Available online at www.sciencedirect.com

ScienceDirect

Procedia CIRP 47 (2016) 460 – 465

www.elsevier.com/locate/procedia

Product-Service Systems across Life Cycle

Urban Mining as a Case for PSS

Christian Johansson[a]*, Jenny Elfsberg[b], Tobias C. Larsson[a], Martin Frank[b], Larry J. Leifer[c], Niklas Nilsson[a], Victor Söderberg[a]

[a]*Department of Mechanical Engineering, Blekinge Institute of Technology, 371 79, Karlskrona, Sweden*
[b]*Volvo Construction Equipment, Bolindervägen 100, 635 10 Eskilstuna, Sweden*
[c]*Center for Design Research, Stanford University,Stanford, CA, USA*

* Corresponding author. Tel.: +46 455 38 55 76. *E-mail address:* Christian.M.Johansson@bth.se

Abstract

Reports about the depletion and pollutant of the earth by human interference and the increasing need for urbanised areas require us to think differently about how we go about achieving this increased urbanisation. In this context, urban mining, where demolition sites are mined for increased recycling and value extraction. Due to high specialisation of construction equipment for this context, as well as sustainability being an important factor, product-service systems are suggested as a way forward in this area. This paper presents key topics that needs to be addressed when developing sustainable product-service systems for the urban mining segment. The idea is to transform from a traditional construction and demolition perspective towards a PSS-based construction product for an urban mining environment, incorporating a circular economy perspective. A modification to the common business model notation of business model canvas, with guiding questions is suggested. Opportunities for improved sustainability lies both in application – within an urban mining site – and in the enabling technology – when technology is specialised, owned by the provider, and utilised by multiple partners.

Peer-review under responsibility of the scientific committee of the 8th Product-Service Systems across Life Cycle

Keywords: Business Model Canvas; Urban Mining; Product-Service Systems

1. Introduction

Ever more people are making the transition into urban areas. In 2014 54%, or the world's population were situated in urban areas, and the figure is expected to grow even more in the future, with 66% being urban by 2050 [1]. The lion's share of this growth is expected to be seen in Africa and Asia [1], which will basically catch up to the levels already seen in Europe and North America. This will likely see both the establishment of totally new rural areas, but also the current urban landscape will need to increase in capacity. Existing urban settings will be replaced by new ones with increased capacity, and new urban landscapes will be formed.

This expansion, as well as resetting, will require mining of new materials. However, in recent years, several alarming reports warn of the depletion and pollutant of the earth by human interference. Natural resources are depleted due to mining seemingly unsustainable quantities raw materials. According to a KPMG report from 2012 [2], 96% of global firms expect an impact on their business performance for reasons relating to raw material scarcity.

1.1. Urban Mining

Urban mining [3] depicts a novel segment of the construction industry where urban areas are 'mined instead of the bedrock. According to the European Commission [4], out of all waste generated in the EU, 25-30% is from construction and demolition. Value can be extracted from existing materials (e.g., concrete, valuable metals, etc.) in buildings and other structures. When resetting an urban neighbourhood, there is potential to utilize materials that were there already and not just go find fresh in the bedrock. Instead of exploiting the

Peer-review under responsibility of the scientific committee of the 8th Product-Service Systems across Life Cycle
doi:10.1016/j.procir.2016.03.089

undeveloped land, developed–and used up – urban areas can be reset into appropriate new ones.

From a construction equipment innovation perspective, urban mining is an interesting segment to innovate capabilities and thus machines that can move the portfolio closer to support a circular economy in this sector. In this context, there is a need for new innovations (e.g., breakthroughs in communition, flotation, sorting, automation), where new construction equipment for urban mining needs to be developed.

This case study was performed in relation to a project with engineering design students from Stanford University (ME310 Product Design course[1]) and Blekinge Institute of Technology (PSS Extreme Innovation course[2]). The students have focused on recovering concrete in an urban mining scenario, sorting it from other materials and having an intermediate storage on site have (see fig 1) – showing opportunities for both financial and environmental gains, because recovered concrete is used as filling in new constructions without having to be taken off-site for recycling and storage.

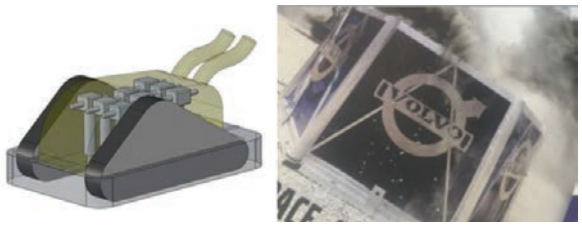

Fig 1. Urban mining prototypes concrete crusher (left) and on-site concrete storage (right).

Specialisation of construction equipment for many of the tasks potentially challenges the viability of the concept from a traditional product supply perspective. Therefore, product-service systems (PSS) [5] offers opportunities to explore more creative approaches to achieve a sustainable and holistic business case.

This paper aims to explore key areas of innovation, and how the business model can support a circular economy in urban mining applications and supporting construction equipment – stringing a balance between PSS, economic growth and environmental stewardship.

2. Methodology

This research is based on case study [6], aiming to investigate and explore urban mining as a future business segment.

Data is collected in total 9 semi-structured interviews with experts from a construction equipment manufacturer, focusing on sustainability, product-service systems, general sales, and business models. The respondents have the freedom to discuss and have opinions related to the investigated topic.

In addition, site visits and observations serve as secondary data, sometimes informing the design of questions for the primary data collection.

The interviews have been transcribed and recorded to ensure traceability and have a higher reliability. Analysis has further been performed by means of pattern matching.

3. Literature review

3.1. Product-Service System

Servitization [7] – where service components are added to hardware-only products – is seen as an opportunity to generate new revenue streams, gain closer relations with customers [8], increase operational performance, and achieve sustainability commitments [9]. This, with products and services combined in a system to deliver value and functionality for users, is known as product-service systems (PSS) [5]. Companies provide customers with desired outcomes [10] instead of products.

There are three different types of PSSs [11]; *product-*, *use-*, or *results-oriented* offerings. With product-oriented PSS, the provider commits to deliver services in addition to the sold product [11]. With use-oriented PSS, the provider does not sell the product but makes it available under a leasing agreement [11]. With a result-oriented PSS, the provider delivers a certain result to the customer rather than a specific product or service.

PSS development is known as functional product development [9], where the solution (any combination of hardware, software and services) is developed in a coordinated development effort. In this context, creating value for customers throughout the lifecycle and hence understanding the customer needs will be paramount [9]. New competencies will be needed, especially in the interface with the customer in order to tie them into closer relationships [9]. Translated requirements from marketing staff are not enough as a basis. PSS designers will need to do needfinding [12,13] to better serve the customers with customised solutions. The PSS is conceived with a system view in mind [14], where features and gimmicks that do not add value will be depreciated.

PSS offers the opportunity to decouple growth from increased material consumption [15], thus serving an opportunity for reduced environmental impact.

3.2. Business Models

A business model is an abstract representation of business logic of a company; a comprehension of how a company operates, creates value [16] and makes money – that is, *what* is offered, *to whom* is it offered, and *how* can it be accomplished [17]. It is a blueprint of the company's logic of earning money [17].

Traditionally, a business model is descriptive (i.e., how a company conducts their business, not how they want to do business). However, a too static focus on creating customer value without regard to changes or competitive advantage might leave a firm vulnerable to both margin erosion and weak growth [18]. A challenge is to explore possible business model configurations and innovations that are likely to be successful for the company [19]. In recent years, business model

[1] http://me310.stanford.edu

[2] https://www.bth.se/tek/mspi.nsf/pages/pss-ei