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Performance and perception in prefab housing: An exploratory industry survey on sustainability and affordability

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Abstract

Provision of adequate and affordable housing is a major challenge in both emerging and industrialised countries. With increasing urgency for addressing climate change and other environmental issues these habitats will need to be environmentally sustainable too. Conventional construction, especially in dense urban centres and in rural or remote areas, is putting great pressures on cost and resource efficiency and is compelling the industry and governments globally to question the approach of business-as-usual. Prefabrication or off-site construction can offer great opportunities for both environmental and economic performance and hence is emerging as an attractive alternative to on-site construction. Although in the established markets the share of prefabrication in overall construction output remains strong, in many countries including Australia it still remains in its infancy. In order to enhance the profile of prefab housing and effectively develop high performance sustainable and affordable housing it is vital that first the needs and perceptions of the industry on these issues are adequately studied. This paper relates to the first of a two part research project aimed at exploring the makeup of the prefab housing industry and identifying various challenges and opportunities. The study was conducted as an international industry survey in which barriers, opportunities, performance and perceptions of sustainability and affordability were explored. The paper presents the results of this survey. Based on a cross-sectional analysis the responses are compared and categorised. Among other things the findings highlight the gaps in our understanding of the relationship between sustainability and affordability. This research contributes to the discourse on the need to better understand the role of design and design decision making for developing high performance prefab housing.

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1. Introduction

Adequate and affordable housing provision is a global problem challenging emerging economies [1] and established economies, such as Australia, equally [2]. Conventional construction due to its cost impacts is a major barrier to addressing this challenge. Prefabrication (prefab) or industrialisation of construction is offered as one of the key ways to reduce the cost of delivering affordable housing [3]. Building and construction industry also has significant energy, carbon, water, materials, waste and other environmental impacts [4]. Prefab has been shown to provide better environmental outcomes too in addition to having several other benefits, such as time, cost, construction quality, on-site safety, productivity and so on [5-7]. Although in the established markets such as Japan, Austria, Germany, Sweden and other European countries, the share of prefabrication in overall construction output remains strong [8, 9], in many countries, including Australia, it still remains in its infancy [10].

In this context, there is a pressing need to enhance the profile of prefab housing and effectively develop high performance sustainable and affordable housing. For that it is vital that first the gaps and needs of the industry on these issues are adequately studied. Although there is literature on broader industry drivers and constraints [11, 12] as well as on environmental benefits of prefab compared to conventional construction [13-17], there is a need for further exploration into the perceptions and performance of the global prefab housing industry to better understand the relationship between environmental sustainability and economic affordability.

This paper aims to present the findings of an exploratory international survey conducted to capture a snapshot of the prefab housing industry, its various needs and gaps, and its perceptions on sustainability and affordability performance. The paper is structured in three main categories: (a) research methodology, (b) discussion of findings, and (c) conclusion and direction for future research. This research contributes to the discussion on the barriers to greater uptake and application of prefab in general, and on the opportunities for greater sustainability and affordability in prefab housing. But more importantly, it draws attention to industry perceptions on its performance and identifies specific gaps in the area of design and decision support systems that can aid in delivering high performance prefab homes. The research presented in this paper is the first of a two stage research project aimed at developing a framework for decision making with a potential for practical utility in the prefab housing industry.

2. Research methodology

The research methodology was designed to explore the makeup of the prefab housing industry and capture a snapshot of the leading stakeholders' and experts' understanding and perceptions in regards to sustainability and affordability as well as the industry's key constraints and drivers. In order to capture this snapshot a quantitative methodological approach was chosen which involved literature review and a pilot survey leading to an online exploratory international industry survey. This exploratory survey was intended as the first stage of a larger two stage research project aimed to gather a pool of willing prefab housing industry organisations, from which an appropriately representative smaller sample would be chosen for the second stage of this study with an aim to develop a decision support framework for high performance in sustainability and affordability.

2.1. Survey design and distribution

The survey was specifically designed for dissemination and access through internet. The technique used to distribute the questionnaire internationally was a Non-probability Sampling Technique which included a combination of Convenient Sampling and Judgement Sampling techniques. A web-hosted survey program called WorldAPP KeySurvey (v8.6) [18] was used to design, launch and manage the survey as well as to gather response data. A unique URL for the survey was generated and included in an invitation letter that was distributed through emails to relevant industry organisations and associations internationally, through postings on relevant web groups hosted on the professional social media site Linked-In, and via individual emails to several industry experts and leading decision makers. The invitation letter as well as the Project Information Statement, before the beginning of the survey,

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