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Introduction

The productivity of the construction industry has lagged behind other sectors for decades, hindered by the linear and fragmented processes of traditional building activities (Aitchison *et al*., 2018). Among the main causes of such fragmentation is the one-off project-based approach of traditional construction that isolates the design and the construction phases (Vrijhoef and Koskela, 2000). The lack of integration across the building value chain accounts for critical decisions being left to be resolved on-site. This results in inaccuracies, delays, rework, increased waste, cost, low productivity, and a lack of continuity of the processes for reusability in future projects (Rocha *et al.*, 2022).

In this context, industrialised building (IB) offers promising opportunities for productivity gain through technical process-related approaches. IB is defined as an approach that incorporates prefabricated building production while adhering to the organisational, technological, supply chain and market-related issues towards continuous improvement of products and processes (Lessing, 2006). Since the early 2000s, companies have developed new production approaches for increased efficiency and process innovations including IB principles such as the one of ‘product platforms’ (Lessing, 2006, Lidelöw *et al*., 2015). Originating in the manufacturing industry, a product platform is defined as the collection of common assets (i.e., components, processes, knowledge, people and relationships) that are shared by a set of products (Robertson and Ulrich, 1998, p. 20). In IB, product platforms allow differentiated production and assembly of standardised building components while supporting continuous improvement of recurring processes (Lidelöw *et al*., 2015).

Two distinct views exist within the product platform approach of IB companies: product and process-orientation (Lessing and Brege, 2015, Maxwell, 2018). It has been argued that IB companies’ product platform approaches are predominantly product-oriented, prioritising product development and production quality over process improvements and product variability, resulting in limited product offerings (Maxwell, 2016). Furthermore, product platform literature in IB has largely emphasised modularity for standardised product development, and less so for process modularity (Veenstra *et al*., 2006, Lessing and Stehn, 2019).

This study aims to bridge this gap by examining the concept of process modularity in IB platforms. Specifically, it investigates how work processes can be structured as modules for reusability in IB projects. Through the analysis of a case study, this research captures data and documents work processes across the design-to-assembly value chain of a ‘live’ IB project— a timber-built prefabricated multi-family residential building development in Australia. By analysing empirical data, this paper presents a view of process modularity within IB platform thinking. It is expected that this work may contribute to IB by informing future strategies for leveraging process knowledge across multiple projects, enabling higher productivity, scalability and product variability in building delivery.

Theoretical background

Industrialised building

IB refers to an approach to building that relies on advanced process considerations supported by standardised components and prefabrication (Crowley, 1998). Recent studies recognise IB as a concept that involves integrating technical and process-related factors, including design, planning, logistics, production technology and product quality into a long-term strategy to provide desirable customer offerings (Lessing and Stehn, 2019). Lessing (2006) introduced the necessity for integrating several constructs to characterise industrialised house-building (IHB) (synonymous with industrialised building), where prefabrication is just one of the constructs, but not sufficient alone to define IB. Lessing's conceptual framework for IHB emphasises eight areas, including planning and process control, developed technical systems, off-site manufacture of building parts, long-term relations, logistics integration, customer focus, use of information and communication technology (ICT) tools, and reuse of experience. These constructs require integration and reinforcement by continuous improvement of solutions (the ninth area) in order to support the industrialisation of house-building beyond single projects. During the early-2000s, renewed interest in industrialisation saw increased investment by a number of companies in Japan, Europe, the USA and the UK, translating in the development of new approaches for IB. Of major significance is the Swedish construction industry, where housing companies have sought effective ways for project delivery based on process innovations and product platforms (Lidelöw *et al*., 2015).

In Australia, the adoption of IB is not widespread. A lack of understanding of the IB systems, limitations in the building industry supply chain to support the establishment of off-site production at scale, and a traditional approach to house design and construction have been identified as hindrances to its holistic adoption (Khalfan and Maqsood, 2014). Currently, a small segment of the housing market involves prefabrication or off-site manufacturing (OSM), representing only 3% of Australia's $150 billion construction industry (Blismas and Wakefield, 2009). Reviewing the current state of IB implementation in the global construction sector, particularly in the Swedish IB industry, provides a valuable reference for the adaptation of product platforms in the specific context of the Australian IB industry, to achieve higher productivity, quality, and flexibility in customer offerings.

Product platforms

A product platform is a method of sharing components and production processes, allowing companies to launch differentiated products efficiently through a flexible, responsive and resource-efficient production system (Meyer and Lehnerd, 1997, Robertson and Ulrich, 1998). By using this method, companies develop 'product families' (groups of related products) to satisfy a variety of market niches, whilst also maintaining economies of scale and scope in their manufacturing processes (Simpson *et al*., 2006). Meyer and Lehnerd (1997, p. 7) define a product platform as "a set of common components, modules, or parts from which a stream of derivative products can be efficiently created and launched". Platform-based product development allows companies to derive modular product families by adding, removing, or substituting one or more modules or by scaling them in one or more dimensions to target specific market segments (Meyer and Lehnerd, 1997).

In the early 2000s, a renewed emphasis on IB resulted in several house-building companies adopting the product platform approach to facilitate continuous improvement of both products and processes (Jansson, 2013). According to Lessing (2019), this approach allows IB companies to balance between the level of predefinition and the level of project-specific solutions to target suitable market segments for their product offerings. Within IB companies' product platform approach, the literature highlights two dominant views: product and process-orientation (Lessing and Brege, 2015, Maxwell, 2018). Product-orientation offers an alternative to the traditional one-off project-oriented approach in building construction. It involves utilising a platform or pre-developed structure to design and produce repeated products (Lessing, 2015). To ensure efficiency, product-oriented IB offers a specific range of products, aimed at specific customer segments. While this approach limits the scope of product variability, it allows predefining production methods, technical solutions, and subsystems, resulting in an efficient end-product configuration (Johnsson, 2013). In contrast, process-orientation primarily focuses on reusing work packages on separate building projects on a recurring basis (Lessing and Stehn, 2019). The value of this approach lies in achieving stable and continuous processes, which can be improved based on performance measurements and experience from previous iterations (Meiling *et al*., 2014). Process-orientation involves integrating design, planning, and production with the supply chain to achieve increased customisation in product offerings. The opportunity presents greater flexibility in handling parallel projects, leading to long-term benefits in speed, quality, cost efficiency, and safety (Jansson *et al*., 2008).

Modularity

Within the product platform literature, modularity is an important concept and a key enabler for customisation (Hvam *et al*., 2008). Modularity refers to the structure of a product or process that is comprised by smaller subsystems (modules or chunks) that can be developed independently, yet can function together as a whole (Rocha and Koskela, 2020). In manufacturing, modularity often involves the repetitive use of a single set of interchangeable units, which are assembled together for the development of differentiated end-products (Ulrich, 1995). Bonev (2015) argues that modularity contributes to an organisation internally through standardisation while having high external variety towards the market. From this perspective, many companies in manufacturing have focused on product modularity, through a product platform approach to derive product families for satisfying a variety of market niches, while maintaining shortened lead times, and reduced costs (Meyer and Lehnerd, 1997).

While modularity has been extensively researched and applied to define manufactured products (Ulrich, 1995), the one-off nature of most projects has limited its impacts in the construction industry (Vrijhoef and Koskela, 2000). In the context of IB, modularity is often understood from a product viewpoint, where a building is assembled using a unique set of standardised components (physical parts, sub-assemblies or modules), with limited opportunity for variation. By contrast, a process viewpoint would recognise a set of predefined activities or work packages as process modules (i.e., workflows, collaborative decisions among stakeholders, design and planning methods, etc.), across the building value chain (Rocha and Kemmer, 2018). In theory, these process modules could be reconfigured for reuse on differentiated building projects, facilitating scalability and customisation. However, there is a research gap in characterising and structuring IB work processes as reusable modules to improve both product variety and process efficiency.

Process modularity

Process modularity in construction refers to the management and control of production methods (Voordijk *et al.*, 2006). The value of a modular process becomes evident when a system expands to a magnitude where achieving integrated design and production becomes challenging due to the interdependence between physical components (Rocha and Koskela, 2020). According to Björnfot and Stehn (2007), process standardisation is the core of modularity. Reijers and Mendling (2008) assert that modular process design can benefit from scalability, which refers to the ability to enhance both production growth and product diversity through the reuse of process modules. Therefore, efficient product delivery depends not only on a high degree of product predefinition but also on predefined processes. From this perspective, IB companies applying such processes require different structures in comparison to traditional building companies in order to effectively utilise well-developed processes with defined value chains, repetitive operations and technical solutions, and experience feedback (Johnsson and Meiling, 2009).

In this context, Lessing (2006) presents the concept of product development and continuous improvements of IB platforms (Fig.01). Lessing structures these development streams into technical and process platforms that must be developed and managed simultaneously. Technical platforms are proposed to configure engineering solutions, establish standards, and develop interfaces and systems suitable for effective production, transportation, and assembly of building components. Process platforms include instructions and guidelines regarding production processes. This involves a systematic collection and organisation of process modules concerning workflows, collaboration, logistics, information handling systems, design and planning methods among others.

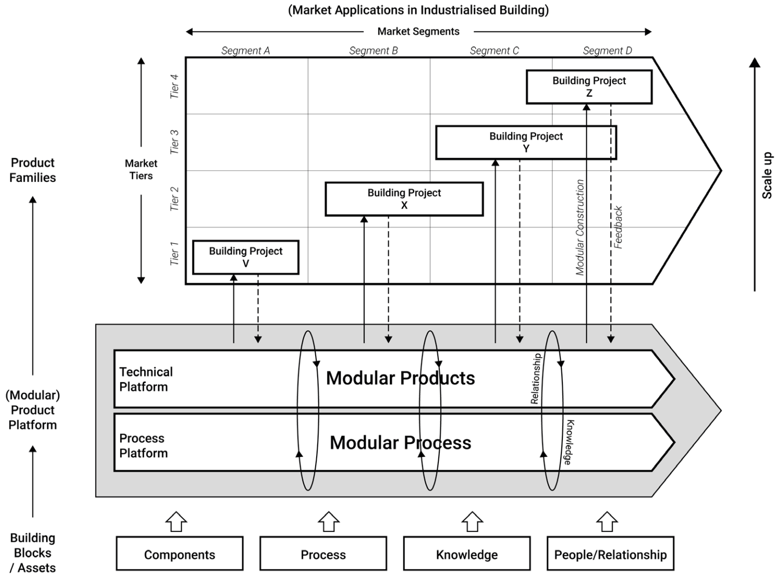


Fig. 01. Enabling scalability through modularity in technical and process platforms in IB.
Adapted from Meyer and Lehnerd (1997) and Lessing (2006).

In this platform approach, buildings are still produced as projects, while effectively scaling between differentiated market tiers. At the end of each project, learnings from executed projects are systematically reviewed to serve as input for further improvement of the overall platform strategy. Product platforms for IB hold the potential to benefit from aligned process modularity in structuring work processes as a means of project support. In this context, the definition and characterisation of process modules is an issue yet to be resolved. Starting from the product platform definition by Meyer and Lehnerd (1997) through to its introduction in IB by Lessing (2006), this research explores the concept of process modularity in IB platforms covering the entire building value chain, including design development, manufacturing, and assembly.

Methods

This study examines modularity in the building processes as an enabler of scalability, specifically in relation to scaling up the production of differentiated end-products through IB platforms. By undertaking case study research, this paper engages in the observation and documentation of data to critically analyse the processes involved in the design, manufacturing and assembly of a prefabricated multi-residential apartment project in Australia. This research methodology provides qualitative methods to understand how companies manage, develop, and operate their processes, technology, and relationships (Yin, 2003).

More specifically, the 'live' IB project involves the development of a 14-unit apartment building, comprising a three-storey and single-basement structure. The project is led by a developer (DE) in Australia, aiming to implement an IB strategy to increase the efficiency of their building delivery process. The platform strategy of the company is in development, which presents an opportunity to investigate how entire building processes can be structured as reusable modules within a platform-based system. In this project the DE has engaged a team of stakeholders for a period of two years (2022-24), covering five specific stages: 1) design development, 2) planning permit, 3) production and manufacturing, 4) logistics and assembly, and 5) completion. At present, the first two stages are complete and the developed design has been locked at an 80% level to obtain the required town planning permits. Throughout the design development and planning permit stages, the work processes have been documented by observing actions and collaboration between stakeholders during regular coordination meetings and team workshops. These meetings have been a crucial source of data to describe stakeholder relationships and processes concerning design decisions, component configuration, interface, material knowledge, supply chain logistics, quality, compliance, regulations, production process and technology among others. This paper analyses observations documented in 15 coordination meetings over a 9-month period (June 2022-March 2023). The documents exchanged during these meetings, including design drawings, compliance reports, developed drawings, and tender documents, have also been documented and assessed to determine the sequence and level of work progress. By collecting and analysing this empirical data, this study explores factors involved in a platform-based approach to structuring process modules for reusability in future IB projects.

Results

This section presents a synthesis of the information gathered from the case study project. During the coordination meetings, a number of stakeholders performed a range of activities within the stage: 1) design development and 2) planning permits. The stakeholders collaborating in this project are listed in Table 01. These stakeholders can be clustered as primary and secondary consultants:

Table 01. List of stakeholders

Primary Consultants	Secondary Consultants
Developer (DE)	Landscape Architect (LA)
Architect & Interior Designer (AR)	Sustainability Management Expert (SM)
Civil/Structural Engineer (SE)	Traffic Engineer (TE)
Prefab Building Manufacturer (PR)	Geotechnical Engineer (GE)
MEP/Building Services Engineer (ME)	Tree Management Expert (TM)
Fire Engineer (FE)	Quantity Surveyor (QS)
Acoustic Engineer (AC)	Market Surveyor (MS)
	Land Surveyor (LS)
	Town Planner (TP)
	Building Surveyor (BS)
	Builder (BU)
	Fit-out Team (FT)

While the primary stakeholders are the main design and technical decision makers, they frequently had to rely on the information and support provided by the secondary consultants. As a result, one defining characteristic of these activities was their level of interdependence between consultants. Tasks performed by one consultant team often served as prerequisites for the progress of other teams, while also supporting future execution. For instance, the development of the ESD report provided support (predecessor) for the MEP team's preparation of initial drawings and concept design report of building services. This collaboration allowed for necessary modifications to be made to the MEP system, ultimately contributing to the architectural layout development by the Architect (successor). Another important activity towards the end of the design development stage involved integrating architectural elements, prefab structures, and building services into a single BIM model. The Architect was primarily responsible for this integration, receiving support from the other two teams. The collaboration among these stakeholders resulted in the consolidation of the design development at an 80% level. As a result, the finalisation of the tender documentation was achieved in February 2023, and prospective builders were invited to participate in the tendering procedure.

In this research, these dynamic relationships between the work processes and dependencies of the stakeholders are meticulously documented. This is to structure these processes as modules to bring efficiency to the case company's management of similar future projects through the reuse of such modules on a platform-based approach. Figure 02 & 03 illustrates the dependency of the stakeholders who performed a range of activities across several months as part of the design development and planning permit stages. Based on the interrelationships between the chronological activities observed across these two stages of the case study project, this research has clustered these work processes in 14 work packages –

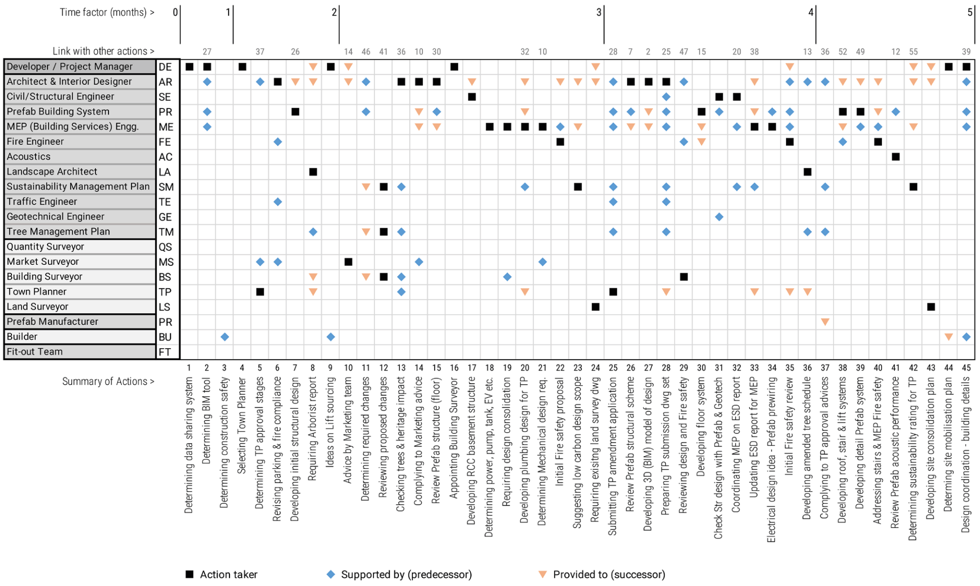


Fig. 02. Dependency of work processes in the case study project (month 1-5)

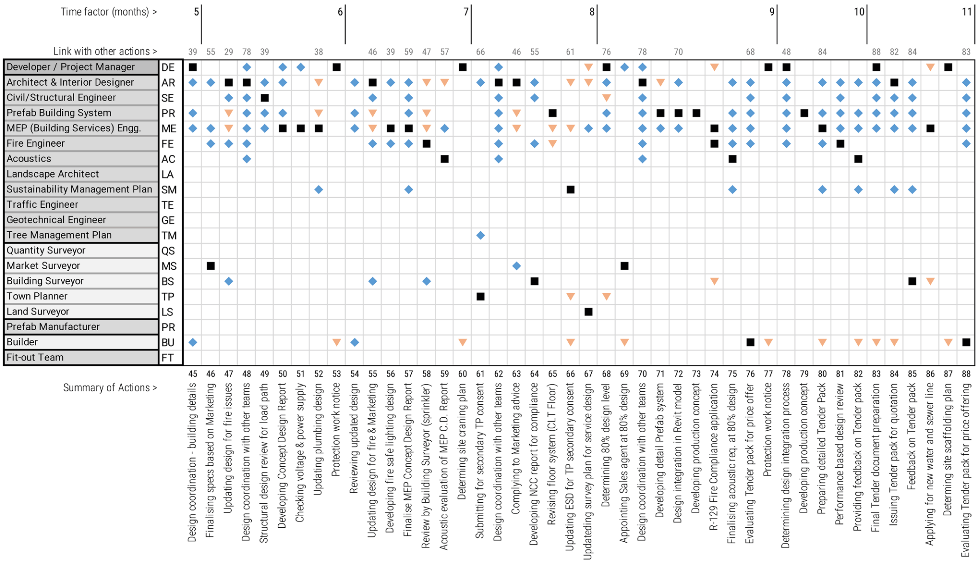
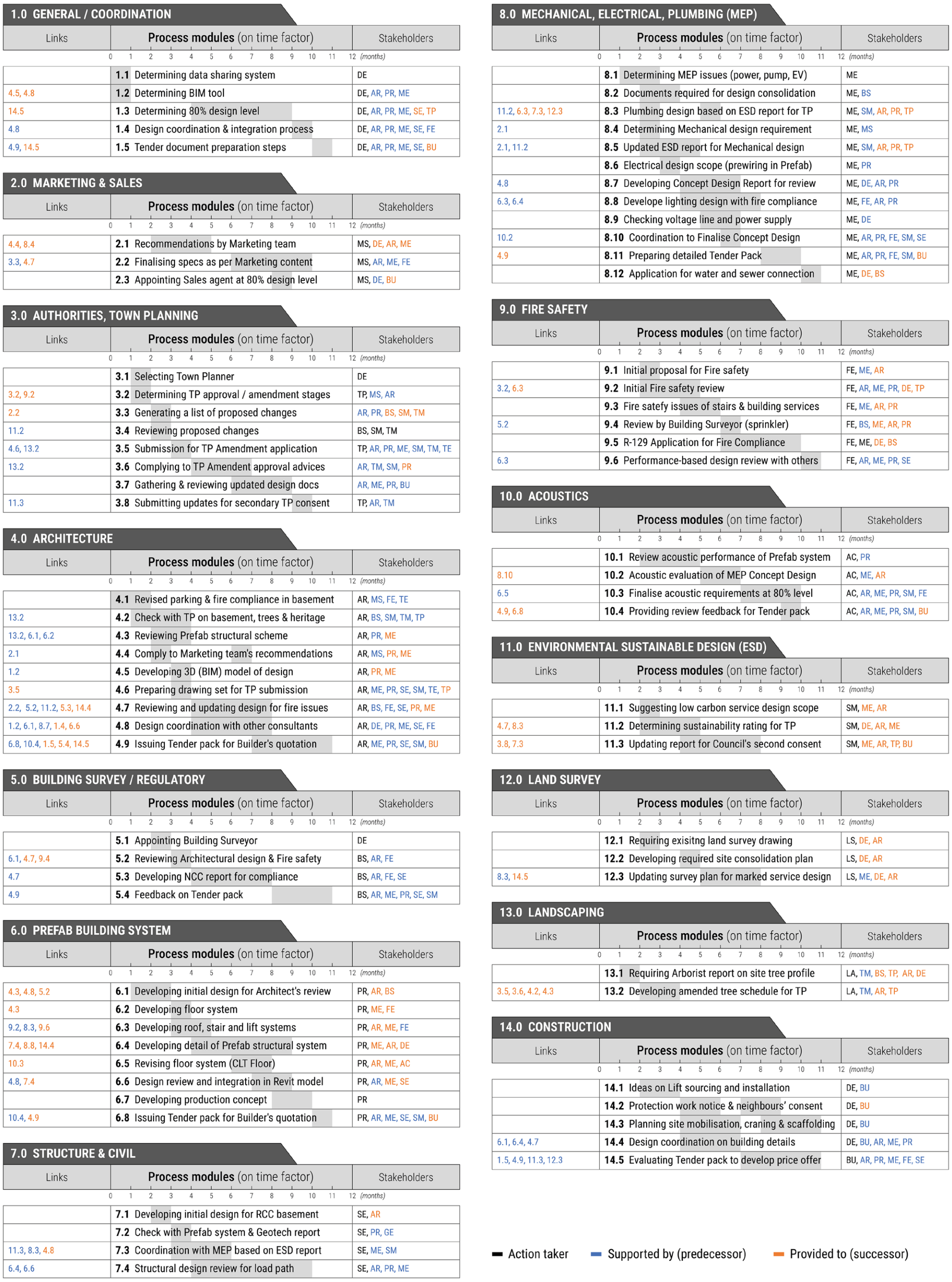


Fig. 03. Dependency of work processes in the case study project (month 6-11)

1) General/Coordination, 2) Marketing and Sales, 3) Authorities and Town Planning, 4) Architecture, 5) Building Survey/Regulatory, 6) Prefab Building System, 7) Structure and Civil, 8) Mechanical, Electrical, Plumbing (MEP), 9) Fire Safety, 10) Acoustics, 11) Environmental Sustainable Design (ESD), 12) Land Survey, 13) Landscaping, and 14) Construction. By organising closely related activities or actions within specific packages, these work processes are structured as modules. The grouping of activities within these packages is determined by the typology of professional activities and the dependency constraints between them. The time sequence further aids in ordering these modules. This method contributes to the development of a concept of process modularity for the case study project. While the current project does not directly implement these modules as a platform-based approach, they serve as essential ingredients for future platform module development. In future, as these modules are applied across multiple projects, the professional boundaries between work packages may become less distinct, resulting in enhanced integration between work processes, improved collaboration between project teams and increased efficiency within future IB projects.

As illustrated in Figure 04, these modules consist of a set of closely related actions that are frequently performed within the same time frame. These process modules (along with their action links) enable the efficient execution of interdependent activities, allowing for greater control and coordination of work activities. It is worth noting that the linked actions belong to other work packages, indicating that when one action or activity takes place, it is supported by relevant actions from other clusters, and often contributes to the execution of a future action. Moreover, the modular structure of the work packages identifies the stakeholders who perform the process either as action-takers, predecessors or successors. Figure 04 further suggests that the Planning, Architecture, Prefab, and MEP work packages consist of the highest number of process modules. These four clusters collaborate primarily through the common module of preparing documents for Town Planning permit.



1.0 GENERAL / COORDINATION

Links	Process modules (on time factor)	Stakeholders
	1.1 Determining data sharing system	DE
4.5, 4.8	**1.2** Determining BIM tool	DE, AR, PR, ME
14.5	**1.3** Determining 80% design level	DE, AR, PR, ME, SE, TP
4.8	**1.4** Design coordination & integration process	DE, AR, PR, ME, SE, FE
4.9, 14.5	**1.5** Tender document preparation steps	DE, AR, PR, ME, SE, BU

2.0 MARKETING & SALES

Links	Process modules (on time factor)	Stakeholders
4.4, 8.4	**2.1** Recommendations by Marketing team	MS, DE, AR, ME
3.3, 4.7	**2.2** Finalising specs as per Marketing content	MS, AR, ME, FE
	2.3 Appointing Sales agent at 80% design level	MS, DE, BU

3.0 AUTHORITIES, TOWN PLANNING

Links	Process modules (on time factor)	Stakeholders
	3.1 Selecting Town Planner	DE
3.2, 9.2	**3.2** Determining TP approval / amendment stages	TP, MS, AR
2.2	**3.3** Generating a list of proposed changes	AR, PR, BS, SM, TM
11.2	**3.4** Reviewing proposed changes	BS, SM, TM
4.6, 13.2	**3.5** Submission for TP Amendment application	TP, AR, PR, ME, SM, TM, TE
13.2	**3.6** Complying to TP Amendent approval advices	AR, TM, SM, PR
	3.7 Gathering & reviewing updated design docs	AR, ME, PR, BU
11.3	**3.8** Submitting updates for secondary TP consent	TP, AR, TM

4.0 ARCHITECTURE

Links	Process modules (on time factor)	Stakeholders
	4.1 Revised parking & fire compliance in basement	AR, MS, FE, TE
13.2	**4.2** Check with TP on basement, trees & heritage	AR, BS, SM, TM, TP
13.2, 6.1, 6.2	**4.3** Reviewing Prefab structural scheme	AR, PR, ME
2.1	**4.4** Comply to Marketing team's recommendations	AR, MS, PR, ME
1.2	**4.5** Developing 3D (BIM) model of design	AR, PR, ME
3.5	**4.6** Preparing drawing set for TP submission	AR, ME, PR, SE, SM, TE, TP
2.2, 5.2, 11.2, 5.3, 14.4	**4.7** Reviewing and updating design for fire issues	AR, BS, FE, SE, PR, ME
1.2, 6.1, 8.7, 1.4, 6.6	**4.8** Design coordination with other consultants	AR, DE, PR, ME, SE, FE
6.8, 10.4, 1.5, 5.4, 14.5	**4.9** Issuing Tender pack for Builder's quotation	AR, ME, PR, SE, SM, BU

5.0 BUILDING SURVEY / REGULATORY

Links	Process modules (on time factor)	Stakeholders
	5.1 Appointing Building Surveyor	DE
6.1, 4.7, 9.4	**5.2** Reviewing Architectural design & Fire safety	BS, AR, FE
4.7	**5.3** Developing NCC report for compliance	BS, AR, FE, SE
4.9	**5.4** Feedback on Tender pack	BS, AR, ME, PR, SE, SM

6.0 PREFAB BUILDING SYSTEM

Links	Process modules (on time factor)	Stakeholders
4.3, 4.8, 5.2	**6.1** Developing initial design for Architect's review	PR, AR, BS
4.3	**6.2** Developing floor system	PR, ME, FE
9.2, 8.3, 9.6	**6.3** Developing roof, stair and lift systems	PR, AR, ME, FE
7.4, 8.8, 14.4	**6.4** Developing detail of Prefab structural system	PR, ME, AR, DE
10.3	**6.5** Revising floor system (CLT Floor)	PR, AR, ME, AC
4.8, 7.4	**6.6** Design review and integration in Revit model	PR, AR, ME, SE
	6.7 Developing production concept	PR
10.4, 4.9	**6.8** Issuing Tender pack for Builder's quotation	PR, AR, ME, SE, SM, BU

7.0 STRUCTURE & CIVIL

Links	Process modules (on time factor)	Stakeholders
	7.1 Developing initial design for RCC basement	SE, AR
	7.2 Check with Prefab system & Geotech report	SE, PR, GE
11.3, 8.3, 4.8	**7.3** Coordination with MEP based on ESD report	SE, ME, SM
6.4, 6.6	**7.4** Structural design review for load path	SE, AR, PR, ME

8.0 MECHANICAL, ELECTRICAL, PLUMBING (MEP)

Links	Process modules (on time factor)	Stakeholders
	8.1 Determining MEP issues (power, pump, EV)	ME
	8.2 Documents required for design consolidation	ME, BS
11.2, 6.3, 7.3, 12.3	**8.3** Plumbing design based on ESD report for TP	ME, SM, AR, PR, TP
2.1	**8.4** Determining Mechanical design requirement	ME, MS
2.1, 11.2	**8.5** Updated ESD report for Mechanical design	ME, SM, AR, PR, TP
	8.6 Electrical design scope (prewiring in Prefab)	ME, PR
4.8	**8.7** Developing Concept Design Report for review	ME, DE, AR, PR
6.3, 6.4	**8.8** Develope lighting design with fire compliance	ME, FE, AR, PR
	8.9 Checking voltage line and power supply	ME, DE
10.2	**8.10** Coordination to Finalise Concept Design	ME, AR, PR, FE, SM, SE
4.9	**8.11** Preparing detailed Tender Pack	ME, AR, PR, FE, SM, BU
	8.12 Application for water and sewer connection	ME, DE, BS

9.0 FIRE SAFETY

Links	Process modules (on time factor)	Stakeholders
	9.1 Initial proposal for Fire safety	FE, ME, AR
3.2, 6.3	**9.2** Initial Fire safety review	FE, AR, ME, PR, DE, TP
	9.3 Fire satefy issues of stairs & building services	FE, ME, AR, PR
5.2	**9.4** Review by Building Surveyor (sprinkler)	FE, BS, ME, AR, PR
	9.5 R-129 Application for Fire Compliance	FE, ME, DE, BS
6.3	**9.6** Performance-based design review with others	FE, AR, ME, PR, SE

10.0 ACOUSTICS

Links	Process modules (on time factor)	Stakeholders
	10.1 Review acoustic performance of Prefab system	AC, PR
8.10	**10.2** Acoustic evaluation of MEP Concept Design	AC, ME, AR
6.5	**10.3** Finalise acoustic requirements at 80% level	AC, AR, ME, PR, SM, FE
4.9, 6.8	**10.4** Providing review feedback for Tender pack	AC, AR, ME, PR, SM, BU

11.0 ENVIRONMENTAL SUSTAINABLE DESIGN (ESD)

Links	Process modules (on time factor)	Stakeholders
	11.1 Suggesting low carbon service design scope	SM, ME, AR
4.7, 8.3	**11.2** Determining sustainability rating for TP	SM, DE, AR, ME
3.8, 7.3	**11.3** Updating report for Council's second consent	SM, ME, AR, TP, BU

12.0 LAND SURVEY

Links	Process modules (on time factor)	Stakeholders
	12.1 Requiring exisitng land survey drawing	LS, DE, AR
	12.2 Developing required site consolidation plan	LS, DE, AR
8.3, 14.5	**12.3** Updating survey plan for marked service design	LS, ME, DE, AR

13.0 LANDSCAPING

Links	Process modules (on time factor)	Stakeholders
	13.1 Requiring Arborist report on site tree profile	LA, TM, BS, TP, AR, DE
3.5, 3.6, 4.2, 4.3	**13.2** Developing amended tree schedule for TP	LA, TM, AR, TP

14.0 CONSTRUCTION

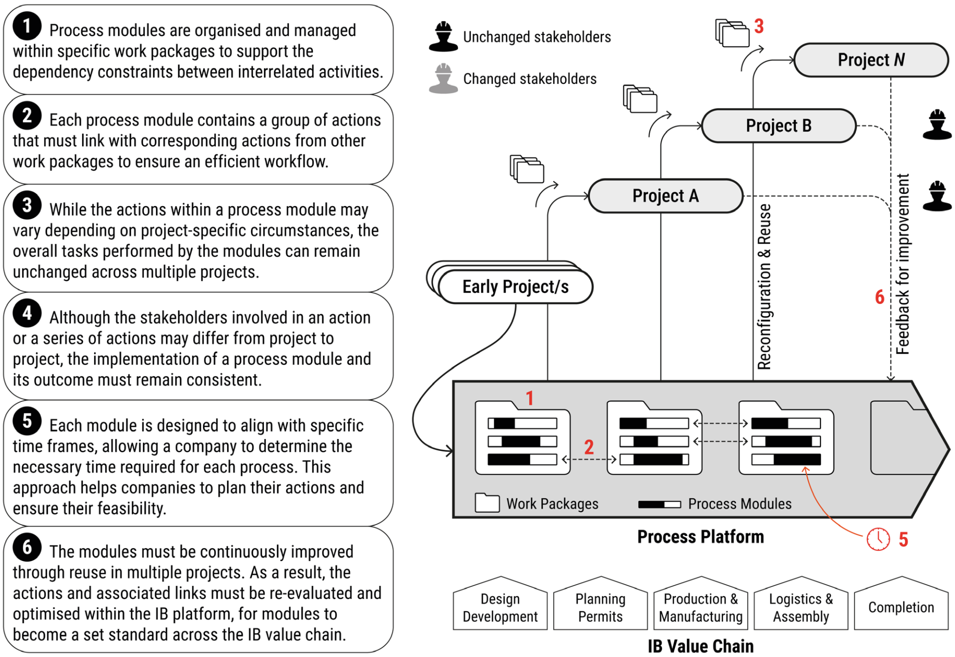
Links	Process modules (on time factor)	Stakeholders
	14.1 Ideas on Lift sourcing and installation	DE, BU
	14.2 Protection work notice & neighbours' consent	DE, BU
	14.3 Planning site mobilisation, craning & scaffolding	DE, BU
6.1, 6.4, 4.7	**14.4** Design coordination on building details	DE, BU, AR, ME, PR
1.5, 4.9, 11.3, 12.3	**14.5** Evaluating Tender pack to develop price offer	BU, AR, PR, ME, FE, SE

▬ Action taker ▬ Supported by (predecessor) ▬ Provided to (successor)

Fig. 04. Developing process modules within IB work packages.

More intricate relationships between work packages, such as General, Architecture, Building Survey, Prefab, MEP, Acoustics, and Construction, can be observed within the common module of preparing and reviewing a detailed Tender Package. Supporting modules from other clusters, such as Marketing, Structure/Civil, Fire Safety, ESD, Land Survey, and Landscaping also contribute to the overall design development and planning permit stages, leading to the execution of the Tender Package development. Therefore, identifying and grouping corresponding actions can allow for optimised project planning and execution, reducing development time and costs while improving collaboration and overall project success.

While this research project is yet to reach the production and manufacturing, logistics and assembly, and completion stages, it is expected that activities involved in these stages can be similarly structured as process modules within the specific work packages for future reusability. The results of this paper align with Lessing's (2006) platform concept in IB that emphasised the way structured process modules can facilitate the development of process platforms that holistically contribute to increased productivity and product variability in IB. Based on the above analysis, preliminary guidelines (Fig.05) are proposed as a means to develop process modules:



❶ Process modules are organised and managed within specific work packages to support the dependency constraints between interrelated activities.

❷ Each process module contains a group of actions that must link with corresponding actions from other work packages to ensure an efficient workflow.

❸ While the actions within a process module may vary depending on project-specific circumstances, the overall tasks performed by the modules can remain unchanged across multiple projects.

❹ Although the stakeholders involved in an action or a series of actions may differ from project to project, the implementation of a process module and its outcome must remain consistent.

❺ Each module is designed to align with specific time frames, allowing a company to determine the necessary time required for each process. This approach helps companies to plan their actions and ensure their feasibility.

❻ The modules must be continuously improved through reuse in multiple projects. As a result, the actions and associated links must be re-evaluated and optimised within the IB platform, for modules to become a set standard across the IB value chain.

Fig. 05. Guidelines to develop process modules

Recent studies focusing on process-orientation in IB primarily highlight the significance of production-related aspects that enable the transfer of knowledge from executed projects to product platforms (Lessing, 2006, Jansson, 2013). However, a relatively unexplored area pertains to the novelty of structuring processes in modular forms for reconfiguration, re-use and refinement. From the examination of work processes in this applied research project, the concept and guidelines presented in this paper offer a structure to explore process modularity in future IB projects.

Conclusion

This study outlines the potential benefits of a platform approach in IB when a distinction is made between product and process-orientation. It is argued that IB companies' product platform approaches are predominantly product-oriented, prioritising standardised and repetitive product development, limiting focus to process orientation, while tending to oversee the potential benefits of developing and reusing standardised building processes. The concept of process modularity is discussed in this context, with Lessing's (2006) platform model, serving as a basis for structuring process modules for scalability and reusability in various IB projects.

The paper focuses on developing an explicit definition of process modules and how they can be structured as a platform-based approach. To achieve this goal the work processes across the design development and planning permit stages of an applied research project in Australia have been analysed as a case study. Australia is experiencing increased interest in IB, but the application of product platforms, from a process-orientation, is not fully explored. The research presents guidelines for organising interdependent activities in specific work packages as process modules that can then be reused in future IB projects. The proposed guidelines advocate for an approach where modules can be reconfigured when implemented across multiple projects, leading to increased efficiency, scalability and variability in IB delivery.

While still in development, this research provides initial insights into the potential of process modularity in IB production and the subsequent ability to achieve economies of scale across wider market segments. Nevertheless, there exists a research gap in the understanding of methods and guidelines for implementing process modules within the organisational structure of companies. To address this issue, further research will focus on how these process modules can be practically applied in future IB projects to increase scalability in product offerings.

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