Abstract

In recent years the circular economy has gained significant popularity, however practical implementation of the concept has not followed accordingly. Especially in the construction industry there is a need for a practical translation of the concept. This research makes this translation through the mutual development of circular economy theory and business model prototypes for a circular construction industry. These prototypes are aimed at service providers in the construction industry as it follows from a literature study that these are essential in developing the circular economy in the construction industry. With the development of both the prototypes and theory two important questions surrounding the circular economy are answered in this research. First, how should a service provider organize itself according to the circular economy, and second, how does the service provider relate to current stakeholders in the construction process?

Relevance of the research

This research is relevant on three different aspects; scientific, societal, and practical. This research is scientifically relevant because: Existing literature on the circular economy often gets stuck at an abstract level, making it hard to connect the circular economy to for instance people, companies, projects, processes, and business sectors (Antink, et al., 2014; De Grauw, 2015; Ellen MacArthur Foundation, 2014; Kok et al., 2013; Mentink, 2014; Van Dijk et al., 2014). In other words there is a literature gap on the practical implementation of the circular economy. When a look is given to the construction industry it becomes apparent that there is (through the aforementioned literature gap) also a literature gap in this particular industry. Although there has recently been an influx of research on the circular construction industry at the faculty of architecture and the built environment at Delft University of Technology in an attempt to close this gap, none of this research focuses on the circular service provider from a supply-side perspective. While De Grauw (2015) touches upon the circular service provider in his research, he does this from a demand perspective and thereby uses the circular economic concept more or less literally as it is laid out by the Ellen MacArthur Foundation (2012). This research is therefore unique in that (1) it investigates the circular service provider from a supply-side perspective, and (2) does this from a carefully built-up theoretical construct that critically reflects upon both existing circular economy theory and the current construction industry before coupling the construct back to practice. Therefore general aims of this research are to bridge the literature gaps by providing a practical model implementing the circular economy within the construction industry while on a higher abstraction level working out the circular economic concept as well.

Furthermore this research is societally relevant because the effects that the circular economy might have on a societal scale are enormous. Bastein et al. (2013) estimate that in The Netherlands alone the circular economy has the potential to create 54,000 jobs and generate €7.3bn in annual savings. The accuracy of these figures can be contested, as its accuracy greatly depends on how one interprets the circular economy. Even so, if the aforementioned figures would hold true for only half their size the observable effects would be considerable. Apart from creating jobs and cutting costs, the circular economy also aims to design out waste through a different approach towards products. In this way, the circular economy shows the potential to make the world a more sustainable place.

And finally this research is practically relevant because the results of this research are directed at the supplying parties in the construction industry, by providing business model
prototypes for these parties. Each prototype will be presented through the sustainable business model framework as presented by Bocken & Short (2015). This business model framework offers guidelines as to how to generate new business models and shows the relationship between different actors and resources. By using this framework it will become clear in what way the role of the service provider will function in the circular construction industry. These prototypes form tools that can be a part of future circular business plans (e.g. the prototypes fit in the lay-out of a business plan given by Osterwalder & Pigneur (2010)) or form different scenarios and therefore the basis for scenario planning as laid out by Lindgren & Bandhold (2003). In this way the results of this research will be applicable to all supplying parties in a circular construction industry, and will be the first (as far as the knowledge of the author is concerned) business model prototypes for a service provider in a circular construction industry from a supply-side perspective.

**Findings**

This report introduced five different business model prototypes based upon the inherent knowledge of parties on their competences in the construction industry. These business model prototypes were developed following an extensive literature review and focused solely on advanced circular services solutions. This was done for two reasons: first this type of business model is as of yet unknown in the construction industry (as can be seen from the circular service level framework). Second, this type of business model can be expected to deliver radical environmental gain. With the development of these business model prototypes the first part of the research question is answered (How to organize the service provider in such a way that its role adheres to the definition and principles of the circular economy).

Afterwards these models were laid out in front of several practitioners in order to answer the second part of the research question (How does this organization relate to current supply side stakeholders in the construction process). However, these interviews set in motion several subsequent case studies that also influenced the underlying rationale of the business model prototypes. As it was found through these case studies that that it might also be beneficial to deliver advanced circular projects based on products instead of processes, these findings have been included in a roadmap.

In general the interviews found that the developed business model prototypes are not seen as directly applicable in the construction industry, on the long term however they were seen as probable. While the interviewees showed some convincing arguments as to why they perceive these prototypes as not directly applicable (see the obstacles that are explained below), from the case studies some examples came forward that could go a long way in circularity. It can therefore be argued whether the prototypes are really as unfeasible in the short run as the interviewees believed.

That being said, there are several convincing explanations that can be given why the developed prototypes are not seen as directly applicable to the construction industry:

1. For advanced service model prototypes to work, innovation has to take place in multiple places within the construction process. These innovations are not always seen as likely to occur in a short timeframe.
2. The respondents in this research perceive financial uncertainty around the business model prototypes (this was also found as one of the obstacles of implementing the circular economy in chapter 3 of this report). Research by Stigter (2016) shows that this uncertainty can be brought down to two factors. First, the profitability of lease-
solutions depends heavily upon resource prices. Second, the financial value of materials or products used in a construction project depends on their usability at the end-of-loop situation (i.e. a substitution risk), which brings us to the third explanation why the developed business model prototypes are not directly applicable to the construction industry.

3. There is legal uncertainty surrounding the materials and products that are used in a construction project. Building regulations for instance tend to be progressive and/or changing over time, this could influence usability of products that are currently present in one building to be re-used again at the end-of-loop situation. This also affects the financial value of the inserted materials and products the aforementioned substitution risk). However, the following factors could arguably diminish these uncertainties; a limitation of the amount of stakeholders that take part in a project, opting for new-built projects over renovation projects, and allowing for flexibility in the design to accommodate for future regulation changes.

4. As of yet there is no clear market demand for advanced circular services. While from the case studies it shows that some market demand has manifested itself for base-to intermediate services. This might have something to do with the relatively small group of potential clients. As the main reason for a client to move into advanced services solutions seems to be the outsourcing of risk related to the investment, possible clients can be found in the following group; parties that deal with a temporary demand, new businesses (start-ups), and/or businesses that need to be on a particular location for the duration of a particular contract.

With regard to the second part of the research question (how does this organization relate to current supply side stakeholders in the construction process), the findings indicate that there is no definitive answer to be found yet. First of all it seems to depend upon the personal preference of the supplying parties whether they would act as a service provider or as a supplier. With the added notion that parties such as main-contractors or developers that have a coordinating role in today's construction industry might be closer to perform the role of the service provider. Although this task does not call for many of the identified competences, in the light of the fragmented construction supply chain it might also be these parties that are able to attract the needed competences the easiest, as this is part of their current operations already.

If these observations are combined with the findings that the interviewees have a preference for variant 3 and 5 and for operating in consortia, it becomes clear that in these cases it would be more fitting to talk about quasi-vertical integration in the construction industry as opposed to vertical integration. Next to these observations, the costs that are associated with setting up a consortium can be quite high, it therefore seems that advanced circular services projects that are delivered through variants 3 & 5 with a consortium would therefore need to be of a considerable size. One of the case studies however exemplified that a consortium might not be needed in order to deliver advanced circular services through variants 3 and 5. In such a case the amount of suppliers might be limited and therefore also the reliance upon these suppliers throughout the project could be limited. Arguably though, also the projects that could be carried out in this way might be smaller (but perhaps have the ability to be built in series). From the map of consequences for the different stakeholders it became clear that the choice for or against a consortium could have significant consequences for the current stakeholders in a construction project. One example could be that without a consortium there would be no rationale for the presence of a main-contractor that merely ‘coordinates’ in a circular project that is carried out according to variant 3 or 5. If a consortium would be used with variant 3 or 5, this same stakeholder
would have added value through this very same capability, ‘coordinating’ the project, and would likely be a part of the service-providing consortium.

If the service provider would be formed through an external stakeholder that is not present in the industry yet, the consequences for the current stakeholders in the construction industry remain unclear. It did show from the consequence map that it might be the case that all but one stakeholder (the financier) may disappear from the construction process (if the external party would be operating through variant 1). The entrance of an external party with a high degree of competences could therefore have a profound impact on the current construction industry.

Given the fact that the developed business model prototypes are (arguably) not likely to be implemented in the short-term, the implementation of the circular economy would likely be restrained to basic-, to intermediate services business models. Evidence of which can already be found in the current construction industry, as can be seen from some of the examples introduced in this research. This will most likely limit the environmental gain by implementing the circular economy in the construction industry to an incremental level.

**Limitations**

As the sample was quite small, it can be questioned whether the findings made in this research reflect the general opinion of the construction industry. Also, some of the interviewees were less familiar with the circular economic concept than others, which might impede the validity of their opinion on specific circular economic subjects. It does however not refrain them from commenting on the degree of which the developed business model prototypes seem probable to them. Which is why it is the belief of the author that the business model prototypes and underlying reasoning are properly reflected in this research. However statements made in this section about for instance the expected market demand (and similar future expectations) and possible preferences for the prototypes are partly dependent upon these interview findings. Therefore in order to enhance the validity of the results, more interviews would need to be conducted. Preferably these interviews would be conducted in a similar way, with both parties that are familiar with the circular economy and parties that are not. Another way of enhancing the validity of this research would be to set-up a questionnaire according to the findings of this research, followed by in-depth interviews with some of the respondents. This however goes beyond the scope of this particular research project.

**Reflection upon the findings**

With respect to the practical relevance, notwithstanding the fact that the developed business models are not directly applicable, this research has given insight into the way these models might work. They did this in such a way that several practitioners could see these as useable on the long-term if circular economy might take off. Therefore, despite of their current inapplicability, the developed models show insight in how an advanced services circular construction industry might operate (especially in combination with Stigter’s (2016) research). If I could hazard a guess who will demand these kinds of models, I would think of companies with an unpredictable need for housing (therefore encapsulating the risk with advanced services). The private real estate market therefore seems an unlikely client, these models will under the prescribed conditions mostly be fit for professional organizations and utility buildings.

With respect to the scientific relevance it can be said that this research played its part in filling the literature gap. Especially the circular services level framework should be able to
help to categorize different future debates and researches on the circular economy. But also
the above described business model prototypes give insight into the workings of a circular
economy.

The circular economy was studied under this research project as an economic system with a
major catch in the form of sustainability gain, and is thus societally relevant. This
sustainability gain might be lower than expected due to the, at least temporary, rejection of
advanced services business models. The basic- to intermediate business models do not
require a drastic change in business operations and will therefore only curb some current
practices. With respect to the environmental aspect, it is not necessarily devastating that the
circular economy probably will not fulfil all of its sustainability promises. Sure it is a let-
down, but as this research has shown, many actors in the construction industry, also those
from whom it might not be expected at first sight, are well under way in developing
sustainable projects. They do this either with or without the circular economic concept
under the influence of changing client demands. Also radical environmental gain through
circular advanced services models in the construction industry might be closer than we
think, as one of the interviewees in this research put it: ‘a circular project might just be a
phone call away’.