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A Question of Continuing Control - Balancing Building Quality of Housing and Building Codes

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The Building Code of Australia seeks to establish “nationally consistent, minimum necessary standards of relevant, health, safety (including structural safety and safety from fire), amenity and sustainability objectives efficiently”\(^1\). These goals are laudable – but where are the goals of quality and maintenance, which are also an essential part of achieving adequate and continuing health and safety for the built environment?

Defects such as dampness, settlement and cracking, staining, wood rot, termite damage, rusting, and roof leakage are common enough to suggest that there are still issues with building quality in housing. They are caused by a combination of initial poor workmanship and poor quality materials and latterly by poorly executed or inadequate maintenance.

Local architecture, developed over many years of trial and error, produce buildings linked to their climate and local materials (think of the typical “Queenslander” house). Today’s architecture imports technologies and materials from many differing countries and climates – that are not necessarily suitable for the location, nor is there necessarily the same quality control over the material quality and production. Inappropriate use and inadequate understanding of new materials and techniques can lead to the generation of further defects.

Whilst the building code contains provisions for initial-build material quality and workmanship, there is no continuing control over a house over its life span. Reliance is placed on advertising the need, for example, to employ qualified tradespeople; replace batteries in smoke detectors; and other good advice to help maintain housing to a minimum standard. Is this sufficient?

Mechanisms to make the transfer of knowledge to those who need to use it – be it the workforce or the houseowner – need to be improved. Should the building code be more visual and accessible in its content? Should the building code include provisions for maintenance? Should the building code require every house to have a “users manual” – much like a car? An extensive review of literature identifies the scale of the problem of poor quality housing and highlights some suggested causes – inadequate knowledge of the BCA by general housebuilders being one. However little work has been done to investigate what could be done to improve the situation. This work suggests that improvements to knowledge transfer would improve the quality of housing and a model of the knowledge transfer process is proposed, identifying those areas

\(^1\) http://www.abcb.gov.au/go/thebca/aboutbca
where the knowledge flows need to occur that would impact both the builders and users of housing.

1.0 BACKGROUND

The Australian housing industry is an important sector of the economy with a yearly expenditure of $30.9 billion in 2006-2007 on new dwellings. Expenditure on alterations and additions accounted for $27.2 billion and constituted 2.9% of the gross domestic product (GDP) (Mills et al 2009). In 2006-2007 the total number of dwelling unit approvals was 152,790 where 24,541 approvals were for new residential buildings (Australian Bureau of Statistics, 2008).

The lack of quality in the housing industry remains a contentious issue (Georgiou et al 2000). Defects, particularly created by registered builders, suggest that the issue of house building quality in Australia should be prioritised (Georgiou et al, 1999; Ilozor et al, 2004). The Australian Housing Survey (AHS, 1999) found over half of all occupied dwellings in Australia, to be in need of some repair, with 2% in need of essential and urgent repairs. Major structural problems such as cracks in walls and floors, sinking or moving foundations, rising damp and electrical or plumbing faults were listed as a defect by the house owner. However, a later survey conducted by AHS in 1999 (reported by Australian Bureau of Statistics 2003, found that the situation had significantly improved with 80% of Australian dwellings reported to be in good condition, with the majority of households reporting no major structural problems. However, 20% of housing still reporting defects suggests significant scope for improvement in the building process.

The main purpose of this paper is to achieve the following objectives;

- To explain the concept of ‘quality’, focusing on the housing industry in Australia;
- To determine the key elements and contributors to quality building in Australia;
- To propose a model that includes areas for improvement in knowledge transfer that could improve quality house building

This paper first defines the concept of quality, reviews the current status of house building, maintenance and repair in Australia and proposes a model that integrates four elements of producing quality (control, innovations, best practice guidance and audit/appraisal). This model identifies the knowledge transfer linkages that could assist construction industry players and ultimately offer a better quality product to the end-user.

2.0 DEFINING THE CONCEPT OF ‘QUALITY’

Research over the last few decades has looked into the quality of building output. The need for improved performance and quality within the total building process has led to the evolution and subsequent adoption of quality assurance in building works. The current trend in the construction industry is now moving towards higher quality (Peng & Hong, 2005). But what is quality? Various authors have offered definitions. Quality is ‘fitness for purpose’ (Juran and Godfrey, 1999; Ho, 1995) and ‘conformance to the requirements’ (Crosby, 1984). The quality of the building is defined as the degree to which the design and specification meets the requirements for that
building (Clift, 1996). Quality or excellence (Sungur & Cagdas, 2003) equals a person’s satisfaction with the physical components of a building that meet the requirements. A definition of quality offered by Burt is ‘the totality of the attributes of a building, which enable it to satisfy needs’ (Burt, 1978). A building that does not achieve a minimum standard or meet requirements can therefore be categorized as a low quality output. These definitions have similarities in that all indicate that quality is about meeting customer requirements. The areas to consider further are therefore customer requirements, fitness for purpose, specification and standards.

In the context of the building industry, customer requirements can refer to the end-users or building user needs. It is therefore important to discover what these requirements are. Douglas (1994) suggests the four primary factors occupiers look for in their buildings are location, quality, flexibility and cost efficiency. If we provide a building product with extras that building users do not want, we will not add quality. If we provide what we think are high quality products or services because they are provided by well qualified and caring professionals who “know what is best”, will the building users agree with the professionals and think that they are receiving a high quality of building? Not necessarily.

‘Fitness for purpose’ is an especially useful definition when considering which building layout, form or services are most helpful for that building’s particular function. Fitness for purpose can also relate to a building’s ability to fulfil the functions of its intended use (Williams, 1993).

Crosby’s definition (1984) - conformance to requirements - means that the requirement must be specified. The specification is frequently described as a ‘standard’ and therefore should give an indication of what must be done if the standard is to be met. It should be easy to assess whether or not a standard has been achieved. Standards are increasingly used in this way in industries where players are required to conform to nationally set standards and building codes. Performance specifications of the building are achieved when standards are met. Performance can be defined as the functions of a building that are required to satisfy human needs (Tivendale, 1997). Standards and specifications should be stipulated clearly so that interpretation is not required, and misinterpretation does not result in defects or poor quality. Whilst the professional should understand the requirements of specifications and standards, the client is unlikely to appreciate or recognise if the required standards have been achieved.

The objective, regardless of definition, is to achieve quality – that satisfies end-user requirements and complies with regulations and standards.

3.0 OVERVIEW OF HOUSING QUALITY IN AUSTRALIA

Housing quality has become a significant issue worldwide. The lack of attention to quality control by house builders in the Australian State of Victoria has been a contentious issue for more than two decades (Georgiou et al, 1999). Housing Association Property Mutual has analysed data from audits of 31,000 dwellings in Victoria and identified common potential defects for six element of construction: foundations, ground floors, external masonry walls, pitched roofs, separating walls and intermediate floors (Ilozor et al 2004).
Ilozor et al (2004) found that particular issues with housing quality are non-compliance with building regulations, lack of technical guidance, conflicting requirements and utilisation of marginal sites. It also confirmed that the majority of defects occur through failure to achieve adequate standards with traditional forms of construction, rather than with novel or innovative construction.

3.1 Building defects, repair and maintenance

There are numerous definitions of what constitutes a defect (Porteous, 1985; 1992). But the simplest definition is that provided by the Oxford English Dictionary, which defines a defect as “a shortcoming or falling short in the performance of a building element”. This definition has been legally validated as can be seen in the case of Schuller AG vs. Wickman Machine Tools Sales Ltd (Dorter & Sharkey, 1990) when defining a defect as “a situation where one or more elements do not perform its intended functions”. According to Georgiou et al (1999), there are three common aspects of defects which should be considered as a priority factor: technical: when the workmanship or material of an element reduces its capacity to fulfil the functional performance of a structure; aesthetic: when the appearance of a material or building element is adversely affected and functional: when a dwelling fails to function in its intended manner.

Most of the housing stock in Victoria Australia is characterised by detached timber, brick-veneer and solid brick dwellings, with concrete slab or suspended timber framed floors, steel sheet or terracotta/concrete tiled roofs and aluminium/timber framed joinery (Ilozor et al 2004). Inadequate design information and poor site practice (Ilozor et al 2004) may cause housing defects. The same study by Ilozor et al found that the most frequent categories of house faults needing attention in Victoria State are timber framing and roofing faults and suggested that a greater focus on both elements during construction would make economic sense. Mills et al (2009) found that defects in footings and water ingress were the major sources of rework in Victoria State. Defects such as these arise from both poor specification as well as poor construction practice (Briffet and Aik 1991). Building defects also occur through the normal wear and tear of building use or result from natural climatic exposure effects. These defects are commonly unavoidable. Therefore, the designer should always specify materials that can tolerate predicted weather conditions, for example the designer should not use inappropriate materials in coastal locations where the salty conditions and high winds generate harsher local weathering. Some paints may not weather well and a higher specification may be needed for high UV situations. These factors should be specified in the design drawings. In addition, poor quality maintenance work, general negligence and abuse by users will also result in poor quality buildings.

Given that one of the identified issues is non-compliance with building regulations, (Ilozor et al 2004) how can this be enforced? Faulty design decisions by the designer can be minimised through using correct specifications and Australian Standards and this should be picked up at working drawing stage by the appointed Building Surveyor, but there needs to be further education of the builders on how to carry out the requirements of the Building Code.

3.2 Defects and Builders’ Classification
In Victoria, there has been an increase in the number of houses constructed by owner builders (Georgiou et al 1999). Whilst Georgiou et al (2009) found a comparable number of defects in owner built houses and those built by registered builders, registered builders were identified as being more able to respond to changes in legislation and quality requirements.

According to Mills et al (2009), the average costs of defects per house built between 1983 and 1997 in Victoria amounted to $4,245 which represents 4% of the contract value of new housing construction. The total cost of defects can be based on builder classification (Table 1).

<table>
<thead>
<tr>
<th>Table 1: Builders’ Classification in Victoria State, Australia</th>
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<tr>
<td><strong>General Builders</strong></td>
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<tr>
<td><strong>Owner Builders</strong></td>
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<td><strong>Restricted builders</strong></td>
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</table>

Source: Mills, Love & Williams (2009)

According to the Housing Guarantee Fund (HGF) database, cited by Mills et al (2009)(Table 2), ‘restricted builders’ had the highest claims made against HGF in terms of amount and number of claims made, Followed by ‘general builder’ and ‘owner builders’. Table 2 indicates that the average total number of claims on building defects (after 1988) was $4,504 which comprises $4,706 for ‘general builders’, $3,672 for ‘owner builders’ and $4,126 for ‘restricted builders’. Mills also concluded that the construction of dwellings by the ‘owner builders’ were better quality than those constructed by other builders because of better organisation and the highest professional approach to quality management.
Table 2: Total number of claims on building defects based on Builder Classification

<table>
<thead>
<tr>
<th>Builder Classification</th>
<th>Number of claims</th>
<th>Amount $</th>
</tr>
</thead>
<tbody>
<tr>
<td>General builder</td>
<td>8,708</td>
<td>4,587</td>
</tr>
<tr>
<td>Owner builder</td>
<td>735</td>
<td>3,672</td>
</tr>
<tr>
<td>Restricted builder</td>
<td>178</td>
<td>4,126</td>
</tr>
<tr>
<td>Group total/average</td>
<td>8,991</td>
<td>4,504</td>
</tr>
</tbody>
</table>

Source: Mills, Love and Williams (2009)

4.0 ENFORCEMENT OF BUILDING CONTROL AND BUILDING CODES

Building control is about ensuring high standards in construction work usually through the means of building regulations. It is a means of protecting the health and safety of people in or about buildings and making sure that the building performance meets peoples’ needs. “Regulation” can be defined as the deployment of legal instruments by public players for the benefit of public and private interest (den Hertog, 2003). The Building Act 1993 for Australia sets up requirements through the building regulations relating to inspections, occupancy permits and enforcement of regulations. The building regulation system in Victoria has been developed during the 1990’s into a leading model for other Australian States and Territories as well as for other countries (Building Regulation Reform, 2004). Building regulation is administered through various government instruments and agencies such as the Australian Building Codes Board (ABCB), the Australian Building and Construction Commissions (ABCC) and local Planning Authorities, etc. Building control includes the monitoring of quality standards in building works and can be an effective means of reducing building defects and material failure within buildings. The building control system is intended to provide controls so that buildings are properly designed and constructed to ensure health, safety, welfare and convenience of people using them. However, it would appear that the current system of building control is not as effective as it could or should be, given the number of defects and their repetitive nature.

4.1 Building Regulations and Enforcement

‘Building Control’ is part of achieving quality of building output. In Australia this is regulated through the Building Code of Australia and other legislation. The Building Code of Australia is a uniform set of technical provisions for the design and construction of buildings and other structures throughout Australia. It is fully performance-based and it allows for state variations to provide additional requirements or caters for specific community expectations.

Whilst the building regulations have continued to develop, the monitoring practices have more or less remained unchanged (van der Heijden, 2006). The building code contains provision for initial-build material quality and workmanship; however, there is no continuing control over a house over it’s life span. Reliance is placed on advertising
the need, for example, to employ qualified tradespeople; replace batteries in smoke
detectors; and other good advice to help maintain housing to a minimum standard. Is
this sufficient?

There needs to be an improvement in current mechanisms or changes in monitoring
practices geared towards ongoing control. Also the means of helping the house owner
 appreciate the requirements to maintain their property could be improved. Should the
Building Code of Australia be more visual and accessible in its content? Should the
building code include provision for maintenance? Should the building code require
every house to have a “users manual” much like a car? These questions address
issues of building control over the lifespan of a building. Quality of the building can be
improved by consideration of maintenance at the design stage and by considering more
appropriate mechanisms for knowledge transfer that suit the end-users.

4.2 Building Code of Australia (BCA) and Ongoing Control

The Building Code of Australia is a uniform set of technical provisions for the design
and construction of buildings and other structures throughout Australia. It is now fully
performance-based and it allows for state variations to provide additional requirements
or caters for specific community expectations. In achieving quality objectives, ideally
any building should not only meet initial design and construction standards, but should
continue to perform throughout its life time. There is only limited provision to ensure this
continuing performance.

Volume 1 (Class 2-9 buildings) of the BCA lays down requirements for the ongoing
maintenance of safety equipment to ensure the ongoing safety of building occupants.
The State of Victoria has more rigorous provisions for buildings built on or after 1st
July 1994 – these must be maintained to ensure building performance continues at the
same level of operation that existed at the time of commissioning and at the time of the
issue of the occupancy permit. For buildings built prior to 1st July 1994, a building owner
is responsible to ensure that safety equipment, safety fittings or safety measures are
maintained in a state which enables them to fulfil their purpose (Building Regulation
Reform 2004). Other states use other regulations to call up maintenance provisions
related to safety. For example -Section I of Volume One is enacted by South Australia
by way of a variation which states that the maintenance of safety measures must be
maintained in accordance with regulation 76 of the development regulations 1993, and
NSW also state essential fire or other safety measures must be maintained in
accordance with the Environmental Planning and Assessment Regulation 2000.

The specific details, policy or any legal requirements enforcing obligations on the owner
to carry out maintenance tasks are those contained in regulations at the time of
approval. Many owners may not however, be conversant with these regulations and
may not maintain any safety equipment, fittings or safety measures in an appropriate
way. Whilst these provisions apply to class 2-9 buildings, there are no ongoing
maintenance requirements imposed on householders. House owners also need
education about the importance of ongoing maintenance to ensure the optimal
performance of what is often, their largest investment.

4.3 Housing Maintenance Policy
Housing maintenance policies have rarely been a high priority of government in many countries (Lawrence, 1995). The Australian government has however established suitable ongoing control for public housing. Under the Housing Standards Policy (Office of Housing (OoH)), construction and maintenance standards have been established to apply to all properties under the care, management and funding of the Office of Housing. The policy standard clearly states that builders must meet the construction and maintenance standards. And additionally, in Victoria, the Construction Standard provides the policy framework for construction, redevelopment and design and construction activities. It’s aim is to ensure a cost effective common standard of amenity, accessibility and accommodation for all dwellings constructed and must comply with the Building Regulations 1994, Building Act 1993, Building Code Australia (BCA) and Australia Standards (AS) requirements. It also provides an outline design and amenity requirement and establishes appropriate, consistent and effective standards for the construction of new properties.

The Maintenance Standard drawn up by the Office of Housing is a legal requirement and reflects best practice in maintaining properties. These policies establish common maintenance standards for all public rental housing properties and specify the required minimum standard for tenanted properties. The maintenance policy sets out the maintenance requirements for occupied properties and aims to ensure that these properties are maintained in good repair and are safe and secure during the life of the tenancy.

These construction and maintenance standards, are however only applicable to those properties under the Office of Housing management for public dwellings. There is no legal requirement or document related to maintenance standard policy for private dwellings. Is this not important? Could government control not be extended to maintenance and applied to both public and private housing properties. The set of standards could be extended and applied to private dwellings as well.

5.0 IMPROVED CONTROL AND KNOWLEDGE TRANSFER

Quality control processes must be established as an approach to achieving quality outputs through various systems in an organization. The best way to measure the quality of any housing and construction project is by evaluating the degree to which the customer’s requirements are met. According to Wong (1996), ‘successful interfacing’ between organisations is one of the factors in achieving quality in the Australian construction industry. The author has argued that the current processes do not adequately deal with improving the performance in project delivery across the industry and experience has shown that these organisations do not always have the necessary knowledge, interest or understanding of the industry. Changes in the supervision system might offer an alternative route to improving the quality of the building control and clarifying the task and responsibilities of building control staff (van der Heijden et al, 2007). Indeed, Graves and Jaunzen (2004) (Figure 1) propose a model of successful building that includes an increased range of supervision at the design stage (briefing) and commissioning and handover.
In an attempt to improve the quality of housing, various mechanisms have been adopted and discarded by industry-based organisations and government organisations. This paper suggests that what is required are better linkages between the four factors considered to influence building quality performance. (Figure 2) - the elements of ‘Control’, ‘Innovations’, ‘Best Practice Guidance’ and ‘Audit/Appraisal’. Figure 2 shows the organisations and current guidance available which influence production of quality building performance in the Australian construction industry. These organisations provide a wealth of excellent advice, standards and current best practice guidance. However, their means of transferring this information to the user (owner-builder, or builder) is very limited. There needs to be significant improvement in ensuring the information transfers reach the “Actors” (ie builders) in the building process.

The element of ‘Control’ refers to the enforcement of any building regulation and policy made by the government in order to ensure that any housing project built should comply with the standard. ‘Control’ is the responsibility of government agencies such as the local authority, Office of Housing, Department of Environment etc.

The element of ‘Innovations’ refers to any research and development (R&D) work that has been made by the various agencies to produce a new technique, technology or greater understanding of the process. The results from these research findings and innovations, if disseminated to appropriate parties, would achieve better housing quality.

‘Best practice guidance’ is a government initiative to motivate key players in the industry to apply proper building practice. This is obtained through research programs organized by agencies such as the Australian Building Code Board (ABCB) and Australian Procurement and Construction Research.

‘Audit and appraisal’ is one of the approaches to set Key Performance Indicators (KPI). Benchmarking the performance of the housing industry can be achieved with the ongoing audit and appraisal of organisations.

If quality of housing is to be achieved, the element of ‘Control’ requires significant improvement. A combination of the 4 elements above creates a model that should indicate those areas requiring improvements in knowledge transfer to facilitate an improvement in housing quality in Australia. Research from other industries offers routes to improving knowledge transfer in the building industry.
5.1 Knowledge Transfer Mechanism

The quality of the environment is maintained and strengthened through the attainment and use of abstract knowledge (Martin, 1998). According to Krough (1998), knowledge is the main driver in business and that knowledge creation within a team is critical to sustain and increase competitiveness.

Knowledge is important to an organization when many researchers have agreed that by exploiting knowledge, it will improve the performance of an organization (Scarborough, 1999; Davenport and Perusak, 2000). According to Nonake and Takeuchi (1995), a company that manages knowledge effectively will have a better chance of long-term survival than those which underperform.

According to Wong (1996), the current processes in project delivery across the construction industry in Australia do not adequately improve quality. Lack of interaction between the key players in industries and non effective communication are the key contributors to this problem. Therefore better mechanisms to transfer knowledge are required to achieve significant improvement.

Knowledge transfer can be defined as a one-way flow of knowledge, but it is also known as 'knowledge exchange' (Meagher et al, 2008). Therefore, it is important to understand that knowledge transfer is one of the approaches that needs to be considered by organizations in order to produce quality of building output. For the body of knowledge to be utilized and enhanced, information sharing between the designer, facility manager, researcher, client, educators, code officials, industry partners and all stakeholders must be encompassing, continuous and evidence based.

In Australia and around the world, local governments are faced with increasing restrictions on resources, with simultaneously increasing demand for effective and accountable services, coupled with diminishing public trust (Brackertz and Kenley, 2001). Lack of expert knowledge and disagreement with the building regulations are the reasons why enforcement is not always adequate (van der Heijden et al 2007). According to Wong (1996), organisations do not have the necessary knowledge, interest or understanding of the industry that will address the issue of project quality in the Australian construction industry.

According to the Facilities Management Association of Australia (FMAA)(2006), there are several factors influencing the quality of building output which can be attributed to inadequate knowledge transfer at handover and inadequate knowledge transfer at turnover. Inadequate knowledge transfer at handover can lead to the building not being operated according to design intent and may increase the risk of operational inefficiencies and poor building performance. This risk can be mitigated by implementing a formal handover process by the designer, contractor and end-users in construction industry. The handover should include education, training, and handover of appropriate documentation and a building user guide with appropriate levels of details to the owner (Wallbank and Price, 2007).

Inadequate knowledge transfer in turnover is basically reflected in the lack of feedback from the client and building users to give significant information on poor building
performance to the designer. Improved feedback mechanisms from clients and users would reduce design problems being perpetuated in future housing projects.

**Figure 2:** Knowledge transfer and factors influencing production of Quality Building Performance in Australia

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**Note:**
- ANZECC: Australia New Zealand Environment Conservation Council
- ABCB: Australian Building Code Board
- DENR: Department of Environmental and Natural Resources
- APCC: Australian Procurement and Construction Research
- OoH: Office of Housing
- FMAA: Facilities Management Association of Australia
- AIBS: Australian Institute of Building Surveyor
- RICS: The Royal Institution of Chartered Surveyors
- CIOB: Chartered Institute of Building
- NABERS: National Australia Built Environment Rating System
- ABGR: Australian Building Greenhouse Rating
- CSIRO: Australian Commonwealth Scientific Research Organization
5.2 The need for change

Good multi-way communication channels should be encouraged between the owners, the designer, construction team and all the contributors to the knowledge base for the construction industry (Figure 2). An example of the benefits of good internal communication between council and community is provided by Brackertz and Kenley (2001) and was seen to be an essential factor in providing better outcomes. Better communication can be achieved through email newsletters, posters, forums or a suggestion box (FMAA, 2006).

Providing clear commissioning method statements in the early stages (sample commissioning method statements could be requested at the team selection stage) will assist better understanding of services by the house owner. This can be achieved through ensuring that all documentation is in order before the handing-over period. In addition, the building commissioner should ask the construction team and the designer to provide ‘user manuals’ which describe the services and their main functions in simple terms and give advice on monitoring their usage. Based on recommendations by the Facilities Management Association of Australia (FMAA), a ‘Building User Guide’ should be provided to occupants which contains a detailed description of the building. This user guide can be made easier to understand by appropriate use of language, diagrams and examples.

The local authority can also contribute to improving housing quality by offering a service that educates the housing owner or tenant. Learning from how buildings perform in use is central to the systematic improvement of the end product (Way, 2005). One issue, which does seem to have gained consensus, is that service quality should be viewed as an overall attitude held by the producer of the service (Shaw & Haynes, 2004). Building users often complain about aspects of their environment (Leifer, 2004), therefore implementing and creating a new policy involving the residents (that pays attention to the requirements for maintenance work on their homes) will facilitate more feedback and customer satisfaction. This could be achieved through consultation between the authority and residents.

6.0 CONCLUSIONS

The issue of quality of building needs to be considered from a range of viewpoints. Quality in housing is something that satisfies end-user requirements and complies with regulations and standards. The current initiatives and regulations are an opportunity to change the process in order to achieve better all round value. In order to do so, we have to become better informed on how the building process can be balanced with regards to the customer or users need. The need to upgrade and improve knowledge transfer approaches will facilitate and enhance building performance throughout its lifetime, by educating the builder, building owner, occupants and involving the local authority through better engaging the owner in the design and commissioning processes. Based on the current issues of housing quality in the Australian construction industry, an analysis of current literature and a review of the organisations providing
regulatory control, research, benchmarking, and best practice guidance, this paper suggests the following:

- There is a strong argument that the organisations identified in the model of knowledge transfer proposed in this paper should improve their communication and interaction with the producers of housing.

- The key elements and contribution to quality of housing in Australia could be achieved through a more effective knowledge transfer mechanism. Education of the end user of the building on how to use, operate and maintain their building – such as a “user-manual” would also radically influence maintenance; together with a stronger feedback mechanism that transmits defects back to the designers and producers of housing.

Therefore, the implementation of better knowledge transfer mechanisms through an effective communication strategy will improve the long term quality of housing. Finally, creating a knowledge chain among the four elements in proposed model 'Control', 'Innovations', 'Best Practice Guidance' and 'Audit/Appraisal', could lead a movement towards the continuous improvement in achieving the required quality in the Australian housing industry.

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