

The 9th CIRP IPSS Conference: Circular Perspectives on Product/Service-Systems

Can social sustainability values be incorporated in a product service system for temporary public building modules?

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Abstract

The temporary constructions industry has cost efficiency and sustainability challenges that may require new innovative business models as well as product and processes. This paper aims to discuss how social sustainability services can be included in product service system (PSS) by investigating a case where employment is offered in distributed temporary building module manufacturing in the PSS context. The case has been evaluated against PSS literature. Recent reviews and literature on inclusion of social sustainability and PSS for buildings were used. It is concluded that the current concept fits basic definitions of PSS although it is not typical. The social value of employment is difficult to evaluate and inclusion in PSS needs further research. Design practice could be used to further develop the services in the studied concept.

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Peer-review under responsibility of the scientific committee of the 9th CIRP IPSS Conference: Circular Perspectives on Product/Service-Systems.

Keywords: product service system; temporary modular buildings; social sustainability

1. Introduction

This paper introduces a case study of a combined value offering providing modular house manufacturing, incorporating social sustainability values and alignment of economic incentives. The case is compared with product service system (PSS) definitions. Typical PSSs combine physical products with services in the use-phase. In this paper, temporary modular buildings combined with the social value, employment, offered to public customers, is examined.

Municipalities in Sweden have been challenged for a couple of years, partly due to large immigration, to provide additional residential buildings, daycare and schools. Up to one third of the need for buildings is only temporary according to some local authorities [1]. For buildings in Sweden, temporary means that the permit for the building has to expire within 15 years, usually within 10 years [2].

In addition, immigrants with lower education level have difficulties to get employment in Sweden and more than half are unemployed [3]. The government has thus called for "Simple jobs" for immigrants which means work with low or

no demand on formal education. There are around 30000 persons in Sweden without secondary education over the age of 39 [4]. The government's intention with this type of jobs is also to train personnel in Swedish and skills that will make it easier to get other jobs afterwards [5].

To build temporary buildings at the same or lower use cost (or rent cost) than permanent buildings is challenging due to the economical lifespan of the investment. The depreciation time of buildings can never be longer than the economic lifespan. In Sweden, the recommended depreciation time is 50 years for permanent residential smaller building and 25-33 years for other non-industrial buildings [6]. For temporary buildings, the depreciation time of maximum 15 years is less than half of that. Thus, building costs need to be decreased to less than half compared to a permanent building.

Traditional building business models of customized houses give more profit to the builder if more features are added. A majority of homes are provided by speculative house-builders typically providing a range of additional features [7]. These give higher price, even when operation and maintenance cost increase [8]. In practice this creates incentives for producers to

drive towards more expensive and more resource demanding solutions. One trend counteracting this is production of standardized modular buildings. With a clear standard, unnecessary expensive customizing is somewhat reduced. Still, there will usually be a higher profit for the producer if more features and thus production work content is added.

By increasing building in Sweden, the government wants to increase the employment rate. However, the building industry mainly needs trained and skilled personnel. Although there is much less demands than on e.g. a nurse or a lawyer, most positions in building industry demands more training than e.g. assembly personnel in manufacturing. By designing manufacturing cells for lean production, introducing standards and visual instructions, the work tasks can become both efficient and easy to learn [9].

Cell layouts providing safety of operators, flexibility error proofing and one piece flow are mentioned as important for a lean design of manufacturing processes [10]. In assembly cells, important sustainability aspects include ergonomics and occupational health and safety [11] and material efficiency of secondary material [12].

By building temporary houses in lean manufacturing factories there is a potential to combine provision of temporary buildings and easy jobs for the community. The aim of the paper is to discuss how social sustainability services can be included PSS. This is done by investigating a case where cheap temporary houses and employment is offered in a PSS context. A comparison is made between this case and other PSSs to discuss if social innovation to enhance employment through temporary housing can be categorized as a PSS. The problem is broken down in two sub-questions.

- Can raised employment be seen as a service in a PSS provided to a public customer such as municipalities?
- What combination of products and services is suitable in the house module production industry?

2. Materials and methods

This case, Husmuttern, has been studied in a grounded theory inspired approach where the concept is studied, described and then a search for fitting theory has taken place [13]. The authors are however experienced with the sustainable business models and PSS field. Due to limited previous research, the questions are best studied with an explorative and qualitative approach, [14]. The research consists of a case study with an integrated literature review [15]. The case concepts were studied and compared against literature definitions and examples (Fig. 1)

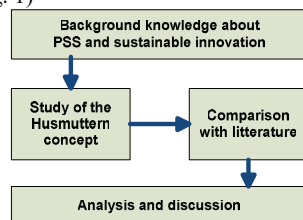


Fig. 1. research methodology

In the discussion, possible developments of the case concept to fit better into the PSS concepts are discussed, as well as the provider and buyer value in different alternatives.

2.1. The Husmuttern case

Husmuttern is a private initiative trying to make a business case around two social challenges in Sweden (and elsewhere), namely the need of cheap temporary houses (e.g. for kindergartens/schools and temporary residential need), and the need for employment, especially for low educated immigrants. The concept is to assemble modular buildings in standardized, highly digitalized, but low automated, flexible, micro factories. The modules are said to be designed for efficient handling and easy to mount and dismount the buildings.

The case company has used an open innovation concept together with Mälardalen University, where students have been working on design or redesign tasks for different part of the product, production and service design. One author participated in a business model brainstorming session with the owners and three concept presentations for suppliers and two departments at the university. The production concept details were further developed in nine student group projects, and in two bachelor theses supervised by the author the logistics and workstation design were optimized [16, 17]. Finally, an additional interview with the owner was conducted to clarify business model connections.

2.2. Literature search

There are several thorough literature reviews on PSSs. The literature search thus was limited to five recent Journal of Cleaner Production review articles in the PSS field [18-22]. These were used to find relevant literature regarding social sustainability in PSS and building/construction. In addition, to find more recent research, conference papers presented at CIRP IPSS 2016 and Euroma 2016 were also checked.

Most of the reviews used do not go into depth into social sustainability inclusion. Except for Bocken et al. [19] where a broader analysis includes value capture of societal benefits, only three papers discussing social sustainability and unemployment were found in the reviews [23-25].

Of the five reviews, only Bocken et al. [19] mention any industry specifics such as PSS involving buildings, two examples of energy-PSS are given. Therefore, resources from the Nordic council and United Nations Environmental Program [8, 26], an article found in Scopus and marketing materials from temporary building suppliers in Sweden [27, 28], were used for building industry PSS comparisons.

3. Product Service Systems

A PSS is a market proposition selling an integrated system of products and services which are jointly capable of fulfilling specific client demands [26]. Service integration is increasingly important to remain competitive, since services are more difficult to imitate compared to tangible products and traditional functionality [29].

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