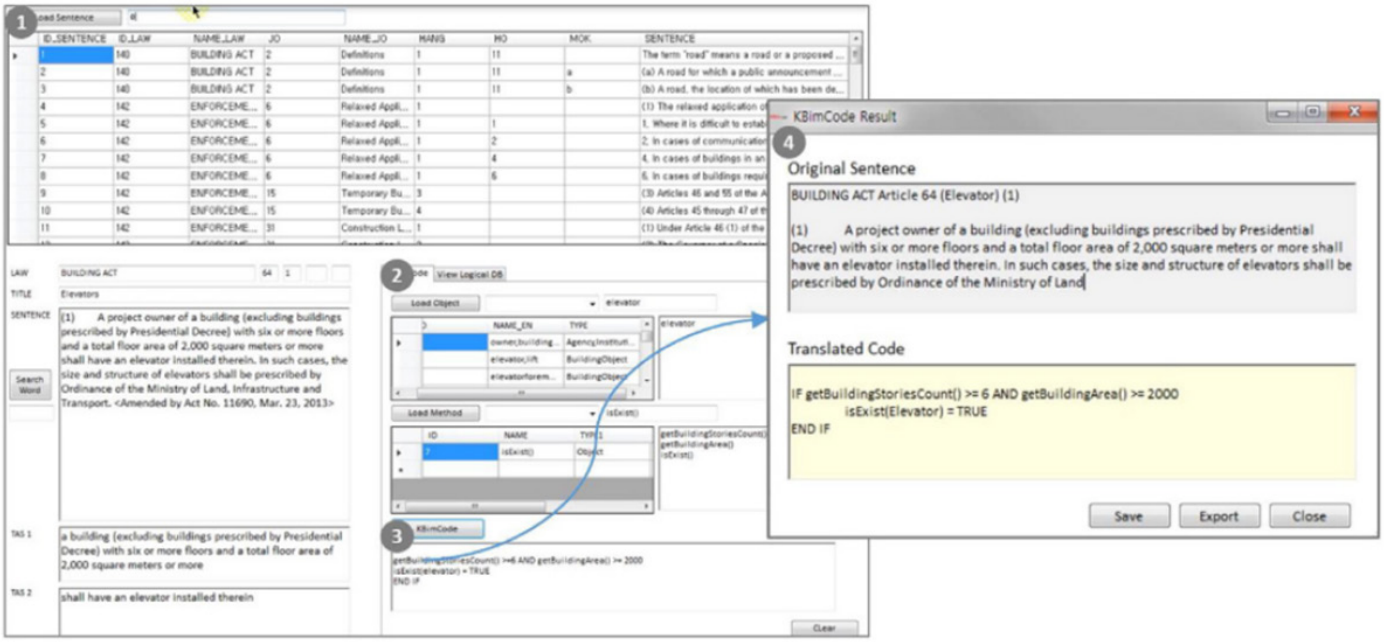


Figure 45: Building a Regulation translation system into a computer-executable format (Lee et al., 2016)

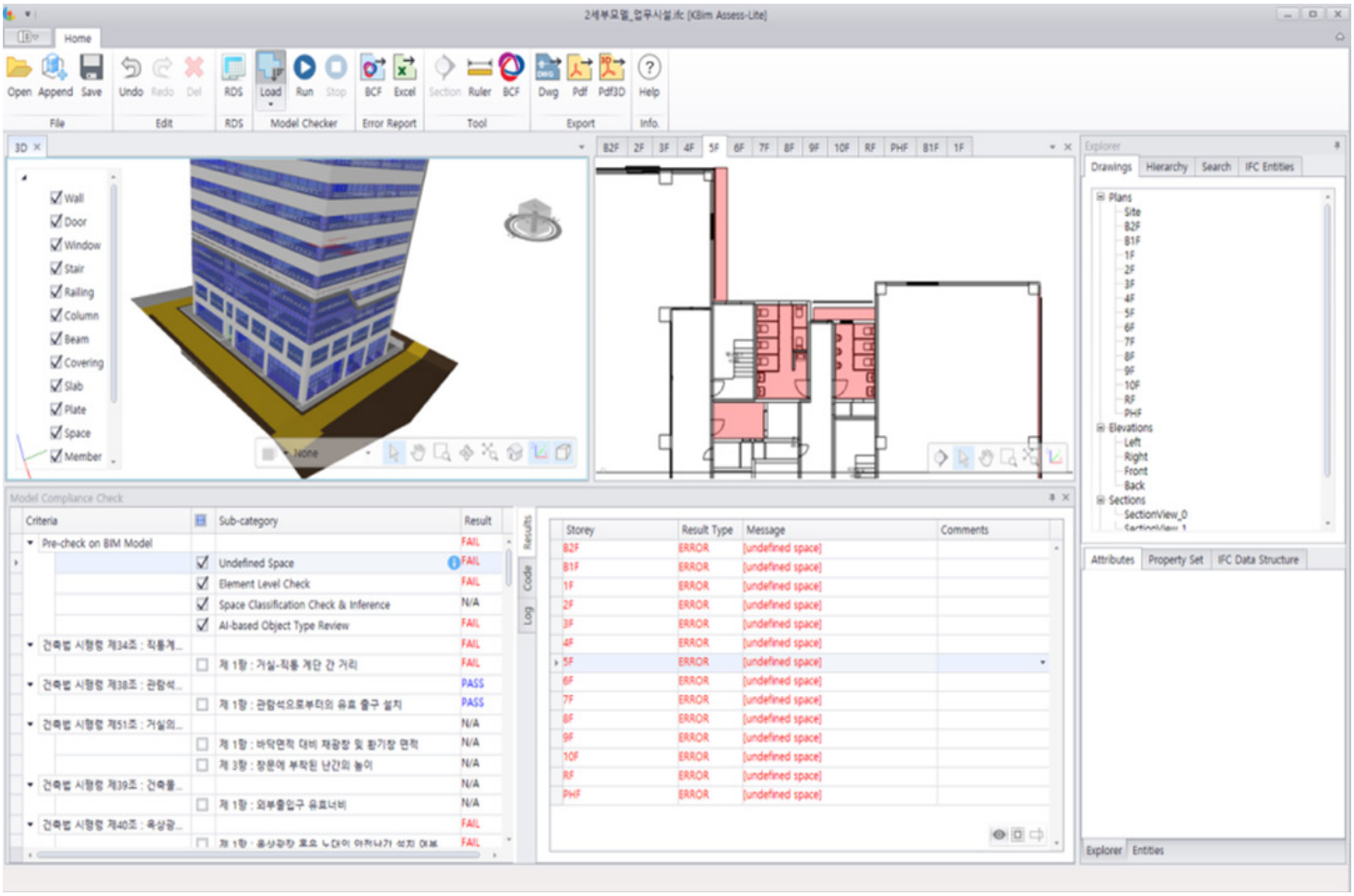


Figure 46: Interface of the BIM-based code compliance checking system in South Korea (KBIM Assess)[99]

[99]http://italab.khu.ac.kr/software

They can avoid design solutions that might be rejected in advance and reduce total building production time (Hjelseth, 2013).

A wide range of initiatives have been operated to develop automatic compliance checking systems. Many jurisdictions have selected BIM as the data environment of the system, such as CORENET of Singapore, KBIM Assess of South Korea, GeoBIM of the Netherlands, and ByggNett of Norway (BuildingSMART International Regulatory Room, 2020).

These systems rely on each jurisdiction's legal context, and are in line with national strategies on digital innovation of the construction industry.

The systems generally consist of four parts: logic-based checking rule interpretation; BIM model preparation; checking rule execution; and checking result (Choi and Kim, 2017; Eastman et al., 2009; Narayanaswamy, 2019; Noardo et al., 2020).

5.5.2.3.2 Blockchain Technology

Blockchain is a decentralised ledger that records every transaction made in the network.

Although it was first introduced as the working mechanism to form the basis of digital cryptocurrency, this decentralised data exchange technology has been widely used in many industries to strengthen security and accountability (Crosby et al., 2016).

It accelerates a shift from a centralised workflow to a decentralised, cooperative chain.

In the building approval process, blockchain can be applied to its digital workflows to create a system with the principle of decentralisation, open governance, and transparency.

It can secure data exchange among the building permit issuers, building authority, relevant authorities, and applicants, with speedy, robust transactions from building permit application to approval.

This technology also supports compliance checking against building regulations using encrypted digital data of the proposed building work, and checking rules for building regulations.

Its integration with the BIM-based workflow has the potential to enhance the building approval process, as shown in Figure 47: Integrated framework of BIM and blockchain for building approval (Nawari and Ravindran, 2019).

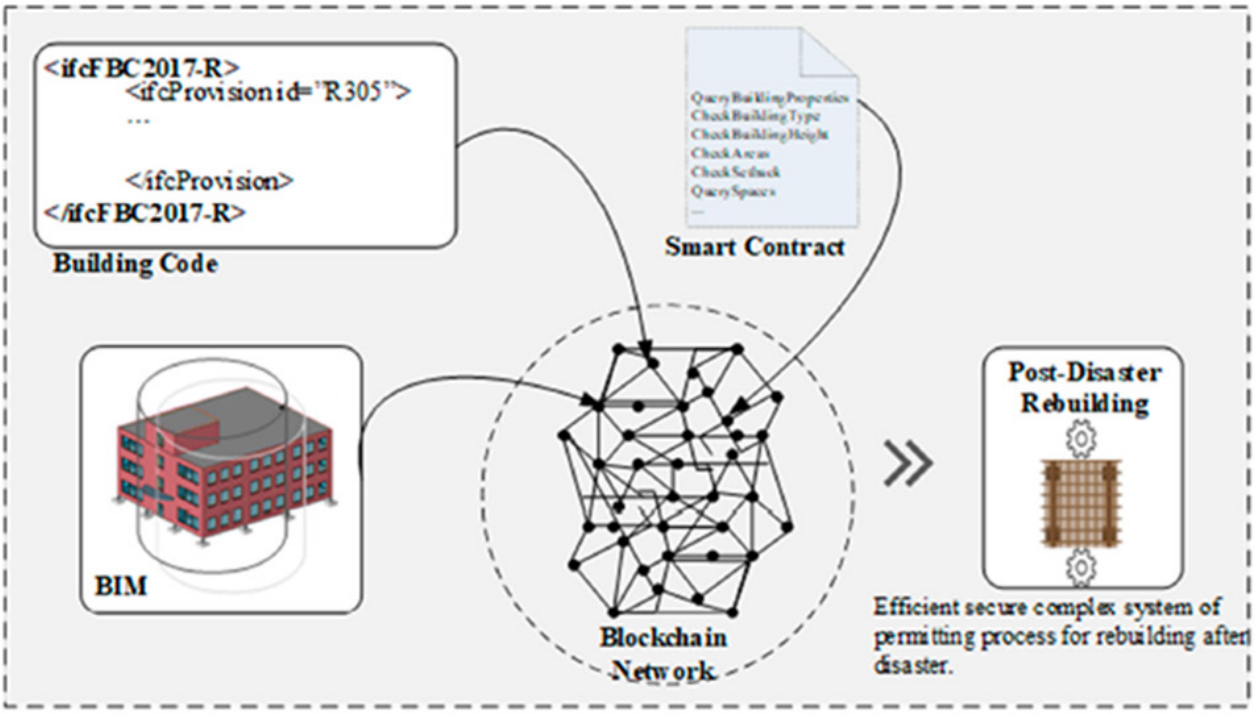


Figure 47: Integrated framework of BIM and blockchain for building approval (Nawari and Ravindran, 2019)

Blockchain structure can store BIM model data, and digitised building codes are stored in off-chain, allowing the chain code to function as the model checker and building permit issuer (Nawari and Ravindran, 2019).

It also supports stable data exchange of geometric and semantic data of the BIM model as well as relevant documents. With BIM, blockchain can lead to reduction in processing fees, paperwork, and time required for issuing building permits without interruption.

In addition, using BCT also negates the need to store all pertinent model checking data in one centralised location.

5.5.2.3.3 Cloud Computing

"Cloud-based system" means that the user does not need to install any applications or tools on their machine to execute the system. It saves time and cost for setting up, managing and maintaining individual applications.

In addition, the cloud-based online services are efficient, user-friendly, and transparent, with a quick turn-around time.

This technology can be applied to the building approval process, as it provides an integrated management platform of a wide range of systems and information and digital technologies.

The possible online services that can be provided by cloud computing are as follows:

- Applying and tracking building permits (Eirinaki et al., 2018).
- Managing information building permit applications.
- Automated compliance checking for approving building permits.
- Integrated database to share and manage all records related to building permits and relevant final documents for councils and relevant authorities.

For security and accountability, a building approval process driven by cloud computing needs to consider integration with blockchain.

Furthermore, the adoption of data mining and analysis techniques (including machine learning) needs to be considered to produce diverse statistics and data that could improve applications' experience in the building approval process and generate the basis of national strategy and policy (Eirinaki et al., 2018).

5.5.2.3.4 Augmented reality (AR)/ Virtual reality (VR)

AR is a computer technology to link digital information (e.g., graphics, sounds, haptic systems, scents) and real objects in physical environments in real-time (Choi, 2009).

It adds visual representation to the user's perception of the real-world that provides an immersive experience to users (García-Pereira, Portalés, Gimeno, & Casas, 2020). VR refers to a technology that generates a visual representation of real-world objects in a virtual environment; it can be integrated with AR as mixed reality (MR) (Raimbaud et al., 2019).

In construction projects, AR/VR technologies can be used for the purpose of project inspection and control.

With the advancement of VR, the integration of BIM and VR has been discussed to provide project stakeholders with a more intuitive and interactive manner to be involved in project decision-making.

The current status of building works captured by 3D laser or drones can be compared with planned building works represented in the 3D BIM data to identify between what has been planned and what has been built (Yin, Liu, Chen, & Al-Hussein, 2019).

The superimposition of the two sources allows monitoring, inspecting, tracking, and modifying construction tasks with off-site construction supervision.

Its integration with AI algorithms and various analysis techniques allows accurate inspection and advanced management of building works that can rely less on individuals' experience (Wang, Wang, Sepasgozar, & Zlatanova, 2020).

In the building approval process, AR/VR-based project inspection can support relevant building surveyors' inspection on milestones of building works according to the issued plan; it also assists inspection of completed all building works for issuing occupancy permits.

It could improve the current inspection practice by encouraging time and cost savings, enhancing precision and efficiency of the inspection process, and creating a near-real-time virtual environment for quality checking of building works.

Figure 48: AR/VR-based building work inspection using the planned BIM data[100]

[100]https://uploadvr.com/vr-and-ar-in-construction/

5.5.2.4 STANDARDS

To successfully implement an eApprovals process, it is paramount that the current standards in the building approval process are identified and any new standards are formulated for the expected eApprovals process.

These standards aim to assist in guaranteeing safety and durability of the buildings, together with ensuring an uninterrupted and seamless flow of information.

In an ICT environment, standards and guidelines have been developed to ensure that the attributes are addressed in every aspect of design and implementation of any ICT initiative. Some of the important standards are discussed in detail below.

5.5.2.4.1 National Construction Code (NCC)

In Australia, standards are published documents based on consensus, which can take the form of specifications, procedural requirements, or handbooks.

They are living documents that are updated to suit the changing needs of the economy and community. In the world of building and construction, standards help to codify best practices, methods and technical requirements to create a safe and sustainable built environment for the community.

The Australian Building Codes Board (ABCB) develops one national building code that has been adopted by each state and territory. The National Construction Code (NCC) is a good example of performance-based regulation.

Simply put, the NCC provides performance requirements for many aspects of building and construction that are based on outcomes. These requirements are laid out in the NCC, which may then refer to Australian Standards as one way for builders to meet these requirements.

Standards Australia works closely with the ABCB and stakeholders from the government, industry and community, to develop standards related to building and construction, which are referenced in the NCC. The list of building standards is provided in Appendix A.

5.5.2.4.2 NATSPEC National BIM Guide

The National BIM Guide is the central reference document that defines roles and responsibilities, collaboration procedures, approved software, modelling requirements, digital deliverables, and documentation standards for projects in general.

It also provides guidance on several uses for BIM. The NATSPEC Project BIM Brief Template provides a means of documenting client requirements regarding BIM for individual projects.

It has places to enter descriptive details of the project such as its location, and to specify what BIM deliverables and uses the client expects. It is also used to record what standards from the NATSPEC BIM Reference Schedule are to apply.

The intent of the Guide's structure is to allow each edition of the National BIM Guide to function as a core reference document and to confine all editing to the Project BIM Brief.

This allows the National BIM Guide to be tailored to individual projects while allowing it to be progressively upgraded in response to users' needs, from edition to edition within a consistent, recognisable framework.

5.5.2.4.3 Virtual Building Information System (VBIS)

The VBIS standard consists of an asset classification structure inclusive of a unique VBIS Tag per asset type, and a Search Syntax that allows interoperability between applications that host asset information.

This collectively provides an application ecosystem where the user can easily access information and make better use of application functionality.

A VBIS Enabled Application supports the VBIS Tag and the Search Syntax and thus becomes part of the end user's ecosystem of interconnected applications.

The VBIS standard will benefit all Commercial Software Providers, offering solutions in the construction and operation of the built environment.

These include:

- Asset and Maintenance Software;
- Document Management Software;
- Finance Software;
- Helpdesk Software;
- Analytics and Lifecycle Software; and
- Building Management Software.

VBIS offers a consistent classification structure for assets and asset information. It provides an easy way to locate key asset and maintenance information to support operations outcomes, and offers efficiencies for operators through better access to existing information.

5.5.2.4.4 Victorian Protective Data Security Standards

The Victorian Protective Data Security Standards (VPDSS) has established 12 high-level mandatory requirements to protect public sector information across all security areas, including governance, information, personnel, Information Communications Technology (ICT), and physical security.

The VPDSS are consistent with national and international standards, and describe the Victorian Government's approach to protecting public sector information.

They focus on the outcomes that are required to enable efficient, effective and economic investment in security measures through a risk-managed approach. The Standards cover:

- *Governance:* executive sponsorship of, and investment in, security management, utilising a risk-based approach, security policies and procedures, training, business continuity and disaster recovery, security incident management, external party engagement and oversight;
- *Information security:* protection of information across the information lifecycle, from when it is created to when it is disposed or destroyed;
- *Personnel security:* engagement and ongoing management, to ensure the continued eligibility and suitability of people accessing public sector information;
- *ICT security:* secure communications and technology systems processing or storing information; and
- *Physical security:* secure physical environment, including facilities, equipment and services, and the application of physical security measures to protect information.

5.5.2.4.5 ISO Standards

There are many ISO standards, such as ISO 16739-1:2018, ISO 19100, ISO 19650, ISO 55000 and ISO 12006, which cover requirements in the digital environment.

- *ISO 16739-1:2018 –Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries:* The Industry Foundation Classes (IFC) are an open international standard for BIM data that are exchanged and shared among software applications used by the various participants in the construction or facility management industry sector. The standard includes definitions that cover data required for buildings over their lifecycle.
- *ISO 19650-1:2018 – Organisation and digitisation of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling — Part 1: Concepts and principles:* This standard outlines the concepts and principles for information management at a stage of maturity, described as "building information modelling (BIM) according to the ISO 19650 series". The standard provides recommendations for a framework to manage information including exchanging, recording, versioning and organising for all actors. Further, this standard is applicable to the whole lifecycle of any built asset, including strategic planning, initial design, engineering, development, documentation and construction, day-to-day operation, maintenance, refurbishment, repair, and end-of-life. The standard can be adapted to assets or projects of any scale and complexity, so as not to hamper the flexibility and versatility that characterise the large range of potential procurement strategies.
- *ISO 12006-2:2015 – Building construction — Organisation of information about construction works (Part 2: Framework for classification):* ISO 12006-2:2015 defines a framework for the development of built environment classification systems. It identifies a set of recommended classification table titles for a range of information object classes according to particular views, e.g., by form or function, supported by definitions. It shows how the object classes classified in each table are related as a series of systems and sub-systems, e.g., in a building information model. ISO 12006-2:2015 does not provide a complete operational classification system, nor does it provide the content of the tables, though it does give examples. It is intended for use by organisations that develop and publish such classification systems and tables, which may vary in detail to suit local needs.
- *ISO 55000 for asset management:* The ISO 55000 family is the first set of International Standards for Asset Management and includes: ISO 55000, ISO 55001 and ISO 55002. ISO 55000 provides an overview of the subject of asset management and the standard terms and definitions. ISO 55001 specifies the requirements for an integrated, effective management system for asset management. Lastly, ISO 55002 offers guidance for the implementation of such a management system.

5.6 TECHNOLOGICAL OPPORTUNITIES AND CHALLENGES IN AUSTRALIA

5.6.1 STATUS OF DATA AND STANDARDS

Vicmap Digital is Victoria's primary provider of spatial information (Geospatial Data Services).

It assembles a collection of spatially related data products derived from individual datasets. In 2018, Victorian Digital Asset Strategy (VDAS) directed an innovative approach to improving the value and use of state assets through digital engineering throughout the asset lifecycle.

The VDAS relies on digital engineering technologies like Building Information Modelling (BIM) and Geographic Information Systems (GIS) to serve as a critical foundation for this whole-of-government innovation shift.

It emphasises the importance of 3D information and information technologies in realising connected information environments for asset management in order to achieve the objectives.

The data and standards in Victoria are unavailable, exclusive, costly, and obscure. This is reflected in the planning approval process.

This current situation of data and standards includes challenges such as:

- *Unavailability:* All non-sensitive data produced during public planning processes, including development approvals data and publicly procured 3D and 4D modelling for digital twin development, are not fully available as open data.
- *Exclusivity:* The public does not have full access to the computer code that represents the planning rules used in public or automated decision-making processes. This needs to be made available to the public in the process of digitalising the planning approval process.
- *Costly:* The cost of software development in agencies is high, and not every agency is able to provide software. To address this challenge, public funding in the development of new digital tools is required, as is collaboration between different authorities.
- *Obscurity:* It is not yet clear whether the coded rules correspond to the intended planning outcomes and comply with relevant legislation. Planning rules are already being incorporated into software systems (e.g., "rules as code", "legislation as code"), such as private sector applications.

5.6.2 DATA

The limited adoption of technologies to the planning and building approval processes in Victoria has led to avoidable delay, little predictability, and a lack of transparent monitoring in issuing building permits.

Digital and information technologies have been regarded as core enablers to facilitate effective, efficient, and timely planning, and building permits and approvals/Initiatives in various jurisdictions have demonstrated their opportunities and benefits.

Developing a digital platform for submitting and approving planning and building permit applications needs to be aligned with the existing systems, standards (national, international), and relevant government initiatives and strategies, including the Planning Information System of DELWP, Building Activity Management System of VBA, and the Victorian Digital Asset Strategy.

This can ensure:

- Interoperability in data exchanges, which allows integrating multidisciplinary project information and using it for both planning and building permit applications.
- Integration and compatibility with systems and databases of relevant authorities, which fosters ongoing compliance checking with planning controls, building regulations, and other regulatory requirements.
- Improved data value and effectiveness in information management from private to public sectors.
- Digital innovation in the planning and building approval processes, allowing the automating or semi-automating of current manual procedures, and improved accuracy through automatic compliance assessment against regulations. The crucial technologies for the eSubmissions and eApprovals process are identified as follows:
  - » Digital data environment to capture, exchange, and deliver required planning and building approval information in a consistent format.
  - » BIM and Geospatial data as a digital process and data model for shifting 2D document-based building information, for applying and assessing planning and building permits, to integrated 3D digital information.
  - » Integration of BIM and Open Geospatial Consortium (OGC) standard data models, to connect information about physical, georeferenced, and ownership status of facilities required for planning and building approval.
  - » Automated compliance checking based on digitally represented regulations, which runs code-checking using machine-readable logic from regulations, for the planning and building approval.
  - » Blockchain technology, to strengthen security and

accountability, which could be a fundamental platform where digital submission and approval of planning and building permits occur.

» Cloud computing, to establish a centralised system to provide online services for applying, tracking, assessing, and managing planning and building permits, and to provide integrated networks and databases across relevant authorities.

5.6.3 DIGITAL LEGISLATION BY DATA61 AND COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION (CSIRO)

Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Data61 collaborated to develop a logic database platform for digital legislation: Regulation as a Platform (Data61, 2018).

The platform is designed to support digital regulation tools and services by converting regulatory rules into machine-readable logic and quality checking the rules.

It allows anyone to leverage the rule infrastructure and regulation data to develop tools or services to help reduce the compliance burden.

From this framework, construction laws and building regulations are available in a machine-readable format.

This could allow automating manual compliance checking of building permit applications against regulations, which, in turn, is expected to improve the efficiency and accuracy of the approval process.

It could reduce the building surveyors' workloads and save applicants time and costs (K. P. Kim et al., 2020). However, further development on this initiative has not been conducted.

6.6.4 DESIGNCHECK BY CSIRO

DesignCheck is a system for automated checking of building code compliance based on Express Data Manager (EDM) (Ding et al., 2006).

This system was developed by CSIRO in 2005 but is not currently active. It was designed to check two building codes (related to the disability codes): Australian Standard (AS1428.1): Design for access and mobility, Part 1: General requirements for access, and Building Code Australia: Part D3 – Access for People with Disabilities.

DesignCheck uses IFC 2x2 as a common model for building information, which is a subject of the compliance review.

EDM is a software integration platform that supports the interoperability of models defined by IFC.

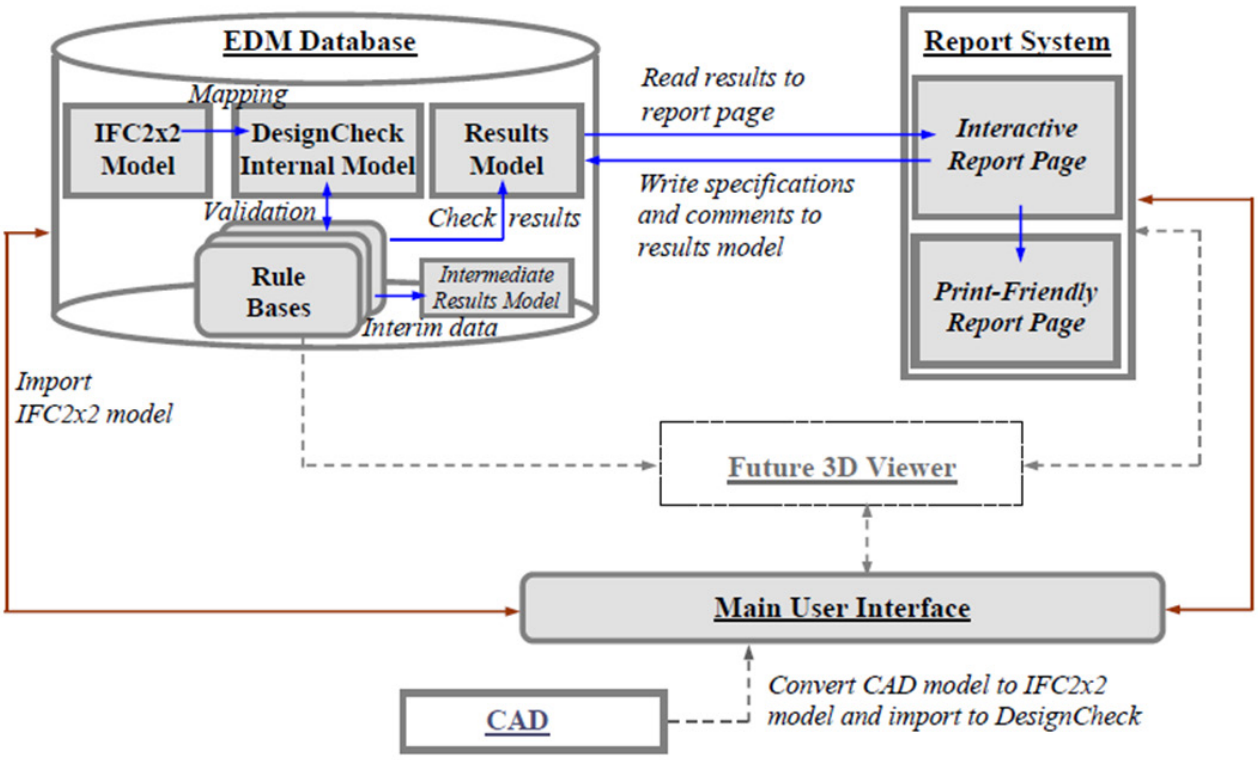


Figure 49: Architecture of DesignCheck System (Ding et al., 2006)

It was considered suitable for building code checking because it provides a publicly accessible definition language to represent building codes (Narayanaswamy, 2019).

In DesignCheck, EDM provides an object-based rule base for encoding design requirements from building codes, and links them with the building model from IFC.

IFC has limitations in incorporating application-specific information. DesignCheck used a mapping schema written in ExpressX language to transfer the building data from IFC format into the DesignCheck schema to enrich information requirements for code checking.

This system runs building code checking in ExpressX language that describes comprehensive design information together with building codes. It does not have the ability to view 3D models, and all reports are text-based.

DesignCheck has the advantage of supporting the ability to check for compliance at various stages in the design process, owing to its rule schema for early and detailed design stages as well as for specification.

It was targeted at architects and designers to support repetitive design compliance checks during design stages, rather than building surveyors/ certifiers for facilitating the building approval process (Shih et al., 2013).

DesignCheck demonstrated the capability of the IFC data environment as a platform for building code checking, although it focused solely on disability compliance without further rule extensions for other sections of the Building Code of Australia.

It is considered that its rule-based engine for interpreting the building code might cause difficulty for designers and non-computer experts to manage the rules.

The platform to define, change, and control the rules in human languages might be required to improve its practicality.

5.7 REQUIRED CHANGES

A technical evaluation of planning and building processes in Australia (Victoria and NSW) reveals challenges about the business process, data management and exchange, fragmented adoption of innovation, and lack of interoperability.

In the planning process, we found that insufficient information from quality and quantity perspectives compromises the transparency and timeliness of decisions.

Over time, several layers of planning legislations, including State Planning Provisions and local planning provisions, have been added to the process of decision-making.

This has resulted in a complex approval system with many layers of State and Local Government policies, standards, and requirements. However, the level of utilising digital technologies to address this complexity is insufficient.

In the development assessment process, there are numerous decision-making authorities and decision stages that can incur significant costs and delays as they navigate the system.

This study indicates that while electronic development assessment (eDA) in both planning and building industries has been investigated and planned over the last decade, it is not yet functional.

In the building approval and certification process, insufficient building surveyors, as compared to the amount of developments, has resulted in a heavy workload and increased cost and time.

Relevant to this issue is reliance on expertise of engineers' specific aspects of building work (i.e., structure, MEP) and, in many cases, the reliance on manual assessment and checking of building permit applications.

From a data perspective, there is a decentralised management of issued building permits by local councils, which also increases the workload and impacts the quality of services.

In addition, we found that inconsistent formats of lodged documents leads to inaccessibility of information stored in the councils. This creates a challenge in tracking records in line with design changes during building work, especially for staged permits.

From a technical perspective, our findings lead to defining high level building blocks of digital transformation in planning and building approval processes.

5.7.1 BUILDING BLOCKS OF DIGITAL TRANSFORMATION

Many public and private organisations are increasingly focusing on strategic thinking and planning for digital transformation (ITU, 2019).

Digital transformation is the sum of changes in method, focus and value (Singh, 2019). It is about using technology to connect and simplify processes to change the foundation of business and operations (Intel Business, 2019; Singh, 2019).

In the context of planning and building approval, our emphasis in on how digital services and applications will provide a better industry and citizen experience and improve the way we do business.

We also intend to focus our digital transformation to improving quality of life and wellbeing, and achieving Sustainable Development Goals (SDGs).

Recently, many organisations started accelerating their transformation journey enlightened by the global pandemic crisis (Laberge et al., 2020).

According to the International Telecommunication Union (ITU) – the UN's specialised agency for information and communication technologies (ICTs) – there are eight high-level building blocks to ensure a citizen-centric, industry buy-in, standard, and efficient digital transformation (ITU, 2019):

- Digital Strategy: It is important to note that digital transformation is more about strategic thinking and adoption of changes, and less about technology. As such, the successful transformation process depends on two critical dimensions: ubiquity and change. These distinct dimensions reflect the maturity level of organisations and play a significant role in the digital transformation journey:
  - » Ubiquity defines the extent to which digital services support all stakeholder requirements and leverage enterprise architecture for industries involved in the planning and building processes (government and private); and
  - » Change determines the degree and pace at which the sum of multiple stakeholders' interactions deliver digital services, including planning and building approval, to satisfy citizen or industry expectations. In this dimension, the interdependent ecosystem of regulation, policy, strategy, governance, skillsets, and shared goals is an important consideration.
- Value Delivery Ecosystem: this building block refers to the main actors and stakeholders who participate in the digital service lifecycle (ideation, planning, designing, deployment, and operation). In this ecosystem, the aggregators play an important role. In the context of ePlanning and eApprovals processes, aggregators collect information on required data, standards, and services from all participating stakeholders (providers) and make that information available in a digital platform in a way that is more consumable for the potential users (consumers). The aggregator's value is providing an attractive ePlanning and eApprovals ecosystem that all stakeholders see value in delivery of required data and services.
- Digital Service Attributes: Almost all digital services claim to have six fundamental attributes of services, delivery of which is aligned with our goals to address the challenges we identified in the project:
  - » *Personalised* services refers to designing and delivering services that suit user requirements and increase the satisfactory level of ePlanning and eApprovals digital service users.
  - » *Paperless* services refers to the two-step automation processes: 1) fully automated workflow of planning and building approval steps; and 2) step-wise automation of development assessment in both building and planning domains.
  - » *Cashless* services refer to digital transaction for services that have monetary dimensions, and requires an integrated ecosystem of regulators, financial institutions, banks, and payment mechanisms to work in tandem. This process is already in place for property information.
  - » *Presence-less* services are suggested for design to minimise the human interventions. Adoption of emerging technologies, such as AI, Machine Learning (ML), and Deep Learning (DL), will improve delivery of insights into users' behaviours through understanding the interaction patterns and increasing trustworthiness. These services should support encoding the behaviours into service design, maintenance, enhancement and improve the operations.
  - » *Frictionless* services in the ePlanning and eApprovals process refers to design and delivery of an end-to-end service. This is a seamless service to which users of a digital platform are not exposed, as all internal coordination and exchange of information takes place between different authorities and stakeholders, but they receive an integrated experience.
  - » *Consent-based* services refers to security and data privacy priorities as two of the utmost important aspects in this digital transformation process. Users must know what data is being collected, who is collecting it, who has access, and for what purpose.
- Digital Enterprise Architecture: This is a whole-of-process approach to support the integration of government and

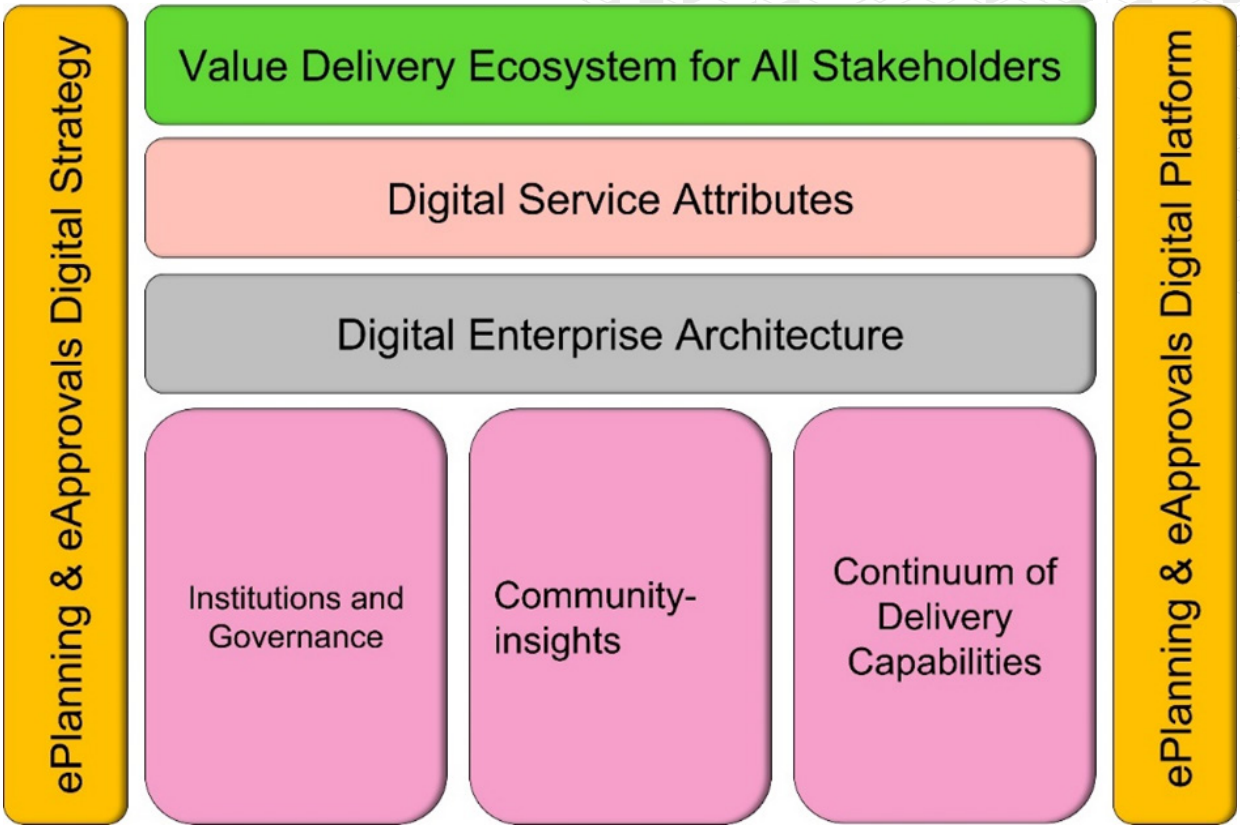


Figure 50: Digital Transformation Building Blocks in ePlanning and eApprovals process. Adapted from (ITU, 2019)

stakeholders, to deliver ePlanning and eApprovals services in a coordinated, efficient, and equitable manner. Several studies identified the Enterprise Architecture (EA) benefits for organisations (Wong et al., 2021). Jusuf and Kurnia (2017) adopted Shang and Seddon's (2002) benefit framework for enterprise systems, and conducted a study to develop an EA success factor and benefit model (EA-SFBM). Their findings suggested 37 validated benefits categorised in five domains: operational (e.g., increased efficiency and effectiveness); managerial (e.g., reduced complexity); strategic (e.g., provided priorities and options); IT infrastructure (e.g., increased interoperability and integration); and organisational (e.g., supported positive cultural change). These benefits are important considerations in the context of an ePlanning and eApprovals project.

- Digital Platform: This building block is the technology component that plays a role as the repository of planning and building data, validation engine, and other applications that should be built on a composable architecture (Panetta, 2020) to be resilient, flexible, and allow for rapid design, development, deployment and delivery of additional digital services. It is important to use standard and open interfaces so that the digital platform is available to all the key stakeholders (in the value delivery ecosystem) to build and use components. A digital platform is the result of enterprise architecture.

In addition to the five building blocks explained above, three foundational pillars of "institutions and governance", "citizen insights", and "delivery capabilities" are imperatives in the digital transformation roadmap (refer Figure 50: Digital Transformation Building Blocks in ePlanning and eApprovals process. Adapted from (ITU, 2019).

- Institutions and Governance: This pillar provides a necessary mechanism to push through the digital transformation journey. The institutions and governance encourage correct behavioural changes that will also contribute to success. An example is the Victorian ePlan project,[101] in which Land Use Victoria championed in testbed, and coordinated the design and development of digital land subdivision plans, implementing required software changes and engagement with key stakeholders. The first step in this pillar is identification of leaders and champions who are the key actors and who drive the digital transformation initiative. The second step is to ensure that all stakeholders sufficiently understand the vision and benefits of digital transformation. Finally, the coordination of IT and ePlanning and eApprovals business processes is very important. The role of standards and guidelines to encourage the innovations and improve the quality of services is also crucial.
- Community Insight: This pillar refers to insights from both digital services provider and user communities, and is at the heart of

[101] https://www.spear.land.vic.gov.au/spear/pages/eplan/about/victorian-eplan-implementation.shtml

digital transformation. New digital services will change the way stakeholders interact by adopting new rules and opportunities that were previously unthinkable. As explained in earlier sections, planning and building approval services deliver via multiple channels. Understanding the community insights will help with coherence and provide a consistent experience. Receiving the community insights will help with the promotion of new systems and capacity building, to change community behaviour and habits.

- Continuum of Delivery Capabilities: This refers to sufficient capabilities and flexibility to which to adapt, based on the users' readiness for accepting different levels of digital transformation. Different levels of transformation should be considered based on the urgency and readiness of each stakeholder:
  - » Urgency is the sum of external and internal demand pressures including, but not limited to: citizen expectations, legal and political mandates, and the risk of digital disruption in the stakeholder's core mission area.
  - » Readiness represents the stakeholder's current capabilities to respond to urgent demand pressures and to successfully execute digital initiatives.

Exploring the application of a step-wised automation process, based on an urgency and readiness assessment, will facilitate efficiency and accuracy of digital services.

A digital maturity model will also be useful. The ability to experiment and learn will help to define the continuum of delivery capabilities.

This needs an agile approach, which integrates the line of architecture, development and operations (Arch-Dev-Ops); an extension from DevOps.

5.7.2 IMPLICATIONS AND RECOMMENDATIONS:

- Given that different levels of governments (Federal, state, and local, as well as private industries) have already developed digital transformation strategies, or are in the process of developing and implementing digital platforms, the Building 4.0 CRC roadmap for ePlanning and eApprovals needs to be aligned with current initiatives, including Planning Information Services, VDAS, Digital Planning Principles, and Digital Twin Victoria/NSW.
- Local governments are at the forefront of providing services and interacting with both service providers and users (citizens). As such, ePlanning and eApprovals projects should start at the local level, in accordance with the existing contextual and local differences, considering their needs as well as local standards. A centralised digital approval system for reporting, monitoring, communication, data sharing, and tracking progress, is necessary for integration of local governments with other stakeholders.
- One of the major challenges in Planning Schemes is the discretionary aspect, which refers to the quality of space. In the development of digital planning systems, outcomes should be citizen-centric, and improve the places and efficiency of approval processes.
- Moving towards digital systems and automation creates challenges with security, privacy, and transparency. Digital decision-making systems should be interoperable and consider accountability, transparency, and trustworthiness.
- Designing digital platforms will change the culture, behaviour, and interaction methods of service providers and service users. Adoption of a design-thinking approach with user experience, to co-design, develop, and testbed digital planning and building approval infrastructure, should be a priority. It is also recommended that a step-wised automation for compliance checking process be adopted to facilitate efficiency and accuracy of approval (Developing a Maturity Model).
- In Australia, building standards and regulations (NCC) are less complex than planning. As such, a digital compliance check on building approval processes can be considered as a quick win.
- While the land administration domain model (LADM) is being designed, accepted and implemented in the international community, there is a lack of standard information frameworks for managing geometric and semantic information for planning and building approvals. In particular, there are a lack in planning application models, which hinders the process of digital transformation. As such, it is recommended that a planning application domain model (PADM) be developed.
- From an eDA perspective, there is a lack of alignment and coordination between planning and building approvals. The application of BIM, integrated with other 3D geospatial data standards, is necessary to bridge the gap in planning and building approval processes over the lifecycle of building design, construction and management.

6. STAKEHOLDER AND RISK ANALYSIS

6.1 STAKEHOLDER ANALYSIS BACKGROUND AND CONTEXT

Stakeholder analysis provides the research with a pragmatic and in-depth understanding of the digital modernisation process and its application within the real-world context of the Victorian development sector and permit application systems.

While the preceding sections focus on the broader structures and systems in which, on paper, this digitisation will occur, this section explores the real-world experiences and perceptions of a digital modernisation process from stakeholders who actively engage with this space day-to-day.

As a result of their fine-grain engagement and everyday experience, these stakeholder perspectives provide vital insights into the inner workings and potential pain points of the existing system that may not be apparent at a desktop level of analysis.

Furthermore, they highlight the nuances that exist in the different sections, aspects and professional inputs in the system, including project typologies, project timing in relation to other aspects, and different professional priorities and values.

These perspectives develop a rich and highly detailed understanding of the digital modernisation process, and will assist in the identification of the most effective and advantageous avenue for implementation of the change.

For this research, the stakeholder analysis focused on the following three deliverables:

- document the needs and requirements (drivers/barriers) of stakeholders;
- risk analysis to identify the possible risks in adopting a digital modernisation process; and
- identify ways to encourage industry and other stakeholders to transition to the new system.

Qualitative interviews enabled the research a greater freedom to investigate and explore, in fine detail, elements of interest that different stakeholders held towards the policy and its production (Richards, 2015).

A semi-structured process enabled the interview to further engage with topics introduced by the participant. and offered the participant greater ability to be actively involved in the interview structure through the level of information that they felt was required by a topic (Bryman, 2016).

The prior establishment of broad questions, and themes required in a semi-structured interview, provided the consistency necessary for analysis between different interviews (Richards, 2015).

These questions centred on each stakeholder's perception of the drivers and barriers for a digital modernisation process in Victoria, potential risks from this change, and why they considered these aspects important to their sector of the industry and/or profession.

Fifteen online semi-structured interviews were conducted over a three-week period with architects, building surveyors, developers, statutory planners, and policy planners. The results of these interviews were complemented by ten presentations and informal discussions with project industry partners on the same issues. Following transcription, the results were thematically analysed against the project deliverables.

The findings were supported by a comprehensive literature review that included case studies and examples from over 15 countries. This literature review found a dominance of the assessor and planners' perspectives on the issue of digital permit systems, and a gap in knowledge from the applicant and architects, developers and other consultant perspectives.

Addressing this gap in user understanding is vital to the holistic understanding required for the successful design and implementation of a system, particularly as architects and developers play a key role in the development of the digital data for use in the system (Juan, Lai and Shih, 2016).

The scoping interviews conducted for this research sought to gather a broad understanding of the scope of this applicant perspective gap in knowledge, and identify important directions for further analysis.

They are by no means comprehensive or complete, but instead, introduce the potential issues that may be raised in relation to a digital modernisation process.

7.2 STAKEHOLDER ANALYSIS TO IDENTIFY DIRECT USERS

Table 6: List of stakeholders in the planning and building approval process in Victoria as outlined by the regulatory mapping in sections prior.

Key stakeholders	Responsibilities
Landowner and Landowner's agent	Instructs the permit application documentation and submits this for assessment. An agent, such as an architect or structural engineer, can oversee and manage the permit application on behalf of the landowner in addition to their own production of the relevant documentation for the application. In this instance, this 'superintendent' then manages all further requests for information from the permit assessors and coordinates all responses from relevant consultants.
Planning Responsible Authority	Manages the day-to-day administration of the local planning scheme. They consider and determine applications for planning permits, ensure consistency with the planning scheme and enforce conditions incorporated in planning permits. Responsible authorities are usually local councils, but some schemes can proceed to the planning minister and his statutory team.
Relevant Building Surveyor (RBS) (local council building inspector or private building inspector)	Either a municipal or independent commercial inspector. They are responsible for assessing and issuing the building permit and occupancy permit. Throughout the build process, they will conduct mandatory inspections of the construction at designated build stages to ensure that construction matches documentation.
Development consultants (Architect and/or building designer, civil/structural engineer, Façade engineer, Mechanical engineer, Electrical engineer, Fire safety engineer, Landscape architect)	Prepare the permit application documentation in accordance with the relevant building and planning permit application requirements and regulations. Respond to any further requests for information and amendments.
Land Surveyor	Prepares plan of subdivision in accordance with Subdivision Act and Regulation. They create titles on newly constructed buildings or amend titles according to the changes of building typologies.
Referral authorities (Heritage Victoria, EPA Victoria, DPCD, Liquor Licensing Commission, water catchment management authorities, VicRoads and Melbourne Water)	A referral authority can be any person, group, agency, public authority, or other body specified in the planning scheme or the Act, whose interests may be particularly affected by the grant of a permit for a use or development. They advise on planning permit applications that potentially impact upon their remit.
State government planning authorities	Develop and amend planning schemes to give direction on how broader state planning policies will be achieved or implemented in the local context.

Key stakeholders	Responsibilities
State government planning authorities	Develop and amend planning schemes to give direction on how broader state planning policies will be achieved or implemented in the local context.
Australian Building Codes Board	Develop and amend the national construction code to set the requirements and regulations of building development approvals in accordance with the Building Act. These regulations include the health, safety and sustainability minimum standards to be met by the development
The Minister for Planning	Has the overall responsibility for the state's planning legislation and framework. The minister has the power to grant exemptions from complying with legislative requirements, make directions to planning and responsible authorities, approve planning scheme amendments, and review cases where there is an issue of state policy. The minister is also the planning authority and responsible authority on an ongoing basis for several designated areas throughout Victoria.
Department of Environment, Land, Water and Planning (DELWP)	Manages the regulatory framework for land use planning, environmental assessment, and subdivisions of land, and provides advice on planning policy, urban design and strategic planning information on land development and forecasting. The department manages the ongoing development and maintenance of the Act, Regulations and the Victoria Planning Provisions on behalf of the Minister for Planning and provides guidance to the sector in relation to planning issues. The department also supports the Minister for Planning to fulfill their responsibilities under the Act.
Local municipal council	Undertakes the roles of planning and responsible authorities, represents the interests of local communities, and responds to constituents' concerns.
Planning Panels Victoria	Manages the conduct of individual panels which are appointed by the Minister for Planning under the Act and the Environment Effects Act 1978.
The Growth Area Authority	Guides sustainable development in Melbourne's five outer urban growth areas. It is an independent statutory body established by the Victorian Government in 2006, and works in partnership with local councils, developers, and state government agencies. The authority aims to facilitate greater certainty, faster decisions and better coordination for all parties involved in the planning and development of Melbourne's growth areas.
Advisory committees	Advise the relevant planning authority or responsible authority. They are generally established to consider site-specific proposals or general policy matters. The Priority Development Panel for instance provides advice to the Minister about how significant proposals can be best presented to facilitate approval.
The Victorian Civil and Administrative Tribunal (VCAT)	Deals with disputes relating to planning decisions. Parties aggrieved by the planning decisions of responsible authorities may appeal to VCAT for a review of the decision. VCAT is an independent review tribunal and its decisions are legally binding.
Neighbours and community groups	Parties affected by the development. Objections to the proposal are able to be made during the planning permit process via the third-party appeal process and must be in accordance with the rights and requirements of the planning scheme.

6.3 NEEDS AND REQUIREMENTS OF STAKEHOLDERS

A series of scoping interviews with industry identified multiple stakeholder drivers and barriers in the introduction of a digital permit system.

These are centred around potential avenues for application and the different typologies deemed suitable or not for inclusion.

This section will discuss the potential applications of an administration system, E-Development Assessment (E-DA), data to better inform policy decisions, and a series of minor considerations raised.

In each instance, the drivers and benefits identified were accompanied by warnings regarding areas of concern and possible difficulties to avoid, at times by the same participant or members of the same profession, and at other times a different perspective offered by a different profession.

6.3.1 POTENTIAL APPLICATIONS

6.3.1.1 ADMINISTRATION SYSTEM

An administration system was identified by each user in the scoping interviews as a vital and easily achievable opportunity to save time on a variety of basic bureaucratic or mundane repetitive administration tasks.

A system that processes, files and verifies applicant data into the application pipeline could lead to significant time savings in applications, and potentially reduce resourcing strain in many areas.

For building surveyors, the reduction or insufficient quantity of administration staff to manage the growth in housing applications was identified as slowing application processing times (participants 12 and 13, building surveyors).

For planners, participant 7 (planner) noted that it could enable greater time to be spent on higher-level qualitative assessment components of the application.

For architects, this would help in the coordination of consultant materials as the project manager (participant 2), and prevent the loss of information that leads to unnecessary and time-consuming 'Requests For Information' at later stages (participant 4).

A developer highlighted that such a system could enable a more specific resubmission process, with only those drawings or documents that need amending required to be revisited by applicant and assessor, rather than the whole package afresh (participant 14).

These resourcing gains from the automation of basic bureaucratic tasks across all professions is supported by the literature (Al-Ashmori et al., 2020; Devlin, 2020; Van Tam et al., 2021; Arunkumar, Suveetha and Ramesh, 2018), with the addition of potentially avoiding human errors that come from tedium and improving consumer experience (Daniel and Pettit, 2021; Velibeyoglu, 2010).

For developers, planners and building surveyors, participants all emphasised the potential benefits of increased transparency gained from such a system.

Both a planner (participant 8) and developer (participant 14) spoke of the reassurance of a system that communicates that the application has been received and the statutory clock had begun for developers whose projects run to tight time schedules.

The planner noted that in this case, developers were the target user and the design of various existing systems had focused on assisting their ease of use foremost.

A building surveyor (participant 13) additionally highlighted that this increased transparency of application processing in local councils from administration systems had exposed and led to the rectification of various time-consuming faults in their system.

It had also highlighted that professional assessment was not a significant stage of time delay, which had removed assumed blame from applicants and encouraged better communication of timelines to clients.

6.3.1.2 E-DEVELOPMENT ASSESSMENT

Planners (participants 7 and 8) also spoke of an 'initial completeness' check that could be completed by the applicant during submission.

At a minimum, this could involve simple prompts to ensure all information is uploaded into the system, or alternatively an automatic code compliance assessment system or E-Development Assessment (E-DA), which would evaluate all model components (for example: building heights or room sizes) against metric regulations.

It was speculated that this system would raise potential issues with the applicant's submission early, and ask them to consider whether they would like to continue with the submission in this format, with the increased likelihood of rejection by the professional assessor, or if they'd like to withdraw the submission for revision.

If this system had statutory support, a developer (participant 14) noted that time saving could reward increased investment in documentation at this stage, while two architects (participants 3 and 5) speculated that

this time could be reallocated to the time-pressured design stage of the project.

Two planners (participants 7 and 9) also emphasised that it would assist assessors to better manage applicant expectations and frustrations, as significant project time and costs are spent waiting on an assessment, only to find that it is incomplete in a minor way mid-way through the process, and resubmission is required.

The architects (participants 5 and 2), by comparison, focused on a non-statutory but in-house guidance system.

The ability to immediately test new designs for approximate compliance would free up resources typically spent on this process by design consultants, and enable greater time to be spent on qualitative elements of design.

Additionally, if this testing could occur in real time for the designer, it would facilitate design changes to occur before significant time and resource investment has occurred by both the design firms and the project client, as opposed to having to document and wait for professional assessment.

Correlating the literature (Van Tam et al., 2021; Shahi, McCabe and Shahi, 2019; Beach et al., 2013), it was highlighted that this real-time guidance could encourage better design outcomes and greater design freedoms from known compliant designs, as clients are reluctant to risk time spent on unknown assessment outcomes or design changes once there is significant investment and confidence in one scheme (participant 5, architect).

The literature also highlighted how 3D E-DA could promote early information sharing and collaboration between consultants, and potentially reveal design clashes between consultants at an early stage when it was easier and more cost-effective to rectify (Al-Ashmori et al., 2020; Georgiadou, 2019).

It was stressed, however, that this system should not replace or introduce assessment into permit pre-application meetings, as these were valuable sites of design collaboration between all consultants due to their non-committal nature (participant 3, architect).

An architect (participant 5) expressed caution that the potential time and resource savings from E-DA might not be as great as expected as the system could raise expectations of the quantity of information required at the permit assessment stage.

They had already anecdotally observed an increase in information required over the past 20 years of practice to manage litigation risk, and felt that an E-DA could potentially exasperate this trend.

The literature highlighted that, for planners, this inability to increase efficiency may be caused by the continued need for auditing and human evaluation in the system (Devlin, 2020).

A developer, (participant 14) also noted that without statutory status for BIM models, 2D documentation would still be required, and these high-quality models would be an additional level of compliance to be produced by the documentation team who are already working within overly-constrained margins at this stage.

They described E-DA as potentially a 'Hollywood BIM', a showcase distraction that adds little value or savings to built environment practices if systems are digitised for the sake of digitisation without understanding or evaluating the reasons for introducing such a change.

6.3.1.3 DATA FOR POLICY DECISION-MAKING

Another use for a digital modernisation process highlighted by planners was assisting with scraping aggregate data from projects to improve government policy decision-making.

Participant 11 (planner) noted how data on different project characteristics on the aggregate level, such as quantities of approvals in locations or building typologies, could better inform government decision-making and provide the evidence necessary to support decisions made.

Although planning assessment data has a long tradition of use in policy decision-making, the planner noted that this was anecdotal, and if statistics were less onerous to gather and generate reports, then their use to inform decisions may become more prevalent.

London's data hub is an example of such an application that captures smart data to measure how a project contributes to an area's annual housing growth targets.

The hub captures the proposed increase in residents in the area, as well as the tenure, building type, and bedroom number mix from applications, and graphs this against the area's targets.

As a result, planners and the community can see how this proposed development contributes to a larger strategic aim for the city, and it communicates a greater justification for urban change than simply responding to them developing individually on its merits and design without this context, as currently occurs in community consultation.

Daniel (2020) also notes that the rapidity of city change, with development as a growth industry, has prompted needs for a system to monitor interactions and trade-offs that are being instigated.

Another planner, participant 7, noted the importance of this data being public infrastructure and open source.

The ability to use the data in academic research and other instances of public good was key to its utility and gaining

the most from this data. Conversely, ownership and development by private developers was cautioned, as it may lead to a monopolisation.

The literature also warned against government over-reliance on private technology companies, and if a monopolisation was to occur, there may be detrimental consequences for data and system utility for public needs that don't align with those of private industry (Devlin, 2020; Duhr and Gilbert, 2020).

6.3.1.4 OTHER POTENTIAL USES:

Other potential drivers and benefits for the system touched upon in the interviews were: streamlining environmental sustainability testing; assistance with building survey auditing requirements; and resource scarcity and re-use potential business case.

These are outlined in further detail below, but would require further investigation to adequately understand their suitability.

Environmental sustainability assessment in built environment construction and products is currently diverse and piecemeal in its approach in different councils in Victoria.

An architect (participant 2) noted that an E-DA could simplify and streamline environmental sustainability assessment for applicants and, consequently, provide greater transparency for consumers.

It was agreed that the technical nature of environmental sustainability assessment was highly suited to this approach, as requirements were measurable, performance-based, and the complexity of testing was often beyond human capacity without errors (participant 5, architect).

The VBA's introduction of auditing requirements for building surveyors in 2021 had placed large time pressures on senior managers to assess and sign-off on the quality on all their team's assessments.

This was adding to already increased bureaucracy and reporting measures, while reductions in resourcing had also occurred.

A building surveyor (participant 12) noted that since these pressures were specifically being felt at senior management levels, this could encourage uptake by surveyors to help with better auditing and project scheduling purposes.

Another building surveyor (participant 13) noted that a digitised system would assist reviews, such as what occurred with the recent flammable cladding recall, where the predominantly paper-based documentation had impeded and delayed the evaluation of all applicable projects.

Finally, digital models could also demonstrate the value of renovating structures and reclaiming material within projects to encourage greater sustainability measures in the building industry.

An architect (participant 4) noted that the predominant perception is that it would be more economic to demolish an existing structure in full and begin afresh, rather than repurposing what is already on site.

They speculated that this cost-benefit analysis of renovation will become even more critical as resource scarcity increases and it is no longer feasible to always build new.

6.3.2 OTHER POTENTIAL USES:

While multiple potential applications for a digital modernisation process were identified in the scoping interviews, the broad-scale application to all built environment typologies was contested by different participants. Instead, certain typologies were viewed as more suitable and advantageous for inclusion, but areas of concern and caution were still raised for each.

6.3.2.1 LARGE SCALE DEVELOPMENT

Large-scale developments, such as phased apartment or office tower schemes, were identified by building surveyors (participant 13 and 12) as the most effective typology to introduce to a digitised system, due to the sheer volume of documentation included in these projects.

For assessors, this large volume had time and cost implications for processing the application, distributing it to referral authorities, and storing these projects if paper based.

Participant 13 also proposed that a digital system would be attractive to developers of this sector of the market, as these large-scale developments had large holding costs from delays, and were typically conducted by large development firms that were already advanced in digital systems.

A developer (participant 14), however, noted hesitancy to be the first to

uptake new government initiatives that promise 'fast-tracking', due to their poor management and longer delays that had occurred in the past.

The importance of system inter-compatibility was also stressed, as firms who were advanced in digital systems had made investments in these systems that they were reticent to abandon.

Moreover, firms were also reluctant to openly share their project files within the same system, and expressed a need for data privacy, particularly from assessors, as developers wished to control the narrative displayed to assessors and not allow free access to all of the project's working information (participant 13, building surveyor).

As a sidenote, public data privacy was raised as a non-issue by a building surveyor (participant 12), as they felt that existing privacy legislation would continue to provide sufficient governance, and staff were already well trained and experienced in data privacy protocols.

6.3.2.2 VOLUME RESIDENTIAL GREENFIELD

Volume residential greenfield typologies, where the product is small in scale but repeated in multiple thousand lot phases, were also identified as another potential area of focus for the digital modernisation process.

These projects were deemed as having a low design risk by multiple participants, as the scheme is already guided by the consensus achieved through extensive master planning and subdivision consultation with local council, design consultants and the community (participant 2, architect, and participants 7 and 10, planners).

Participant 2 felt that volume residential did not have onerous regulation requirements additional to the master plan, and these projects could greatly benefit from predictable timelines offered by E-DA.

It was also noted that the resource pressure of manually assessing individual applications within this typology was an unnecessary burden for local councils who had already participated in the prior consultation.

Participant 10 (planner) also proposed that these conditions also applied to industrial estates, and felt that similar automation procedures could also be applied to this typology.

The accumulative impact of E-DA for the volume residential typology, however, was contested by different participants.

Concern was expressed that the predictability of such a system could encourage standardisation in design, as either the most cost-effective design to meet compliance evolved or restrictions in the software (participant 5, architect).

The resultant repetition in streetscape this produced was felt by some as cause for concern, others as consistency that afforded character, and for others, the result was dependent on the place.

One planner (participant 10) noted that the design criticisms were those generally made of greenfield volume construction, and that the automated compliance had simply continued and not addressed or improved these poor elements of design in the typology.

Participant 7, planner, further noted that this accumulative impact must be recognised and reflected in the regulation requirements.

While a specific metric – for example, for impervious land cover –may be acceptable at a lower level individually, when consistently applied in multiple instances in the same location, this can have significant unintended consequences.

Additionally, when metrics apply across a range in lot sizes, i.e., 150-300sqm, problems were raised if multiple instances occur at the upper threshold of this range i.e., 290sqm lots (participant 10, planner).

Two architects (participants 5 and 9) proposed that consumer-felt pressures like housing affordability could, however, be eased through the economies of scale that can be achieved through standardisation.

6.3.2.3 SMALL-SCALE, BESPOKE PROJECTS

The inclusion or targeting of small-scale, bespoke projects and the firms that focused on this work was also contested.

Two architects (participants 5 and 4) noted that smaller design firms and consultants tend to exclusively focus on this typology in either residential, commercial or retail sectors, due to the reduced software licencing costs and technical capabilities that these typologies require.

A widespread introduction of digital applications or digitising these particular typologies, they felt, may place unmanageable pressures on these firms and risks losing consultant knowledge and diversity in Melbourne.

Charef et al. (2019) note the need to be mindful that the business case for the introduction of an automated system may not be positive for some smaller firms.

A building surveyor (participant 13), however, felt that past digitisation and industry-wide changes had the benefit of eliminating smaller surveying firms, described as 'dining top surveyors', who did not upkeep the same levels of professional development, had lower overheads, and were undercutting larger firms.

Additionally, research on Brisbane's digitisation strategy, which targeted small to medium firms, found that the initiative assisted smaller businesses to increase their economic productivity through behavioural changes that they otherwise would not have done (Alizadeh, 2017).

6.3.2.4 ESTABLISHED AREA INFILL PROJECTS

The location of projects and associated relationship to neighbours was also highlighted as a further point of consideration in deciding which typologies were suitable to a digital system.

Greenfield residential projects were championed as highly suitable, not only due to their rigorous masterplan support, but also due to the lack of existing neighbouring residents who could object to the proposal (participant 10, planner).

Residents of the community, instead, 'buy into' the proposed development, and are still able to make choices to another development if they object to a certain design quality in the proposal. Established areas, however, must negotiate the objections of existing neighbouring residents who will be impacted by the proposal.

Third-party appeal rights were noted by a range of participants to be the greatest source of delay and uncertainty in the permit assessment schedule by a significant quantity, and a satisfaction with the timeliness of professional assessment was expressed in comparison (participants 5 and 3, architects, participant 10, planner, and participant 14, developer).

For a digital modernisation process, this delay and uncertainty has consequences for model completeness at the permit application stage.

The permit application initiates the third-party appeal process, whose objections can cause significant changes to the design and documentation of a project.

Due to this timing, a developer (participant 14) outlined how it was unfeasible to significantly invest in project documentation at the stage of permit application, due to the high risk of design change still present. Instead, BIM models for permit applications were typically limited to basic massing models, with an insufficient level of detail and project resolution for extensive or automatic assessment.

If further detailed digital models were required at this stage, they noted that this documentation investment was unlikely to gain return, as there were currently no issues or delays due to insufficient information for professional assessment, but a high probability that this higher cost model detail would need to be changed or redone due to changes as a result of third-party objections.

The developer (participant 14) felt that it was difficult to do established area infill development that was 100% compliant to all planning and building requirements, and avoid upsetting local residents in the area.

The subjective nature of this part of the permit application process was heavily criticised, as the project was seen to move from an empirical and logical assessment process with professional assessors to a more subjective and less rigorous evaluation through town council meetings (participant 14, developer and participant 9, planner).

Councillors were presented as not being professionally trained in design or assessment, but being time poor and influenced by election cycles.

The increased time for an application in proceeding to town council meetings, not particularly in planner's time but in project delay, was noted, as was the arbitrary trigger of a certain quantity of objections that had been received.

One planner (participant 8) noted the practice of door knock petitions occurring to gather this required quantity of objections, often with complainants not living in the immediate area of the proposal, unaware or misinformed of the implications of their objection, or with unrealistic expectations that their objection would cease all development.

As a result, it was noted as common practice to put in ambit claims to bypass the third-party objections stage of the process and, by association, the professional assessment at local council, and proceed straight to legal proceedings at VCAT to save time (participant 14, developer and participant 5, architect).

This bypass practice, or 'gamification' as it was described by the developer participant, has implications for a digital modernisation process in that it could reduce the use and significance of the part of the permit application system where digital modernisation would be located, unless the reasons for avoiding this stage are addressed.

A planner (participant 9) speculated that without addressing third-party appeal rights, E-DA 'would not get far.' Another planner (participant 7) speculated that an E-DA without the mediation of local planners could further aggravate third-party objections, unless community trust and transparency of the system was properly managed.

Participant 11, planner, highlighted that this trust was associated with the reassurance that the voice of the community was being heard in planning, both strategic and statutory, and that this would still need to be addressed in a digital system.

The developer (participant 14) did, however, support a mandatory requirement of as-built project models to a government library at project completion, as this documentation was already being done and would reduce site survey needs for future projects.

6.4 POSSIBLE RISKS IN ADOPTING A DIGITAL MODERNISATION PROCESS

6.4.1 APPLICATION TO THE VICTORIAN PLANNING SYSTEM AND RISK TO THE AUTHORITY OF QUANTITATIVE ASSESSMENT

This research has found a series of benefits for a digital modernisation process and introducing E-DA in the early stage of permit assessment.

Multiple interview participants, however, highlighted the difficulties in applying this system to the Victorian planning system specifically as opposed to the building permit system, and the consequent risks overcoming these challenges may pose for achieving good design outcomes.

The complexity of the Victorian planning system was strongly emphasised as a significant hurdle to overcome in the development of an E-DA.

The large quantity of combinations possible in zoning and overlays, with further incongruences with Precinct Structure Plans (PSP), has hindered previous attempts by local government to develop such a system.

One planner (participant 8) noted their failure to develop a system that automatically selected, assessed and approved the simple applications that are without an overlay, and do not need a permit.

They also noted that the volume of PSP in greenfield areas, and the statutory requirement to review these plans every five years, further extended the difficulty to design such a system.

Furthermore, the continual addition of new policies from multiple government departments, and their occasional tensions to other policies due to different prioritisations, added further complication (participant 10, planner).

As a result of this complexity, this participant's local municipality had reduced the scope of automation developed, and still needed to retain the manual mode of assessment with a system to manage both modes effectively, as there were always projects that did not fit their basic automated system.

Another planner (participant 10), who had been in the development of another pilot system, outlined how some regulations and their definitions had been found to be unclear and hard to consistently navigate by applicants, and had resulted in projects returning to manual methods of assessment.

It was proposed that to better manage this complexity, the development of an E-DA should selectively focus only on specific sections of the Victorian planning system (participant 10, planner).

It was advised that this focus should be on the quantitative sections, whether mandatory and discretionary, which are best suited to automated assessment, as they are measurable and objective.

Both an architect (participant 6) and planner (participant 9) noted that selectively targeting and separating out the quantitative planning regulations into a digital system could provide distinction between quantitative and qualitative regulation types in the planning system assessment.

This distinction, both noted, would facilitate greater clarity of the difference in approach and purpose between the two forms of assessment, and therefore provide greater transparency and confidence for applicants.

Multiple architects, however, cautioned that this quantitative automated component of assessment must still be complemented by a qualitative assessment (participants 6 and 2).

They described how a planning assessment is intended to be more than simply regulation compliance validation, and that, instead, it is the result of a 'combination of the art and science of town planning', in that regulation needs to be accompanied by design thinking to recognise and promote good design (participant 6, architect).

While a proposal may meet each metric regulation separately, this does not necessarily guarantee a good design outcome. Instead, the 'layered look and feel' of these regulations, and how the 'trade-offs were managed' in the project as provided by design and recognised by qualitative assessment, are vital components in creating quality spaces (participant 2, architect).

An example was given of a design project that had met all regulations for wind exposure and yet the turbulence, coupled with the shaded siting, resulted in café seating that was inhospitable and seldom used.

While compliant, this poor design resulted in the project being unable to realise the value of the significant investments spent on landscaping and community use.

It was highlighted that the design thinking of qualitative assessment was particularly important for matters of heritage, where stricter adherence to quantitative regulations could lead to greater protection of old buildings, but also a formulaic response to

Melbourne's design legacy, without consideration in response or necessarily good places (participant 6).

Leveraging this design legacy, as well as the equally hard to measure collective memory, into quality design places was emphasised as critical for creating distinctive cities and realising the economic value this brings.

Participant 2 (architect) noted that in introducing an E-DA, it was vital to instigate measures to ensure this did not lead to reductions or removal of the qualitative component of the assessment.

They noted the risk that the clarity and certainty of success from such a system could be misinterpreted – that the replacement of qualitative assessment by quantitative measures could successfully meet calls to simplify the planning system.

It could encourage the pursuit of compliance, only to obtain the permit and the financial benefits associated with a fast approval, rather than reward good design and its value to the project in the long term.

Moreover, a planner (participant 9) highlighted that while these financial gains may encourage, in some instances, development innovation, such as build-to-rent initiatives, this prescription also runs the risk of restricting other avenues of development innovation, and so a rationalised balance between the two is required.

6.4.2 RISKS FROM INADEQUATE SUPPORT WHEN INTRODUCING THE DIGITAL SYSTEM

Caution was expressed by various stakeholders of the importance of providing adequate support to industry when introducing a digital system. In the literature, this was listed as vital to the uptake and successful implementation (Daniel, 2020; Daniel and Pettit, 2021).

A developer (participant 14) noted that the permit stage of approval was already under significant feasibility pressures, and that a poorly communicated or overly complex system change would be 'detrimental to a fragile supply chain' and the viability of developments.

Alternatively, others raised concerns with the reduction in application and assessment quality without sufficient support and training.

An architect (participant 4) warned that applicants and their consultants may not be able to see the value or manage the change, and so applications provide only what information is required to pass submission and not the rich and helpful information intended to improve assessments.

It was also noted that designer understanding of drawing conventions could also decrease, as designers become better equipped in 3D communication knowledge, but defer to the computer output when this project is translated to the 2D documentation necessary for statutory assessment.

This translation illegibility further complicates assessment for planners, and can be exasperated by the sheer volume of communication differences that may result from ill-trained uptake across the entire design industry (participant 5, architect).

A building surveyor (participant 12) noted the typical criticism that a checklist or automated system could decrease assessor understanding of the project as a whole, and would eventuate in applications restricted to the quantitative requirements only – but that, again, this risk could be managed through sufficient training and support.

The literature also highlighted recurring risk that could occur from insufficiently resourcing the introduction from a scheme and policy perspective.

The rapidity of technological advancements could easily outpace meaningful policy integration without care, and could result in policies being applied retroactively, rather than proactively (Goodspeed and Hackel, 2019; Alizadeh, 2017).

This, in turn, limits the utility and further application of this policy to guide new technological advancements, and only exasperates the problem.

For this policy-tech integration to properly occur, support is required for implementation personnel and value education at management levels to ensure that this support is provided (Russo et al., 2017).

7. CAPACITY BUILDING AND TRAINING

7.1 CAPACITY BUILDING AND TRAINING

7.1.1 WAYS TO ENCOURAGE INDUSTRY AND OTHER STAKEHOLDERS TO TRANSITION TO THE DIGITAL SYSTEM

The literature highlighted four avenues to potentially encourage industry acceptance and uptake of a digital modernisation process. These suggestions correlate with the advice of one participant (participant 7, planner) who had advocacy experience. It is important to note that these recommendations are in addition to, and do not include or extend to, the unique drivers, barriers and risks identified by the research scoping interviews, and that further research is required to make recommendations on these identified issues.

7.1.1.1 DATA REQUIREMENTS AND SYSTEM DEVELOPMENT SUGGESTIONS

Suggestions as to how greater uptake of a digital system could be facilitated often revolve around specific data requirements.

The required data often exists in the wrong format, timescale and resolution for integration (Noardo et al., 2020; Duhr and Gilbert, 2020; Eadie et al., 2015) and requires tedious data cleaning or significant time investment to be useable (Deal et al., 2017; Russo et al., 2017).

Currently available data was criticised for being fragmented across departments and levels of government, leading to a recommendation that data needs be considered earlier in the strategic cycle (Duhr and Gilbert, 2020).

This challenge was also raised in the interviews, with comments on data mismatch between contemporary and historical spatial record-keeping methods, the difficulty to digitise handwritten historical information through efficient methods of data scraping, and the ongoing need and therefore the resource implications associated with data maintenance for accuracy (participant 13, building surveyor).

Recommendations include more efficient data collection methods (Daniel and Pettit, 2021), greater transparency regarding the sources of data used in the system, and recognition of the need for ongoing data updates and monitoring practices (Daniel, 2020; Lock, Bain and Pettit, 2021).

A common aim is also to ensure that the data being collected be better integrated with policy, and adequately fit to fulfill their intended use (Daniel, 2020; Duhr and Gilbert, 2020).

Alizadeh (2017) stresses the need for a close alignment and integration of digital systems into wider government policy directions, to ensure the continued relevance to government directions.

The points relevant to government are also echoed in Williamson and McFarland's (2015) proposal, that data practices and digital technologies be centralised or in some way standardised.

Building upon these data barriers, the literature also stressed frustration by planners that the technology was not fit-for-purpose.

Digital systems and development have, to date, predominantly focused on complex urban technologies to complete complex tasks, including future scenario planning (Klosterman, 2012). However, these systems have lacked the sufficient detail and complexity to provide meaningful analysis in wicked problems (Van Tam et al., 2021; Williamson and McFarland, 2015; Juan, Lai and Shih, 2016; Salama and El-Gohary, 2011).

These systems have also lacked flexibility to translate regulation into a computer executable code, or allow local edits or updates to the system (Beach et al., 2013; Ismail, Ali and Iahad, 2017).

Criticisms also exist that interfaces have also been designed without consideration of the intended user of the technology and their technology capacities (Al-Ashmori et al., 2020; Kitchin, Young and Dawkins, 2021). Nor have systems addressed basic bureaucratic tasks where the most significant areas for planning efficiency improvements could be made, but instead focused on commercial functionality or more showcase research questions (Klosterman, 2012; Daniel and Pettit, 2021; Kitchin, Young and Dawkins, 2021).

Greater consideration of user requirements was identified as a critical component of a digital modernisation process. Involving planners in the co-design of digital systems was a common suggestion (Punt et al., 2020; Goodspeed and Hackel, 2019; Russo et al., 2017; Williamson and Parolin, 2013).

Web developer training was also highlighted as a way of ensuring the system designers understand the users' needs enough to create tools and systems that are fit-for-purpose (Vonk and Geertman, 2008). Sentient systems, which can respond and adapt to evolving users and data, were emphasised (Deal et al., 2017), while those that fill the gaps in existing systems, instead of starting completely from new, encourage user familiarity (Malsane et al., 2014).

Aside from systems developed with an awareness of user needs and capabilities, digital systems that can adapt to local context and regulations, and readily incorporate data from more qualitative forms of engagement like social media, were also strongly endorsed (Russo et al., 2017; Jiang, Geertman and Witte, 2021).

7.1.1.2 ORGANISATIONAL LEADERSHIP AND CHANGE

Resistance to change within the senior management level is a barrier within both the planning and construction industry to adopt digital system changes (Charef et al., 2019; Al-Ashmori et al., 2020; Daniel and Pettit, 2021; Juan, Lai and Shih, 2016).

Organisational structures and senior management can challenge the adoption of digital systems, as they can cause the abandonment of projects and eventual cancelling of investments for the system (Velibeyoglu, 2010).

This barrier can be overcome through the encouragement of workplace cultures that welcome and value opportunities for learning and innovation (Daniel and Pettit, 2021; Williamson and Parolin, 2013). Structural changes to workflow practices can help facilitate this shift and better accommodate any new technologies introduced (Daniel and Pettit, 2021; Kitchin, Young and Dawkins, 2021).

Geertman et al (2015) specified that efforts are required to design institutions around digital systems, since these tools have limited inherent utility otherwise.

The need for technologies to enhance or complement planning capabilities, rather than replacing or adding to practitioners' tasks, was also emphasised (Lock, Bain and Pettit, 2021; Vonk, Geertman and Schot, 2005).

Other necessary contextual factors that were emphasised include the need for funding and legal support (Goodspeed and Hackel, 2019), as well as supplementary, tailored support for small and medium businesses who tend to face greater implementation barriers (Charef et al., 2019; Al-Ashmori et al., 2020).

Despite clear organisational barriers, there is a consensus among planners that new technologies will play a key role in the future of their work (Velibeyoglu, 2010).

7.1.1.3 EDUCATION AND TRAINING

The need to encourage users' awareness of and familiarity with digital systems was also made clear in the literature.

The inclusion of greater technology-related training in higher education courses was a suggested means of achieving this (Houghton, Miller and Foth, 2014; Russo et al., 2017). Russo et al (2017) further specify that greater documentation of, and guidance on, the specific assumptions included, and a stronger insistence on using feedback to guide the interpretation of results, was required to develop trust from users.

Renewed workforce training was also deemed necessary (Ullah et al., 2020; Juan, Lai and Shih, 2016). Juan, Lai & Shih (2016), and specifically suggested was that trial periods and greater policy support can help encourage the organisational change required to successfully implement a digital modernisation process.

In addition to software and systems costs, it was also important to properly manage the costs of continual training for staff to maintain capability with technological advances (Daniel, 2020; Russo et al., 2017; Williamson and Parolin, 2013).

7.1.1.4 A STATE GOVERNMENT-LED INITIATIVE

The need to develop a digital system and data for public infrastructure occurring at the state government level, as opposed to local level, was also noted.

Local governments were described as unwilling to invest in such development due to their limited capacity, and the uncertainty of the future value of this investment in that it won't be superseded by other local or state government initiatives later on (participant 7, planner).

The literature also observed this 'wait and see attitude' among consultants (Juan, Lai and Shih, 2016; Kuang et al., 2019).

Participant 13 (building surveyor) also noted the difficulty within local government to gain adequate funding for the unglamorous or 'difficult to understand' but necessary elements of such a development, such as data maintenance and cataloguing, through the local government system.

Approval for such costs needs councillor approval who, as lay people, may not see the value of such an investment as opposed to other issues competing for the limited funding available.

State government development of a digital modernisation process could also assist the centralisation of planning policies to one unified whole as opposed to multiple local variants (Salama and El-Gohary, 2011; Beach et al., 2013).

This could integrate and simplify policies and data while also decreasing the silo nature of government departments and municipalities (Goodspeed and Hackel, 2019).

For this to occur, a contractual legal framework that supports this collaboration culture would be required (Liao and Ai Lin Teo, 2018).

An issues paper for the Local Government association of South Australia (2021, p. 11), however, warns against blanket centralisation of planning policy content, as state-wide requirements are useful for holistic evaluation but are a 'blunt instrument' without the nuance of 'geospatially designed regulations, calibrated for local conditions, and which support optimal business operations.'

Devlin (2020) also stresses the possibility that digital systems could undermine the need for local planning roles, leading to loss of local workers, knowledge, and authority.

That said, Godspeed and Hackel (2019) present a contrasting view, suggesting that individual users at the local government level are the main actors driving the adoption of digital systems, mostly as a way to manage insufficient resourcing and lack of strategic support.

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APPENDIX A. LIST OF NCC STANDARDS

AS/NZS 1170.0:2002 General principles

AS/NZS 1170.1:2002 Permanent, imposed and other actions

AS/NZS 1170.2:2011 Wind actions

AS 1170.4-2007 Structural design actions - Earthquake actions in Australia

AS 1187-1996 Farm milk cooling and storage systems

AS 1191-2002 Acoustics - Method for laboratory measurement of airborne sound transmission insulation of building elements

AS/NZS 1260:2009 PVC-U pipes and fittings for drain, waste and vent application

AS 1273-1991 Unplasticized PVC (UPVC) downpipe and fittings for rainwater

AS 1276-1979 Methods for determination of sound transmission class and noise isolation class of building partitions

AS 1288-2006 Glass in buildings - Selection and installation

AS 1289.6.3.3-1997 Methods of testing soils for engineering purposes - Soil strength and consolidation tests - Determination of the penetration resistance of a soil - Perth sand penetrometer test

AS 1345-1995 Identification of the contents of pipes, conduits and ducts

AS 1375-2013 Industrial fuel-fired appliances

AS 1397-2011 Steel sheet and strip - Hot-dipped zinc-coated or aluminium/zinc-coated

AS 1428 DESIGN FOR ACCESS AND MOBILITY

AS 1428.1-2001/2009 General requirements for access - New building work

AS 1428.2-1992 Enhanced and additional requirements - Buildings and facilities

AS 1428.4-1992 Tactile ground surface indicators for the orientation of people with vision impairment

AS/NZS 1428.4.1-2009 Means to assist the orientation of people with vision impairment - Tactile ground surface indicators

AS 1428.1 Supp 1-1993 General requirements for access - Buildings - Commentary (Supplement to AS 1428.1-1993)

AS 1530 METHODS FOR FIRE TESTS ON BUILDING MATERIALS, COMPONENTS AND STRUCTURES

AS 1530.1-1994 Combustibility test for materials

AS 1530.2-1993 Test for flammability of materials

AS/NZS 1530.3:1999 Simultaneous determination of ignitability, flame propagation, heat release and smoke release

AS 1530.4:2014 Fire-resistance tests for elements of construction

AS 1530.8.1-2007 Tests on elements of construction for buildings exposed to simulated bushfire attack - Radiant heat and small flaming sources

AS 1530.8.2-2007 Tests on elements of construction for buildings exposed to simulated bushfire attack - Large flaming sources

AS/NZS 1546 ON-SITE DOMESTIC WASTEWATER TREATMENT UNITS

AS/NZS 1546.1:1998/2008 Septic tanks

AS/NZS 1546.2:2001/2008 Waterless composting toilets

AS/NZS 1546.3:2001/2008 Aerated wastewater treatment systems

AS 1546.4:2016 On-site domestic wastewater treatment units - Domestic greywater treatment systems

AS/NZS 1547:2000/2012 On-site domestic wastewater management

AS 1562 Design and installation of sheet roof and wall cladding

- AS 1562.1-1992/2018 Metal
- AS/NZS 1562.2:1999 Corrugated fibre-reinforced cement
- AS/NZS 1562.3:1996 Plastic

AS/NZS 1596:2008 The storage and handling of LP Gas

AS 1603.3-1996 Automatic fire detection and alarm systems - Heat alarms

AS 1657-2013/2018 Fixed platforms, walkways, stairways and ladders - Design, construction and installation

AS/NZS 1664 ALUMINIUM STRUCTURES

- AS/NZS 1664.1:1997 Limit state design
- AS/NZS 1664.2:1997 Allowable stress design

AS/NZS 1668 THE USE OF VENTILATION AND AIRCONDITIONING IN BUILDINGS

- AS/NZS 1668.1:1998/2015 Fire and smoke control in multi-compartment buildings
- AS 1668.2-2012 Mechanical ventilation for acceptable indoor-air quality
- AS 1668.4-2012 Natural ventilation of buildings

AS 1670 FIRE DETECTION, WARNING, CONTROL AND INTERCOM SYSTEMS - SYSTEM DESIGN, INSTALLATION AND COMMISSIONING

- AS 1670.1:2015/2018 Fire
- AS 1670.3-2004/2018 Fire alarm monitoring
- AS 1670.4:2015/2018 Emergency warning and intercom systems

AS/NZS 1680 INTERIOR LIGHTING

- AS/NZS 1680.0-2009 Safe movement
- AS/NZS 1680.1:2006 General principles and recommendations
- AS/NZS 1680.2.1:2008 Specific applications - Circulation spaces and other general areas
- AS/NZS 1680.2.2:2008 Specific applications - Office and screen-based tasks
- AS/NZS 1680.2.3:2008 Specific applications - Educational and training facilities
- AS/NZS 1680.2.4:1997 Industrial tasks and processes
- AS/NZS 1680.2.5:1997 Hospital and medical tasks

AS 1684 RESIDENTIAL TIMBER-FRAMED CONSTRUCTION

- AS 1684.2-2010 Non-cyclonic areas
- AS 1684.3-2010 Cyclonic areas
- AS 1684.4-2010 Simplified - Non-cyclonic areas

TIMBER FRAMING SPAN TABLES

- AS 1684.2 Supp 0-2010 Non-cyclonic areas - General introduction and index (Supplement to AS 1684.2 - 2010)

AS 1692-2006 Steel tanks for flammable and combustible liquids

AS 1720 TIMBER STRUCTURES

- AS 1720.1-2010 Design methods

AS 1720.4-2006 Fire resistance for structural adequacy of timber members

AS 1720.5:2015 Nail plated timber roof trusses

AS 1735 LIFTS, ESCALATORS AND MOVING WALKS

AS 1735.1-2003 General requirements

AS 1735.2-2001 Passenger and goods lifts - Electric

AS 1735.7-1998 Stairway lifts

AS 1735.11-1986 Fire-rated landing doors

AS 1735.12-1999 Facilities for persons with disabilities

AS 1735.15-2002 Low rise passenger lifts - Non-automatically controlled

AS/NZS 1859.4:2004/2018 Reconstituted wood-based panels - Specifications - Wet-processed fibreboard

AS 1860.2-2006 Particleboard flooring - Installation

AS/NZS 1891.4:2000 Industrial fall-arrest systems and devices - Selection, use and maintenance

AS 1905 COMPONENTS FOR THE PROTECTION OF OPENINGS IN FIRE-RESISTANT WALLS

AS 1905.1:2015 Fire-resistant doorsets

AS 1905.2-2005 Fire-resistant roller shutters

AS 1926 SWIMMING POOL SAFETY

AS 1926.1-1993/2012 Fencing for swimming pools

AS 1926.2-1995/2007 Location of fencing for private swimming pools

AS 1926.3-2010 Water recirculation systems

AS 2001.5.4-1987 Methods of test for textiles - Dimensional change - Determination of dimensional change in laundering of textile fabrics and garments - Automatic machine method

AS 2047-2014 Windows in buildings - Selection and installation

AS 2049-2002 Roof tiles

AS 2050-2002/2018 Installation of roof tiles

AS 2070-1999 Plastics materials for food contact use

AS 2118 AUTOMATIC FIRE SPRINKLER SYSTEMS

AS 2118.1-1999 General requirements

AS 2118.2-1995 Wall wetting sprinklers (Drenchers)

AS 2118.4-2012 Residential

AS 2118.5-1995 Domestic

AS 2118.6-2012 Combined sprinkler and hydrant

AS 2118.9-1995 Piping support and installation

AS 2118.1-2017 General systems

AS 2159-2009 Piling - Design and installation

AS/NZS 2179.1:2014 Specifications for rainwater goods, accessories and fasteners - Metal shape or sheet rainwater goods, and metal accessories and fasteners

AS 2220 EMERGENCY WARNING AND INTERCOMMUNICATION SYSTEMS IN BUILDINGS

AS 2220.1-1989 Equipment design and manufacture

AS 2220.2-1989 System design, installation and commissioning

AS/NZS 2269.0:2012 Plywood - Structural - Specifications

AS 2293 EMERGENCY ESCAPE LIGHTING AND EXIT SIGNS FOR BUILDINGS

- AS 2293.1-2005/2018 System design, installation and operation

AS/NZS 2327:2017 Composite structures - Composite steel-concrete construction in buildings

AS 2419.1-2005 Fire hydrant installations - System design, installation and commissioning

AS 2441-2005 Installation of fire hose reels

AS 2444-2001 Portable fire extinguishers and fire blankets - Selection and location

AS 2658-2008 LP Gas - Portable and mobile appliances

AS 2665-2001 Smoke/heat venting systems - Design, installation and commissioning

AS/NZS 2699.1:2000 Built-in components for masonry construction - Wall ties

AS/NZS 2699.3:2000 Built-in components for masonry construction - Lintels and shelf angles (durability requirements)

AS 2746-2008 Working areas for gas-fuelled vehicles

AS 2870-2011 Residential slabs and footings

AS/NZS 2890.6:2009 Parking facilities - Off-street parking for people with disabilities

AS/NZS 2904:1995 Damp-proof courses and flashings

AS/NZS 2908 CELLULOSE-CEMENT PRODUCTS

- AS/NZS 2908.1:2000 Corrugated sheets
- AS/NZS 2908.2:2000 Flat sheet

AS/NZS 2918:2001/2018 Domestic solid fuel burning appliances - Installation

AS/NZS 3000:2018 Electrical installations (known as the Australian/New Zealand Wiring Rules)

AS/NZS 3000:2007 Electrical installations (known as the Australian/New Zealand Wiring Rules)

AS/NZS 3000:2000 Electrical installations (known as the Australian/New Zealand Wiring Rules)

AS/NZS 3002:2008 Electrical installations - Shows and carnivals

AS/NZS 3013:2005 Electrical installations - Classification of the fire and mechanical performance of wiring system elements

AS/NZS 3500 PLUMBING AND DRAINAGE

- AS/NZS 3500.0:2003 Glossary of terms
- AS/NZS 3500.1:2015/2018 Water services
- AS/NZS 3500.2:2015/2018 Sanitary plumbing and drainage
- AS/NZS 3500.3:2015/2018 Stormwater drainage
- AS/NZS 3500.4:2003/2015/2018 Heated water services

AS 3600-2009/2018 Concrete structures

AS 3660 TERMITE MANAGEMENT - NEW BUILDING WORK

- AS 3660.1-2000/2014
- AS 3660.3:2014 Assessment criteria for termite management systems

AS/NZS 3666 AIR-HANDLING AND WATER SYSTEMS OF BUILDINGS - MICROBIAL CONTROL

- AS/NZS 3666.1:2011 Design, installation and commissioning
- AS/NZS 3666.2:2011 Operation and maintenance

AS 3700-2011/2018 Masonry structures

AS 3735-2001 Concrete structures retaining liquids

AS 3740-2010 Waterproofing of domestic wet areas

AS/NZS 3760:2010 In-service safety inspection and testing of electrical equipment

AS 3786-1993/2014 Smoke alarms

AS/NZS 3823.1.2:2012 Performance of electrical appliances - Air conditioners and heat pumps - Ducted air conditioners and air-to-air heat pumps Testing and rating for performance (ISO 13253:2011, MOD)

AS 3959-2009/2018 Construction of buildings in bushfire-prone areas

AS/NZS 4013:1999 Domestic solid fuel burning appliances - Method for determination of flue gas emission

AS/NZS 4020:2005/2018 Testing of products for use in contact with drinking water

AS 4055-2012 Wind loads for housing

AS 4072.1-2005 Components for the protection of openings in fire-resistant separating elements - Service penetrations and control joints

AS 4100-1998 Steel structures

AS 4118.2.1-1995 Fire sprinkler systems - Piping - General

AS/NZS 4130:2009 Polyethylene (PE) pipes for pressure applications

AS/NZS 4200 PLIABLE BUILDING MEMBRANES AND UNDERLAYS

- AS/NZS 4200.1:2017 Materials
- AS/NZS 4200.1:1994 Materials
- AS/NZS 4200.2:1994 Installation requirements

AS/NZS 4234:2008 Heated water systems - Calculation of energy consumption

AS 4254 DUCTWORK FOR AIR-HANDLING SYSTEMS IN BUILDINGS

- AS 4254.1-2012 Flexible duct
- AS 4254.2-2012 Rigid duct

AS/NZS 4256 PLASTIC ROOF AND WALL CLADDING MATERIALS

- AS/NZS 4256.1:1994 General requirements
- AS/NZS 4256.2:1994 Unplasticized polyvinyl chloride (uPVC) building sheets
- AS/NZS 4256.3:1994 Glass fibre reinforced polyester (GRP)
- AS/NZS 4256.5:1996 Polycarbonate

AS/NZS 4284:2008 Testing of building facades

AS 4464-2007 Hygienic production of wild game meat for human consumption

AS 4465-2006 Construction of premises and hygienic production of poultry meat for human consumption

AS 4466-1998 Hygienic production of rabbit meat for human consumption

AS/NZS 4505:2012 Garage doors and other large access doors

AS 4552-2005 Gas fired water heaters for hot water supply and/or central heating

AS 4586-2013 Slip resistance classification of new pedestrian surface materials

AS/NZS 4586:2004 Slip resistance classification of new pedestrian surface materials

AS 4597-1999(R2015) Installation of roof slates and shingles (Non-interlocking type)

AS/NZS 4600:2005/2018 Cold-formed steel structures

AS 4654 WATERPROOFING MEMBRANES FOR EXTERNAL ABOVE-GROUND USE

- **AS 4654.1-2012 Materials**
- **AS 4654.2-2012 Design and installation**

AS 4674-2004 Construction and fit out of food premises

AS 4678-2002 Earth-retaining structures

AS 4696-2007 Hygienic production and transportation of meat and meat products for human consumption

AS/NZS 4766:2006 Polyethylene storage tanks for water and chemicals

AS 4773 MASONRY IN SMALL BUILDINGS

- **AS 4773.1:2015 Design**
- **AS 4773.2:2015 Construction**

AS/NZS 4859.1:2002/2018 Materials for the thermal insulation of buildings - General criteria and technical provisions

AS/NZS 4859.2:2018 Thermal insulation materials for buildings - Design

AS 5008-2007 Hygienic rendering of animal products

AS 5010-2001 Hygienic production of ratite (emu/ostrich) meat for human consumption

AS 5011-2001 Hygienic production of natural casings for human consumption

AS 5113:2016 Fire propagation testing and classification of external walls of buildings

AS 5146.1:2015 Reinforced Autoclaved Aerated Concrete - Structures

ATS 5200.026-2004 Technical Specification for plumbing and drainage products - Cold water storage tanks

AS 5216:2018 Design of post-installed and cast-in fastenings in concrete

AS 5344:2019 Permanent labelling for Aluminium Composite Panel (ACP) products

AS 5637.1:2015 Determination of fire hazard properties - Wall and ceiling linings

AS ISO 9239.1-2003 Reaction to fire tests for floor coverings - Determination of the burning behaviour using a radiant heat source

AS/NZS ISO 9972:2015 Thermal performance of buildings - Determination of air permeability of buildings - Fan pressurization method

HB 230-2008 Rainwater Tank Design and Installation Handbook

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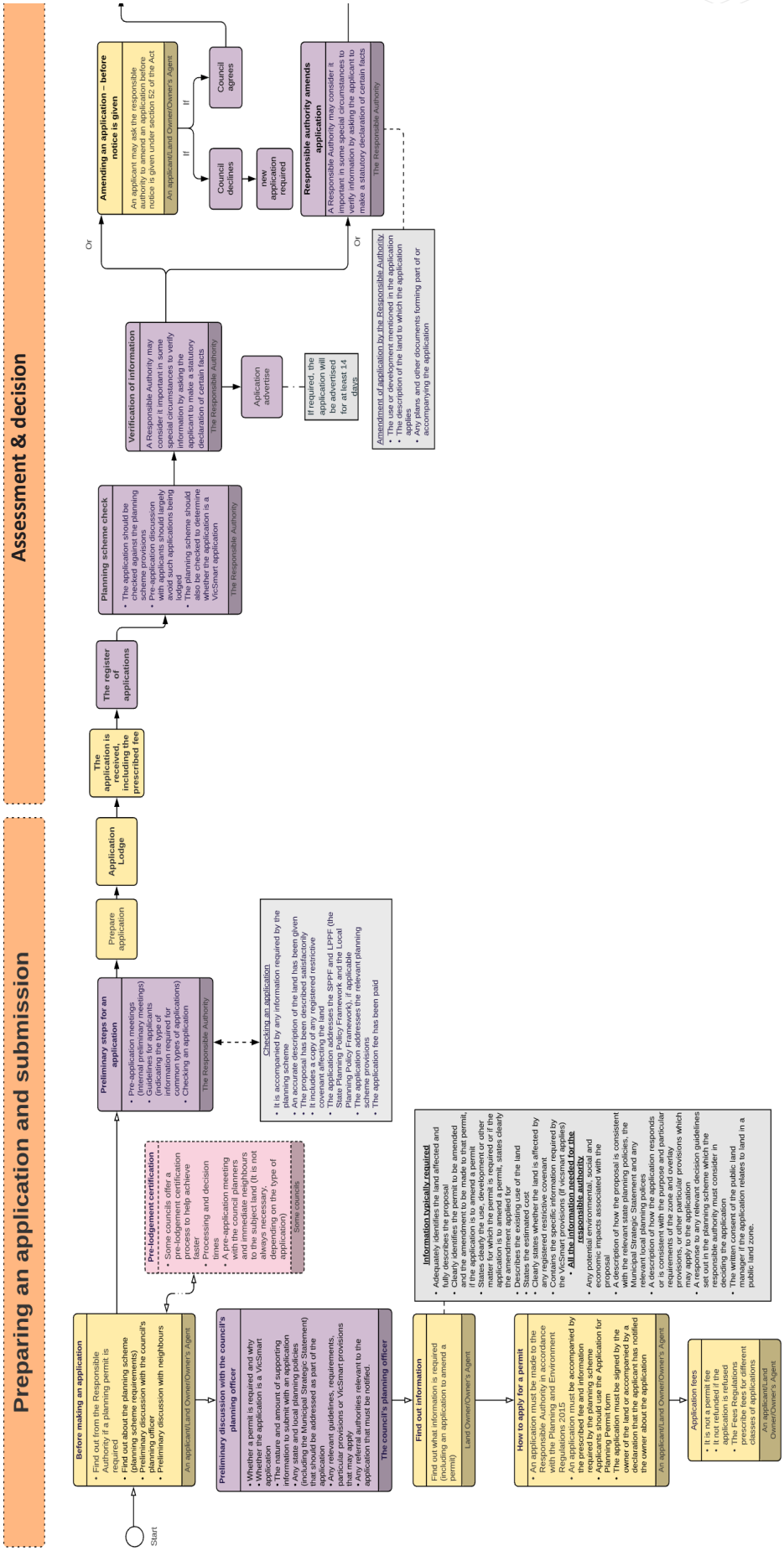
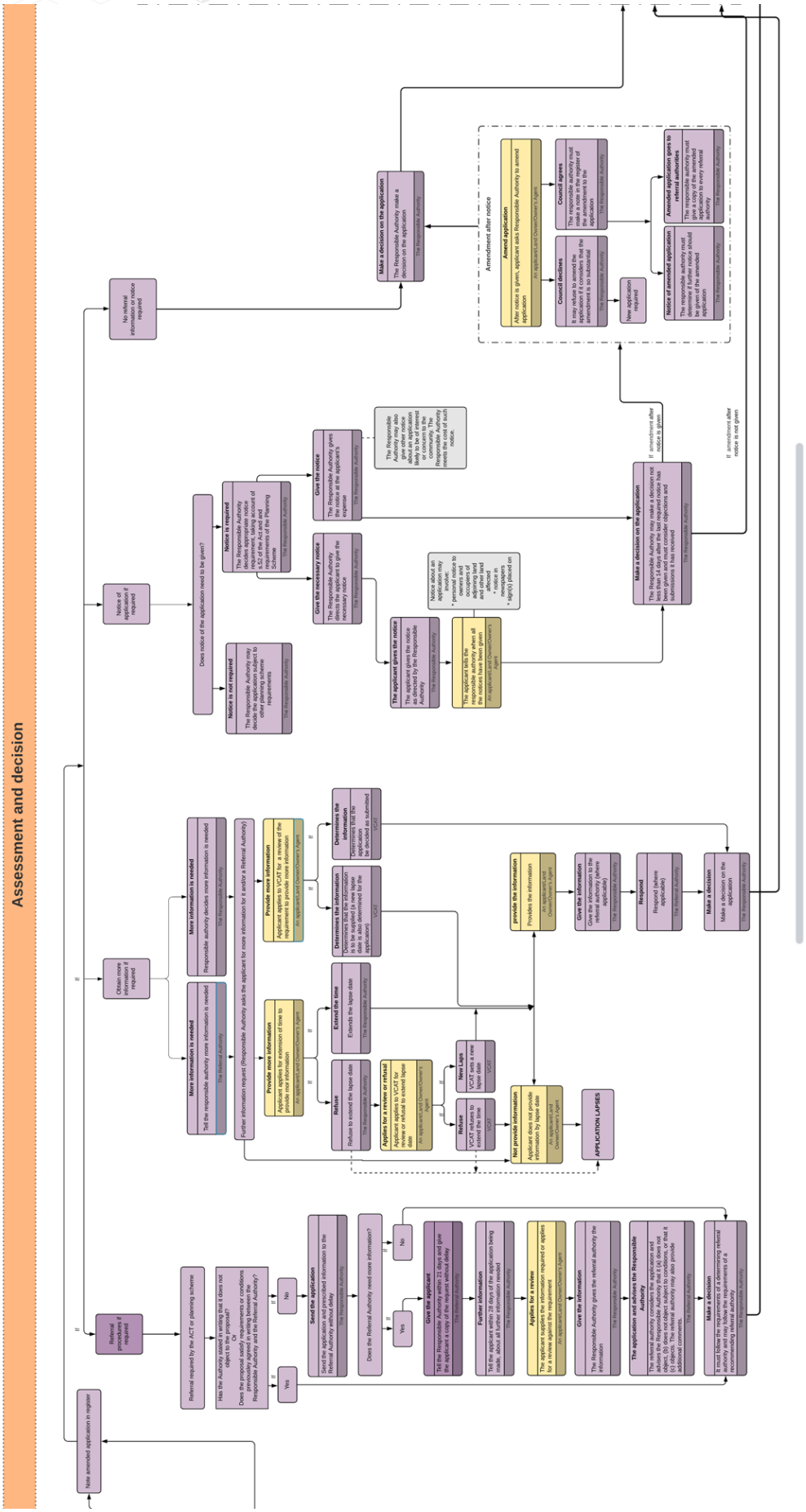
APPENDIX B. PLANNING APPROVAL PROCESS IN VICTORIA

1. Preparing an Application and Submission Stage and Parts of Assessment & Decision Stage



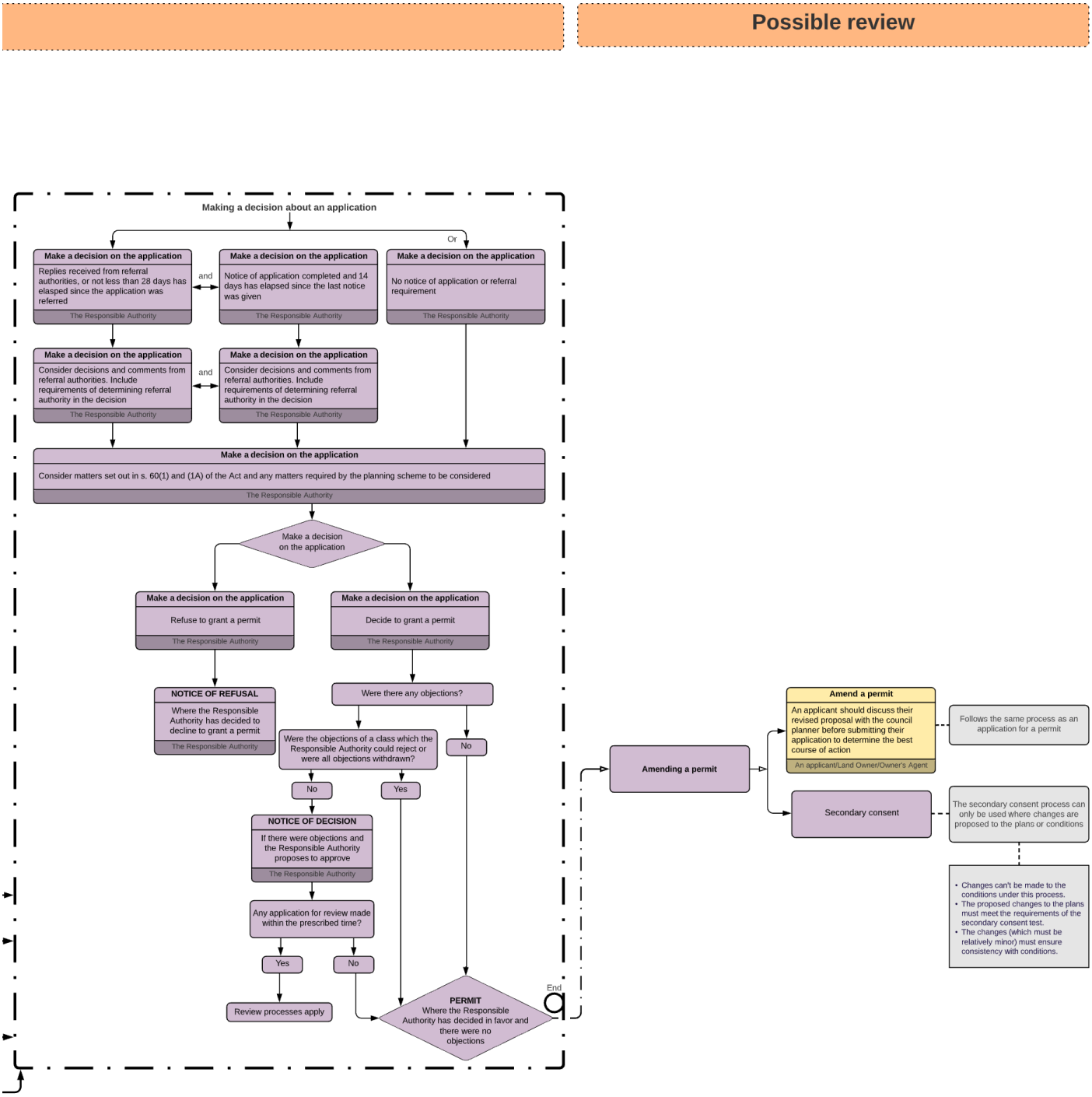
APPENDIX B. PLANNING APPROVAL PROCESS IN VICTORIA

2. Parts of Assessment and Decision Stage



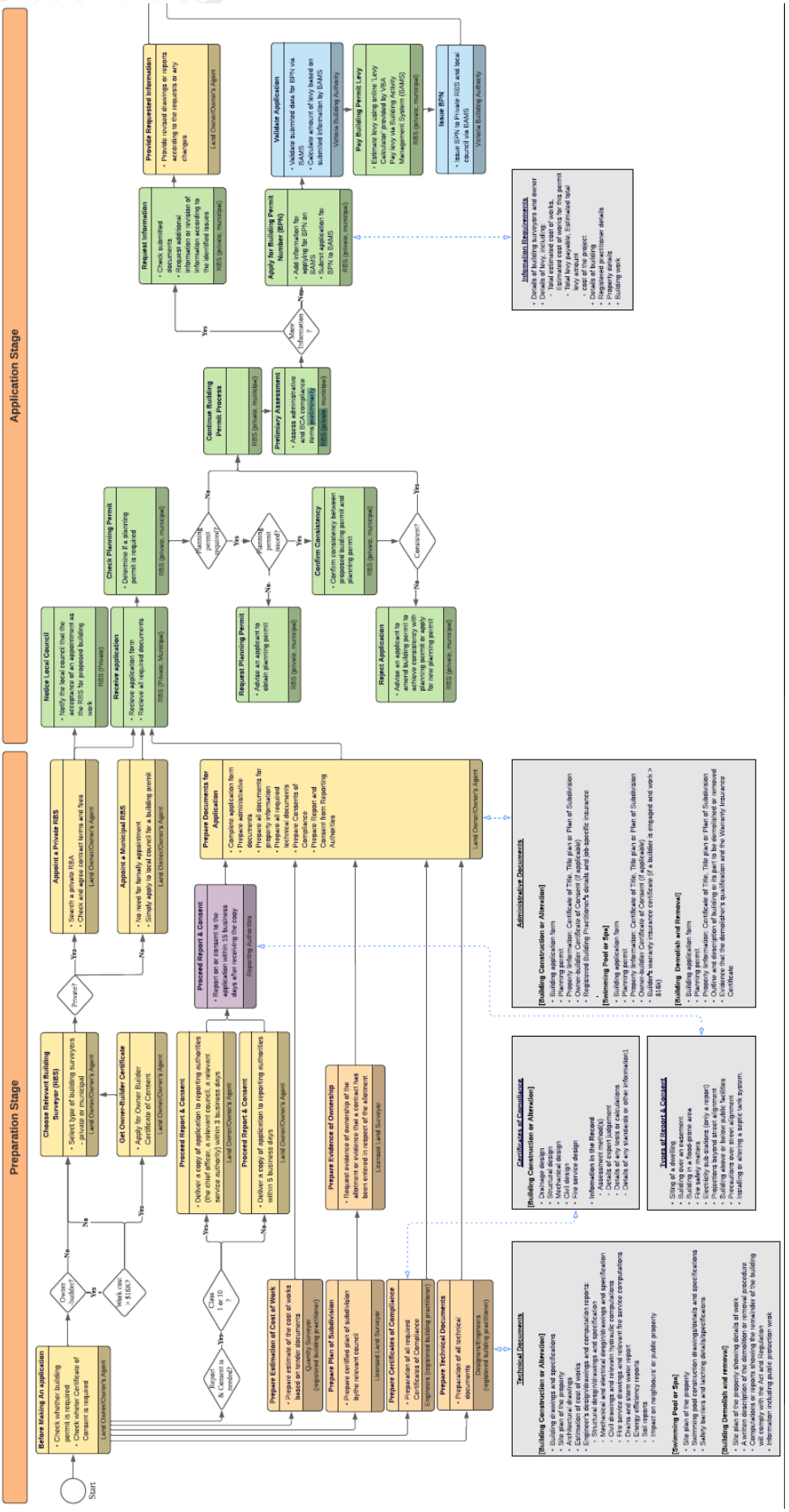
APPENDIX B. PLANNING APPROVAL PROCESS IN VICTORIA

3. Parts of Assessment and Decision Stage and Possible Review Stage



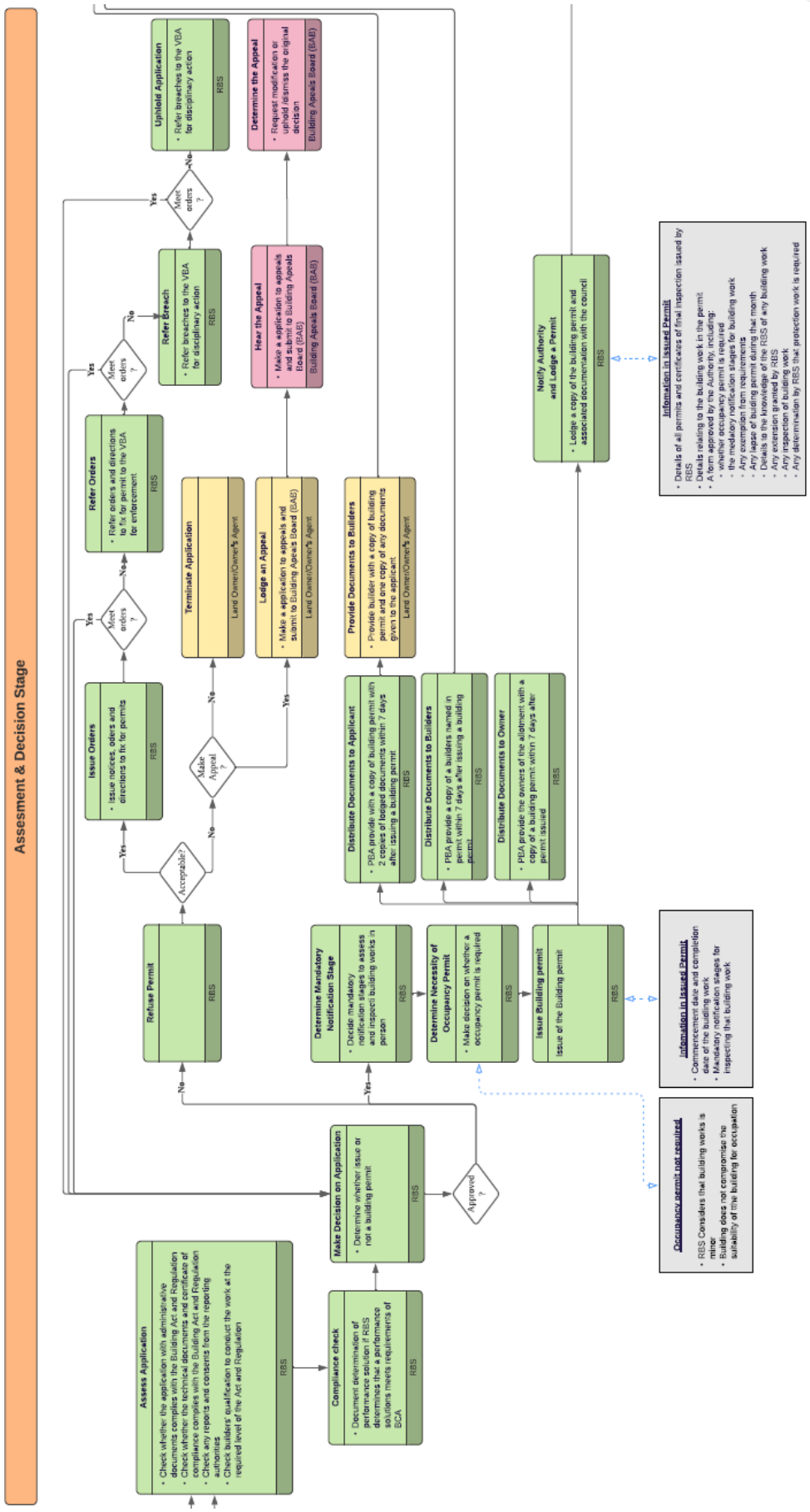
APPENDIX C. BUILDING APPROVAL PROCESS IN VICTORIA

1. Preparation and Application Stages



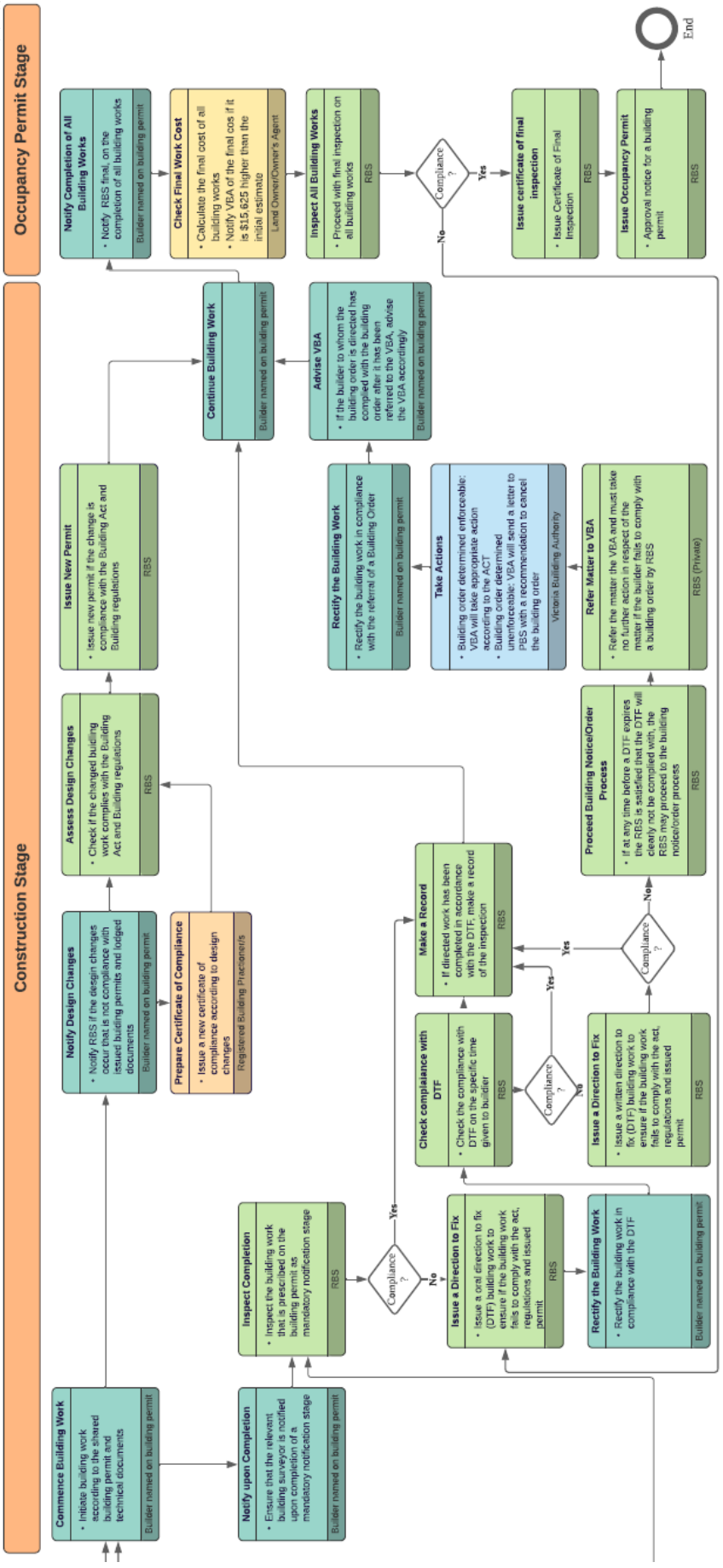
APPENDIX C. BUILDING APPROVAL PROCESS IN VICTORIA

2. Assessment & Decision Stages



APPENDIX C. BUILDING APPROVAL PROCESS IN VICTORIA

3. Construction and Occupancy Permit Stages



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