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Using Relationship Mapping To Understand Sustainable Housing Stakeholders' Actions

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ABSTRACT

The production of sustainable housing requires the cooperation of a variety of participants with different goals, needs, levels of commitment and cultures. To achieve mainstream net zero energy housing objectives, there is arguably a need for a non-linear network of collaboration between all the stakeholders. In order to create and improve such collaborative networks between stakeholders, we first need to map stakeholders' relationships, processes and practices. This paper discusses compares and contrasts maps of the sustainable housing production life-cycle in Australia, developed from different perspectives. The paper highlights the strengths and weaknesses of each visualisation, clarifying where gaps in connectivity exist within existing industry networks. Understanding these gaps will help researchers and practitioners identify how to improve the collaboration between participants in the housing industry. This in turn may improve decision making across all stakeholder groups, leading to mainstream implementation of sustainability into the housing industry.

INTRODUCTION

Globally the key barriers inhibiting the residential construction industry's ability to implement sustainability requirements include technical, economic and regulatory issues, the culture and practices of the industry, the lack of feedback loops and poor levels of stakeholder engagement and communication (Holloway and Bunker 2006; Williams and Dair 2006; Osmani and O'Reilly 2009). The realization of efficient sustainable housing arguably requires the integration of functionality, cultural sensitivity and local climatic conditions into a long-lived product (Larsson 2004), enabled by the implementation of sustainability practices throughout the product life-cycle, from green field development and infrastructure provision, through design, manufacture and construction, to ultimate deconstruction, re-cycling or demolition (Romero et al. 2009; Miller and Buys 2012). This life cycle involves the contribution of many stakeholders such as infrastructure providers, building designers, constructors / contractors, product suppliers, policy makers and end-users /

occupants. Each stakeholder has different goals, needs, level of commitment and culture that influence their participation in the construction sector and, as a result, impact on the level of sustainability achieved by the end product.

Issues such as the lack of trust and communication among the participants, the short term demands rather than the long term goals, the opportunistic behaviours, and the lack of communication, contribute to producing low performance houses (Tzortzatou 2007). Tzortzatou proposes that these problems call for the need to follow a "partnering approach" that encompasses "*Collaboration, open channels of communication, and maximization of each participant's recourse and expertise through information and knowledge exchange*" (Tzortzatou 2007). Other studies show that firms that have trust-based, cooperative ties with their stakeholders are more likely to succeed than firms that do not (Heugens, Bosch and Riel 2002). Further literature suggests that a "relationship management" system that provides a collaborative environment and a framework for all stakeholders to adapt their decisions to project objectives is needed to expose hidden risks and maximize sustainability outcomes (Cheung and Rowlinson 2011).

In order to optimize sustainable housing outcomes, there must be a non-linear network of collaboration between all the stakeholders. This would enable essential building information to flow between stakeholders, thus minimizing uncertainty (Cheung and Rowlinson 2011) and influencing the decision making of all parties towards more efficient and sustainable outcomes (Miller and Buys 2013). However, the highly fragmented nature of the housing construction industry continues to constrain development of these networks (Cheung and Rowlinson 2011; Epstein and Widener 2011; Miller 2011), possibly due to the difficulty in developing a collaborative tool that could be implemented in such a fragmented industry. Rohracher suggests that socio-technical mapping can be used to identify the relevant actors, technology and means of interactions and communication between those actors, in order to understand and improve these networks (Rohracher 2001).

As an intermediate step between theory and practice, there is a need to develop an understanding of the map that charts the players, their inter-relationships, processes, knowledge, and goals. This paper will first describe a range of 'mapping frameworks' that represent the sustainable housing production life-cycle in Australia from different perspectives. These maps will be assessed to identify likely gaps in connectivity between the relevant stakeholders. The paper will then propose a new network map that closes these gaps, as a way to improve the collaboration and information exchange between different stakeholders, towards greater sustainable housing design and implementation in Australia

REVIEW OF AUSTRALIAN HOUSING NETWORK MAPS

This section presents three housing industry relationship maps, from the perspective of building information flows, construction industry relationships and end-user experiences.

Map1: Building Information Flows and Stakeholder Relationships. This network map (Figure 1) depicts current common practices relating to the creation and flow of information about an individual dwelling from site development through to first resale to a subsequent purchaser. The stages of the house production process are represented on the x axis (e.g. site development, land sale, planning, construction etc), whilst the key players involved in the processes are presented in the y axis. The diagram attempts to present, for each stage of development, which stakeholder creates information about that specific dwelling, and to whom this information is passed. This mapping shows that not all information about a dwelling is passed on through the supply chain, arguably impacting on decision making of subsequent stakeholders. It identifies four key relationships that impact on information flows: (i) developer / infrastructure provider (circular dot-dash lines); (ii) sales / valuation / finance (ellipse dotted lines); (iii) regulation / industry (square dotted lines); and (iv) initial purchaser / subsequent purchasers (ellipse dot-dash lines).

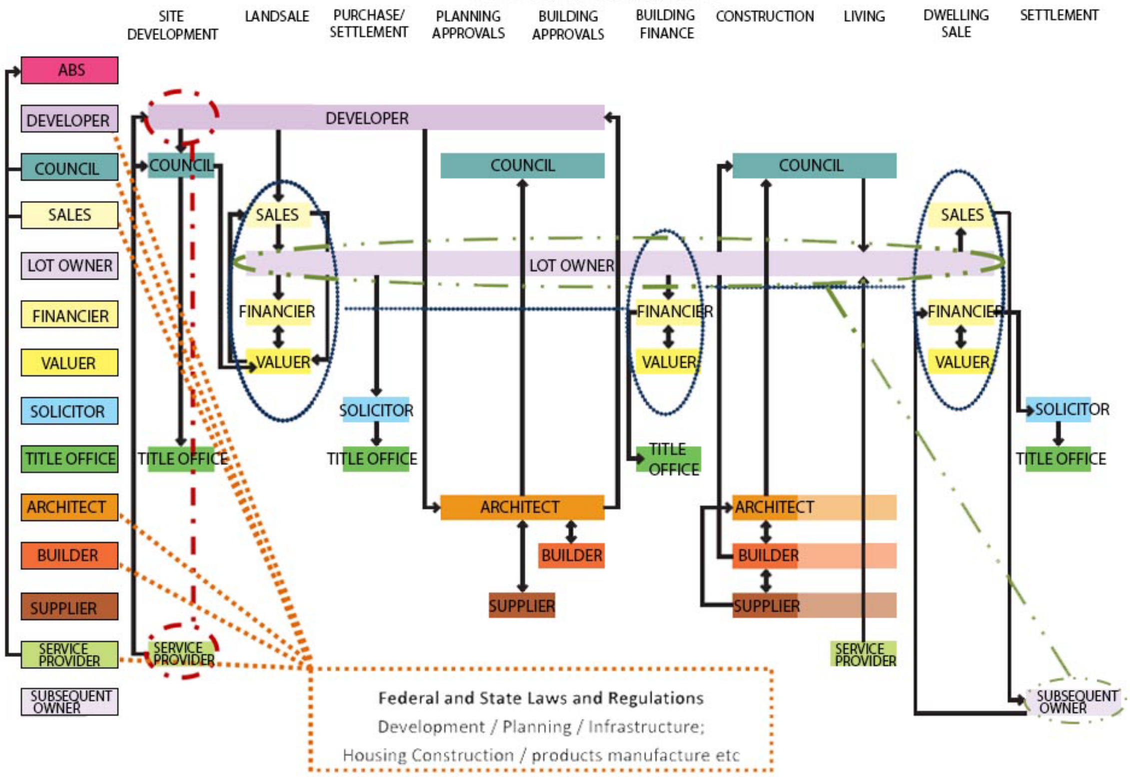

Figure 1. Housing Information Flows and Relationships map.

Map 2: Life Cycle Stages Of New And Existing Sustainable Houses. A housing production lifecycle map (Figure 2) was initiated by an Australian state government authority in 2014 and developed in a number of collaborative workshops with housing industry and associated supply chain stakeholders. The purpose of the mapping exercise was to help gain an understanding of the multiple stakeholder perspectives and network gaps in the industry. This map represents the ongoing production life cycle of existing and new buildings, starting from manufacturing until demolishing and reusing the materials in the creation of a new building. It depicts the key players involved in the creation and use of dwellings, and the collaboration between members of different sectors of the industry: resources, research and development, marketing, valuation, finance and real estate. Compared to the previous map, this map acknowledges the role of research as a key influencer in the production of sustainable housing. The map also considers the whole life cycle of a dwelling and the management of both new and existing homes.

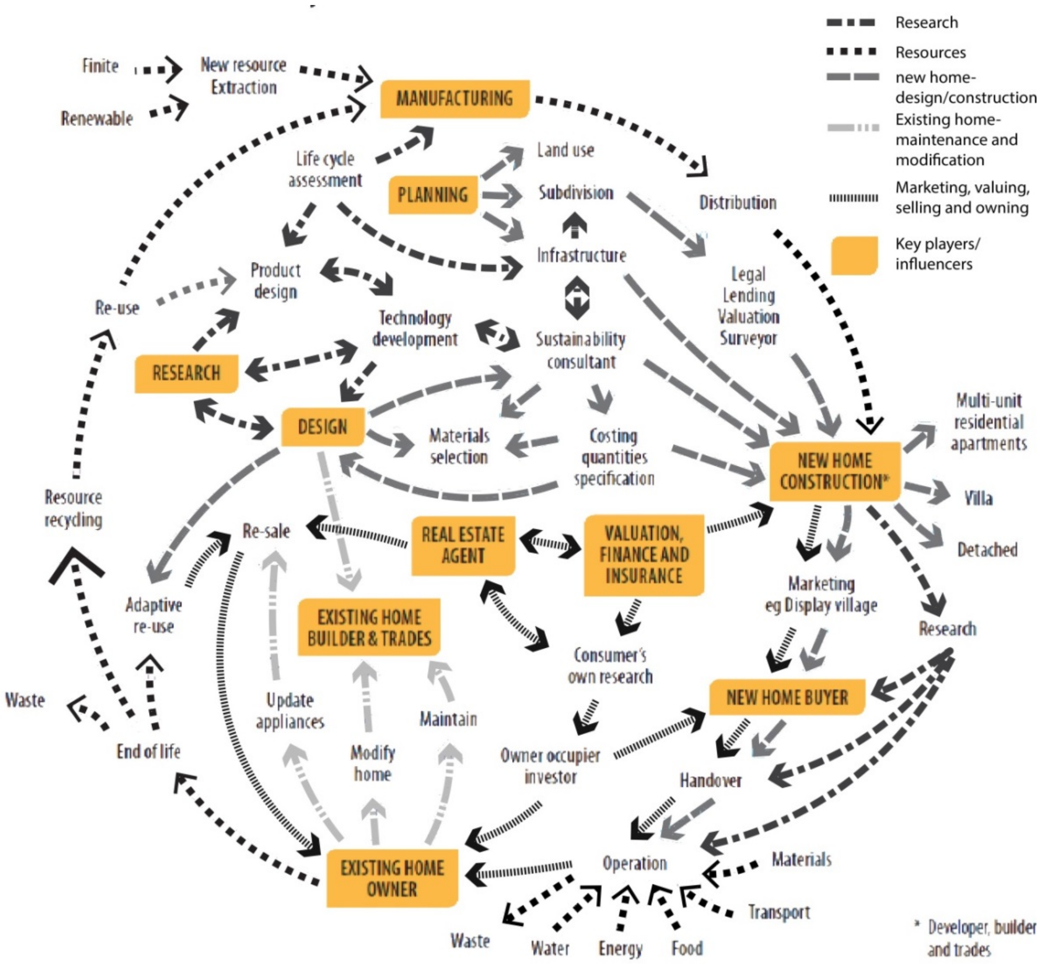

Figure 2. Life Cycle Stages of New and Existing Sustainable Houses map.

Map 3: A Sustainable House As An User-Centered Integrated System. The third map (Figure 3) was developed by examining and evaluating the experiences of end-users who were early adopters of contemporary sustainable homes in sub-tropical Queensland. This research strongly suggested that a sustainable house is an integrated system that is centered on end-user goals and aspirations (the centre hexagon), and incorporates the interconnections between these goals and aspirations, specific building elements, design and construction processes and practices, and the urban context (the six surrounding hexagons). These interactions take place within the context of multiple supply chain agents (the outer circle). Collectively these components contribute to the product - a sustainable house. This research further revealed that the success of the integrated system is highly reliant on good communication between stakeholders regarding goals, processes, and performance outcomes, and on robust decision support tools.

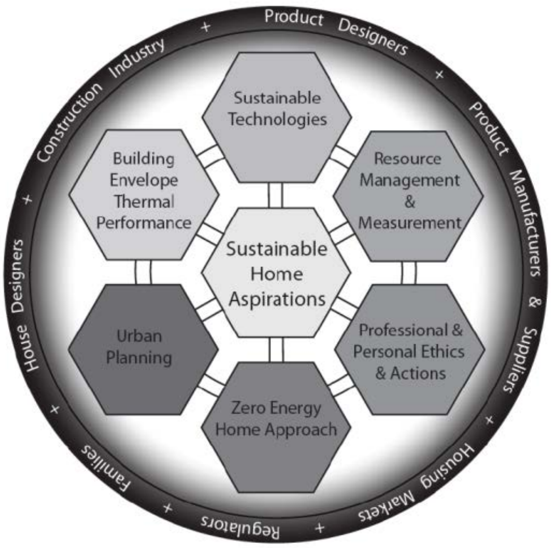

Figure 3. A sustainable house integrated system.

GAP ANALYSIS OF AUSTRALIAN HOUSING NETWORKS

Whilst all three maps reveal relationships between the Australian housing industry stakeholders, each map portrays different aspects of housing industry collaboration (or lack thereof). Maps 1 and 2 are industry focused, based on existing practices. Map 4 (Figure 4) represents an integrated version of these maps, where the outer circle represents the life-cycle phases while the inner circle identifies the key members in both maps, involved in each specific phase. This revised representation makes it easier to identify the many missing direct channels

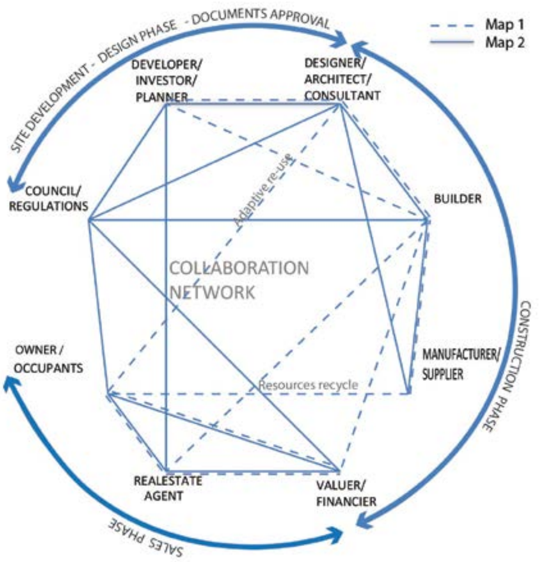

Figure 4. Gaps in existing practices. (Network density=0.6)

of information exchange between stakeholders within the construction life cycle (e.g. between the real-estate market and designer or occupant and builder).

Three key gaps are revealed in these industry-focused maps: (i) where information flows (or should flow); (ii) the direction of information flows; and (iii) the (lack of) active involvement participation of end-users. Map 1 (Figure 1) revealed that information created about a dwelling at different stages of its production is often not passed on from one set of stakeholders to subsequent stakeholders. For example, very little information is passed from the developer / infrastructure provider relationship to other parties, while no information at all is passed from the sales / valuation / finance relationship to the designer. Another example is the little information passed to the subsequent owner, whose only source of information is the sales agent who is likely not aware of most of the information. This lack of information exchange leads to un-informed decision making or additional costs in the re-creation of the information. One way to overcome this gap is to create a ‘building file’ which holds all data sets that could be utilised by different members throughout the building life-cycle. The building file concept is already being developed in several EU-countries. It provides sets of information related to a particular dwelling, such as description of the construction’s materials and elements, legal information, condition report, quality reference, maintenance guide and energy label. These sets of information support the buyers, occupants and policymakers in their decision making process (Van der Bos and Meijer 2005). The building file concept could be expanded to include sets of information that are distributed to all stake holders since the inception of the project, using a variety of information generation, storage and collaboration tools, such as building information model, energy simulation software, building diagnostic tools, and post occupancy evaluation. Such a building file acts as a storage hub that stores all the building data for future reference, and is updated throughout the building life cycle to enhance transparency, so that the impact of every decision is shown to all members.

Map 2 depicts many of the production stages as uni-directional (e.g. transition from design to consultant to construction to marketing to new home buyer). A bidirectional exchange of information would arguably enable each stage to provide feedback loops to previous stages to enhance efficient and sustainable construction outcomes. Robust building documentation systems and feedback loops, combined with a ‘living lab’ approach, are needed in order to achieve the user-centered aspirational view depicted in Map 3. The living lab involves the user in the creation, exploration, experimentation and evaluation of innovations through active involvement in all stages, including post-occupancy feedback (Romero, et al., 2009).The living lab could be the link between maps 1, 2 and 3 in integrating research, user participation and the on-going cycle of information flow between research and practice, occupant and the housing industry.

TOWARDS A COLLABORATIVE NETWORK

Map 5 (Figure 5) is a theoretical representation of how gaps in common practice might be filled, enhancing the bidirectional flow of information between stakeholders during the different housing construction lifecycle phases through a network that directly connect each stakeholder to all the other stakeholders. In this map, each key member (including energy efficiency evaluator that was added as a key member in the construction phase), has access to an "information hub". This hub contains information collected from all the stakeholders that are related to the specific key member and can better inform the decisions of that member. Table 1 gives examples on how the decisions of each stakeholder are affected by other parties within the same network, and therefore how better access to information could improve the participation of each stakeholder in the housing network. This network impacts on different outcomes of the housing industry: stronger networks are expected to lead to more informed decisions which in turn should lower risks and result in higher performance sustainable homes.

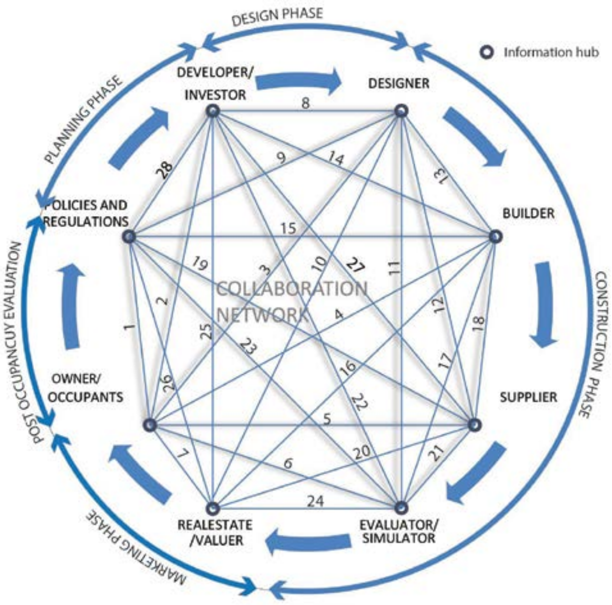

Figure 5. A Collaborative Network (network density =1)

Table 1: Examples of Collaborative Communication Networks (Map 5)

line	Members	Sample Relationship Descriptions
1	Occupant/policy and regulation	Policies are made for the safety and well-being of the occupant. Occupant awareness of the regulation assists his choice.
2	Occupant/developer	Developer makes investments based on the needs of targeted occupant.
3	Occupant/designer	Occupants' needs and behaviours influence designer (user-centred design). The design influences the behaviours and wellbeing of the occupants.

4	Occupant/builder	Quality construction (insulation, airtightness) influences occupant's behaviour and enhance wellbeing. Occupant feedback can influence quality construction.
5	Occupant/supplier	Quality of materials can influence occupants' decisions and health.
6	Occupant/simulator	Occupancy (number and behaviour) impacts on simulation results. Feedback from occupants can influence simulation development.
7	Occupant/real-estate market	Occupants influence as well as are influenced by, the market value. Real estate agents can promote sustainable housing benefits to occupants
8	Designer/developer (investor)	Designer incorporates aspirations of the investor into his designs, and integrates sustainability in a way that does not compromise the goals of the investor
9	Designer/ regulator	Regulations stipulate minimum design and construction standards. Designers can exceed regulatory requirements for best practice.
10	Designer/real-estate market	Designers and real estate agents can respond to, and create, market demand for sustainable housing.
11	Designer/simulator	Ongoing modification in the design based on the simulation results could achieve optimal sustainability performance at least cost.
12	Designer/supplier	Designer awareness of the lifecycle impacts of construction products and locally available sustainable materials.
13	Designer/builder	Ongoing bidirectional relationship to adapt the design to circumstances without compromising performance quality and ensuring construction is as per design.
14	Builder/developer	Developer goals should not be altered during construction.
15	Builder/regulator	Construction is bound by the regulations. Regulators should ensure compliance.
16	Builder/real-estate	Quality construction leads to higher market value. Valuation strategies need to incorporate sustainability characteristics.
17	Builder/simulator	Simulator modifies simulation based on 'as constructed' information, verifies existing situation is similar to design, and gives evaluation feedback to builder
18	Builder/supplier	Quality of supplies is assessed by builder. Supplier assists in the quality implementation of his products into construction.

19	Supplier/regulator	Regulations regarding the use of materials, production and transportation.
20	Supplier/real-estate	Knowing products and materials quality will assist in the valuation process.
21	Supplier/ simulator	Knowledge of material impact on energy performance.
22	Simulator/developer	Simulation can influence initial decisions of the developer.
23	Simulator/regulator	Construction to be checked for compliance with simulation's energy rating.
24	Simulator/real estate market	Simulation results (e.g. energy performance certificates) can be used as a sales promotion document by real estate agents.
25	Real-estate /developer	Consideration of mechanisms and tools to value the project in the current market and future markets (over the lifecycle of the dwellings / estate).
26	Real-estate/regulator	Agents are bound to regulations when promoting or contracting a property.
27	Developer/supplier	Developer should invest in using and developing sustainable materials.
28	Developer/Regulator	Developer should follow regulation. Regulation should encourage investments.

CONCLUSION

The paper examined two maps that represented existing common practice and stakeholder relationships in the Australian housing industry and a third map, centered on the end-users' perspectives. From the analysis of these maps it became evident that there are gaps in the information network that connect the stakeholders to each other throughout the housing production life-cycle. These gaps could impact the sustainable housing outcomes. The paper then represented a map which reflects the need to treat sustainable housing as an integrated system, where collaborative processes are made to reach solutions that maximize sustainable housing outcomes. A further development of this paper could be the integration of maps three and five, where the information from each member's related "information hub" in Map 5 is used to make informed decisions that contribute to the fulfilment of a centeral goal which is the sustainable house aspirations of the occupants.

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