Design Evaluation: Current Practices and a Framework for Future Use

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Abstract

There is significant anecdotal information that good design leads to enhanced quality and higher community outcomes in the built environment. In theory, investing early in design brings better outcomes in regard to whole of life costing and value for money. Evaluating design by considering economic, social, aesthetic and environmental aspects, which includes consideration of objective and subjective attributes, is difficult. For the community a consideration of quality design for new facilities should not be left to chance. Design evaluation should be considered in a structured and consistent manner.

This paper consolidates the findings of how best to evaluate the value of design by forming a comprehensive framework for discussion. The paper analyzes and compares design evaluation tools in terms of functional, social, environmental and economic aspects. It is considered that this framework provides a holistic basis for evaluating design by considering societal benefits and sustainability, design cost, construction cost, operating outcomes and maintenance costs.

Key Words: Design Quality, Design Evaluation, Design Value, Value Quantification, Whole Life Cost

1. Introduction

Design quality is usually subjectively understood or sometimes may be misunderstood. Without an appropriate approach which can help model the outcomes of investing in design it might be perceived that a high quality design may become a luxury. There are several quotes from the government sources promoting the benefits of good design in built environment (Drogee, 1999; Victorian Government Architect, 2011). And also it is been cited in government publications that benchmarking is needed for design assessment (Miles and Chan, 2006; Victorian Government Architect, 2011). A need for design evaluation framework or tool becomes more evident when making procurement decision is aiming among different options. This need becomes more serious when the designers claim that their designs incorporate innovative ideas which may benefit the community and the environment.

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In Australia, at project level there are tools and methods introduced by the government which are used to assess the value for money (VfM) in public and infrastructure projects such as Public Sector Comparator (PSC). But these tools and processes usually tend to focus on financial issues and risk matters associated with projects. Design quality and related metrics are rarely considered in these processes or tools (Duffield 2005; Raisbeck et al. 2010; Sharp&Tinsley 2005). At design level of buildings there are few other tools such as NABERS and Green Star scheme which mainly have been developed to assess buildings or design of buildings with regard to environmental and energy use matters (1200 Buildings, 2012; GBCA 2011). Yet from perspective of building and construction industry there is not a holistic model or framework which considers all design aspects in order to evaluate the real value of good designs.

This study has undertaken a detailed review of approaches and methods used to quantify design value and then develop a consolidated list of quantitative and qualitative attributes of design quality. Of course what is attempted by this study is not unproblematic. One problem is comparing completely different tools which have different sets of attributes. The other problem would be justifying the importance of attributes from different parties' perspectives. Even identifying an appropriate list of attributes is challenging. The list of attributes has to be comprehensive enough to cover whole of life costs, operating revenues, energy expenses and other social and environmental issues. The findings have been used to establish a theoretical framework that can be used for design evaluation by practitioner as thinking tool in procurement and investment decision making process. This study documents a basis for future research in developing more practical evaluation and quantification tools.

2. What is already known about Design Quality Measurement?

A variety of methods may be used to assess design quality including qualitative and quantitative approaches. These methods include but not limited to multi-criteria analysis, opinion survey, expert judgment, benefit realization, cost-benefit analysis and other forms of assessment. In this study current techniques for the review and measurement of design quality have been undertaken by a reviewing the available evaluation tools and techniques related to design. Specific techniques considered include Design Quality Indicators, Housing Quality Indicators, Post Occupancy Review of Buildings, BREEAM, SPeAR, AEDET, NABERS and Green Star. A consolidated comparison of the techniques has then been undertaken and discussed.

DQI (Design Quality Indicator)

DQI is a tool for measuring design quality of buildings. This tool has been used for design as well as a tool for evaluating the value of post occupied building such as hospitals to improve their performance. The DQI's developers have emphasized that it is a tool for thinking not to provide absolute measures and also DQI cannot be used for design process improvement, it is only used for assessing the quality of design as a product (Gann et al., 2003; J. K. Whyte and Gann, 2007).

One of the arguments put forward by Thomas Markus about DQI is that using this tool to measure the quality of occupied building is not sensible due to the fact that it has been developed for measuring the design quality from the beginning. The other critic by Markus is mixing and balancing subjective and objective components of design in DQI (Markus, 2003).

DQI is lacking to integrate economic measures and also there are some problems with the DQI weighting system. The design quality drivers are treated equally. But this issue can be addressed in future work by using modeling techniques to provide more reliable results.

HQI (Housing Quality Indicator)

The Housing Quality Indicator has been developed by Department for Environment, Transfer and Regions (DETR) and The Housing Corporation in UK. HQI has been developed to satisfy the need for a method which directly can assess the housing quality. HQI not only can be used to evaluate different design against a fixed brief but also is applicable to evaluate the quality of existing buildings (Wheeler, 2004). Ten key indicators are considered in this tool including; location, site: visual impact, layout, landscaping, open space, routes and movements, unit size, unit layout, unit noise control, light quality, services, accessibility within the unit, energy, green and sustainable issues, performance in use.

PROBE (The Post-Occupancy Review of Building)

PROBE is a questionnaire based tool to reflect a building occupier view points as well as an energy survey which can be used for comparison and benchmarking. In fact, it is a system to convey feedback to clients and designers rather than a quantification tool. PROBE is usually used for further improvement to the building functionality and performance (Leaman and Bordass, 2001)**.** It is providing clients, designers, developers and occupiers with useful points from the actual users (Gann et al., 2003).

BREEAM (Building Research Establishment Environmental Assessment Method)

BREEAM is basically developed to provide energy consumption measures in building by UK Ecopoints but it fails to integrate sustainability lifecycle issues (J. Whyte et al., 2003). It is a scheme aiming at quantifying environmental impacts of building in order to reduce environmental burdens of buildings by rewarding good designs(BRE, 2012).

SPeAR (Sustainable Project Appraisal Routine)

SPeAR is an alternative to BREEAM developed by ARUP and provides different sustainability indicators to evaluate environmental issues related to the project(J. Whyte et al., 2003). It is a decision making tool which communicates visualized results of several key themes such as transport, biodiversity, culture, employment and skills in a traffic light system diagram(ARUP, 2011).

AEDET (Achieving Excellence Design Evaluation Toolkit)

AEDET is a tool developed by DH Estates and Facilities in UK to assist trust to measure and manage the design quality of new and existing healthcare buildings from initial proposals through to post project evaluation. This tool has 10 evaluation criteria including; Character & innovation, Form & materials, Staff & patient environment, Urban & social integration, Performance, Engineering, Construction, Use, Access and Space which has been categorized in three main sections as Impact, Build Quality and Functionality. It is mainly developed based on DQI's evaluation criteria (NHS, 2008).

NABERS (The National Australian Built Environment Rating Scheme)

NABERS is a set of tools to evaluate the environmental performance of buildings. It is a new developed version of Australian Building Greenhouse Rating (ABGR) scheme. NABERS includes four tools for Energy, Water, Waste and Indoor Environment assessment which rate buildings out of 5 stars scale. Rating is based on building performance data not design of buildings(1200 Buildings, 2012).

A base building rating considers the building's central services such as energy consumption rating including air conditioning, lifts and common area lighting. The environmental impact of certain tenancy is considered in tenancy rating tool. Occupant's light and power consumption is evaluated for energy consumption by this tool. A whole building rating considers both base building and tenancy data (1200 Buildings, 2012).

Green Star

Green Star is a set of tools provided by Green Building Council of Australia to evaluate the design of buildings. Each design receives a rating out of six stars. A four star rating means best practice. Five stars rate signifies Australian excellence and six stars rate introduces world leadership. Compared to NABERS, it considers more environmental criteria and the other difference is that it can be used to rate the design not the building itself. Management, indoor environment quality, energy, transport, water, materials, land use and ecology, emissions and innovation are all taken into account for the development of this tool(1200 Buildings, 2012; GBCA, 2011).

3. Design Quality Attributes

In previously discussed section on tools and techniques different researchers have focused on specific sets of attributes to define design quality measures. The focus of this study was to identify a thorough set of attributes which can lead to an integrated and holistic framework for future use by critical consideration of previous approaches to form a consolidated set of attributes. These attributes are compiled in Table 1. The assessment methods are identification, qualitative and quantitative approaches. Identification means that particular attributes are only identified and described. Quantitative is a kind of objective assessment in physical units or probably in monetary terms. Qualitative is more related to an evaluation based on personal judgment.

Table 1: Design Quality Attributes From Different Tools or Guidelines

Tool/ Guideline	Attributes Measured	Evaluation Method		
		Identification	Quantitative	Qualitative
DQI	Functionality, Built Quality, Impact	√	×	√
HQI	Location, Site (Visual impact, layout, landscaping), Routs and movement, Unit (size, layout, noise), Accessibility, Energy, green and sustainable issues, Performance in use	√	√	√
PROBE	Process (delivery and operational management), Functional Performance (users' needs) and Technical Performance (physical systems)**.**	√	×	√
BREEAM	Management, health and well being, energy, transport, water, materials, waste, pollution, innovation, land use and ecology	√	×	√
SPeAR	Environment, Social, Natural Resources and Economic	√	×	√
AEDET	Functionality, Built Quality, Impact	√	×	√
NABERS	Energy, Water, Waste and Indoor Environment assessment	√	√	×
Green Star	Management, indoor environment quality, energy, transport, water, materials, land use and ecology, emissions and innovation	√	√	×
Communication Tool By: Wong, Lam, & Chan,	Aesthetics, Functionality, Build-ability, Economics	√	×	×
Design Quality Manual By: National Capital Authority Australia	Contextual Analysis, Public Space, Built Form, Land Use and Density Mix, Activation and Vibrancy, Aesthetics, Environmental Performance, Materials, Inclusive, Safe Design, Movement, Urban Art	√	×	×
Principle of good design, Macmillan CABE (UK)	Functionality in use, Build quality, Efficiency and sustainability, Designing in context, Aesthetic quality	√	×	×
What is a well-designed building? Macmillan CABE (UK)	Appearance, Context, Build-ability, Maintenance, Operation	√	×	×
What is a well-designed place? Macmillan CABE (UK)	Character, Continuity and enclosure, Quality of the public realm, Ease of movement legibility, Adaptability, Diversity	√	×	×
√= Used ×=Not used				

Design value drivers have been categorized into four groups: Economic, Environmental, Functional and Impact Value drivers. Each group consists of several features and these have been summarized and presented as Figure 1. Economic and environmental factors are more objective and quantifiable and on the other side functional and impact factors are mainly subjective which are challenging to be quantified however they can be evaluated in other ways. To develop an integrated and thorough framework, all the Economic, Environmental, Functional and Impact factors should be assessed at the same time. Evaluating one or some of the value drivers in isolation would never give a reliable measure. The other important issue is the inter-relationship between factors and combining them together in a proper way based on their importance.

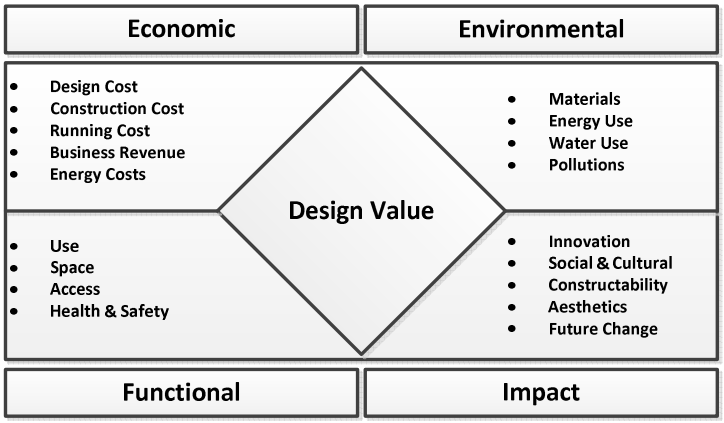

Figure 1: Design Quality Attributes

Current tools and techniques are compared in Table 2 to address which areas might not be studied with regard to the new proposed design attributes grouping.

Table 2: Comparison between Current Tools/Framework

Tool/ Framework	Areas of Consideration				Application		Description
	Functional	Impact	Environmental	Economic	Design	Building	
DQI	√	√	√	×	√	√	A tool for measuring design quality of buildings.
HQI	√	×	√	×	√	√	Mainly used to assess the housing quality.
PROBE	√	×	√	×	√	×	Reflects occupiers' view points by questionnaire.
BREEAM	×	×	√	×	√	√	Basically for energy consumption measure in buildings.
SPeAR	×	×	√	×	√	√	Like BREEAM with different sustainability indicators.
AEDET	√	√	√	×	√	×	Measure the design quality of healthcare buildings.
NABERS	×	×	√	×	×	√	Evaluate the environmental performance of buildings.
Green Star	×	×	√	×	√	×	Evaluate the design of buildings environmentally.
√= Considered ×=Not Considered							

As it can be seen in Table 2, none of the current reviewed methods have a comprehensive and holistic approach for assessment however some of them are really good in their own studied areas such as SPeAR and AEDET. This comparison shows that there is still a gap to bridge in design quality assessment.

4. Design Value from Different Perspectives

Different people have different perceptions about value of design. Everyone tries to satisfy their needs through a specific interpretation of design value. The owner (sometimes financiers play this role) usually considers the economic values more than other ones. Designer on the other side would like to place more emphasize on impact values. But what users are looking for through these wide range of attributes is their convenience through functional values and they are usually concerned with efficiency in use. In this study it is assumed that all the involved parties are concerned about environmental values and accept them as a must (Figure 2).

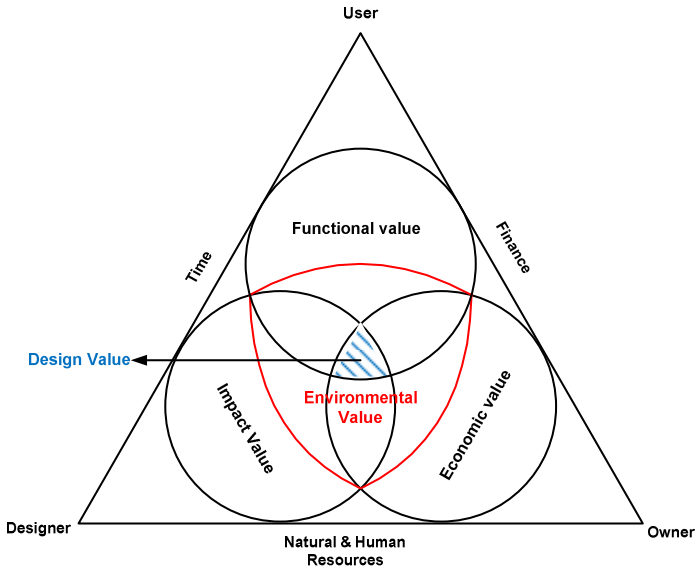

Figure 2: Design Attributes Interaction and Different Perceptions of Value

However, achieving high value design is ideal but defining an optimum balance between this wide range of attributes while considering time, finance and other resources limitations would be crucial as well. Main issue in this context is when quantifying design we need to think from different perspectives but client's view seems to be more important most of the time so there is a need to provide an index as a value indicator which could be realized not only by the client but also by the other involved parties.

As stated before one of the key point in design evaluation would be value for money thinking by applying whole life cost-benefit analysis approach. It means design value especially economic value should be assessed over the project's lifecycle. As it can be seen in Figure 3, different stakeholders are concerned differently about their needs at different stages of projects. For example, in design phase usually designers and the clients are playing the main role while in operation phase users are at the top of the list. Also Figure 3 illustrates that the client always plays a key role over the whole lifecycle of projects.

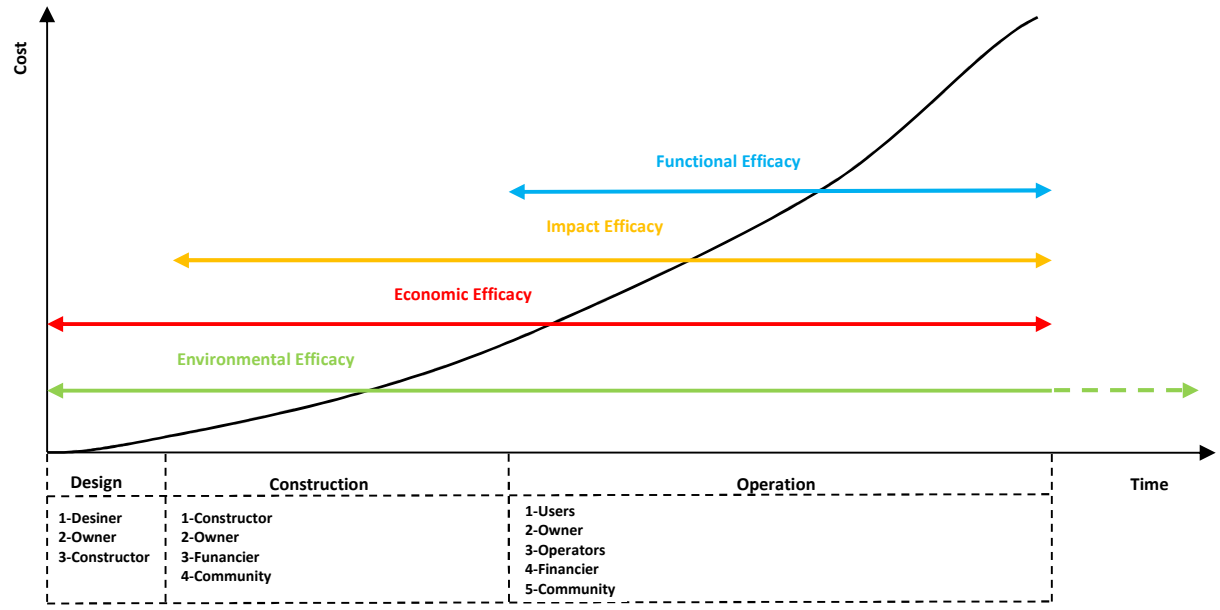

Figure 3: Project Lifecycle and Different Perspectives of Design Value

Figure 3 demonstrates that over the lifecycle of project different drivers are impacting the project differently. For instance, environmental drivers not only affect the whole life cycle but also their impacts may exist for a longer time even after the project. Functional factors are playing the main role in the operation phase but they should be taken into account in design and construction phase as well. Thus it may be assumed that without a whole life costing approach the results of design evaluation would not be reliable.

5. Conceptual Framework for Design Evaluation

This framework could be used in two ways, first as an evaluation framework when to select the best option among different proposals at decision making stage. Secondly, it can be used as a research platform to bring different stakeholders together at the design stage to find an optimal configuration of a design.

If the evaluation is intended tangible and intangible design attributes would be better to be defined into two distinct categories to produce more realistic measures. In other words, finding two distinct indices for objective and subjective factors is really needed. It would be more sensible to evaluate economic and environmental value drivers objectively and functional and impact value drivers subjectively. Figure 4 shows a very basic conceptual framework for design quality evaluation process.

As it is shown in Figure 5, this framework can be used as a process tool if determining the optimal configuration is aiming. This process might be undertaken for example in an interactive workshop environment to capture all the stakeholders' thoughts and viewpoints.

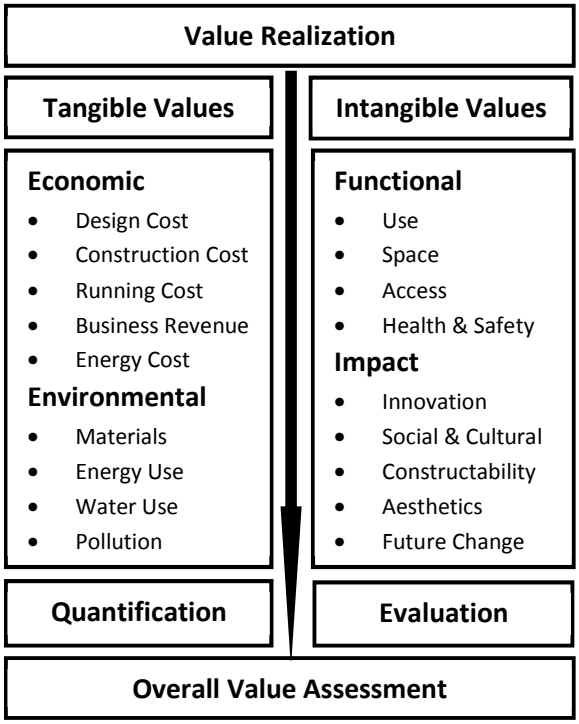

Figure 4: Design Quality Evaluation Framework

The method of quantification for tangible values and evaluation approach for intangibles may be chosen based on the availability of information as well as the intended confident level of assessment. These methods may vary from financial and economic ratios to opinion survey or expert judgements.

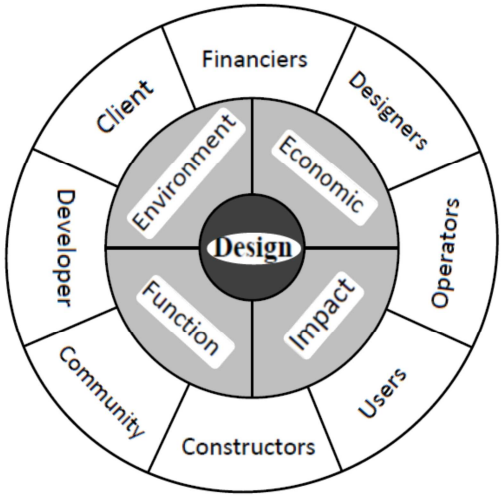

Figure 5: Design Configuration Consideration

When optimal configuration of a quality design is intended the interests of all stakeholders should be taken into account. In the process of design all the stakeholders' view points and thoughts must be captured and justified. There is no doubt that each of these stakeholders tries to satisfy their own needs through the process of design but caution should be exercised to have a balanced approach in this regard.

6. Conclusion

This study undertook a detailed review of approaches and methods used to quantify design value and it then developed a consolidated list of quantitative and qualitative attributes of design quality.

Having reviewed common design tools (e.g. DQI, BREEAM, HQI, PROBE) (often with a sustainability emphasis) through the lenses of economic, environmental, functional and impact value drivers it was found that many of the tools adequately consider functional and environmental attributes but no tool integrates all four attributes encompassing design quality. It is concluded that an integrated design evaluation tool that considers all four attributes would assist in providing a more balanced evaluation of the real value brought to projects by quality design.

Assessing the value of a set of design value drivers primarily focussing on function and the environment may not produce proper measures to make an informed decision. A more holistic design evaluation tool would enable practitioners and researchers to evaluate the design quality at different stages of the project such as business case development, feasibility study or even design. Such an approach would assist clients, developers, investors and project teams to maximize design opportunities when they are making investment decisions.

To commence the process of developing a more holistic evaluation tool both quantitative and qualitative attributes need to be considered. Based on a critical review of the literature a list of important design quality attributes have been identified that embrace economic, environmental, functional and impact value drivers. These design attributes have been developed into a conceptual evaluation framework that specifically considers both tangible and intangible values. It is anticipated that use of this framework may better inform the real value of design quality.

Research is continuing to test the validity of this proposed evaluation framework by testing the benefits of innovative practices and ideas in projects through a whole of life analysis that incorporates value for money (VfM) thinking.

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