



OPEN SOURCE DEVELOPING, DESIGNING AND CONSTRUCTING SMALL URBAN AREAS WITH RE-USED DEMOLITION WASTE IN THE CITY OF UTRECHT.

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ABSTRACT

The research group Supply Chain Redesign in the Built Environment of HU University of Applied Sciences is working on research that combines principles of the circular economy with open source architectural design & urban planning. The aim is finding new ways to re-use demolition waste and recycled materials in small scale urban area developments. And to “democratize” traditional processes in the built environment. Different recent studies have shown the potential benefits, such as a reduction of emissions. In “Hof van Cartesius”, a practical case-study in Utrecht, the ambitions and implications of this approach are being questioned, investigated and tested.

BODY OF PAPER

1. INTRODUCTION

Current emphasis on sustainability – e.g. reduction of CO₂ emissions - and new, upcoming technologies gives rise to new possibilities and innovations in the built environment. In Utrecht, the Netherlands, the research group Supply Chain Redesign in the Built Environment of HU University of Applied Sciences is working on research that combines principles of the circular economy with the concept of open source architectural design & urban planning.

The aim is finding new ways to re-use demolition waste and recycled materials in small scale urban area developments. And to develop, share and use the knowledge and outcomes of these experiments in open source concepts. Thus enabling various parties to participate and benefit from it and to accelerate innovation by doing so.

The first part of this paper contains explorations of both topics: open source architecture and the circular economy, applied to the built environment. The latter unfolds the case-study “Hof van Cartesius”: an open source and circular small urban area development in Utrecht. In addition, a reflection on the issues and challenges that accompany this initiative will be given.

2. OPEN SOURCE ARCHITECTURE

2.1 Democratize production

In his paper “An Open-Source Building System with Digitally Fabricated components”, Pieter Stoutjesdijk (2013) describes recent developments in both production technologies and communication technology that, according to specialists in the field will initiate the next industrial revolution.

Developments such as 3D-printing enables “the larger public” to make, adjust, assemble and use their own products. The information, knowledge and “blueprints” needed to do so, are being accessed,





shared and developed in online communities and collectives.

In theory, everybody from a single inhabitant to large-scale companies and institutions can now be engaged in designing, producing and assembling smaller or larger built structures.

Stoutjesdijk (2013) states that whereas the first industrial revolution democratized consumption, it can be expected that the next will “*democratize production – through digital networks of shared knowledge and digital fabrication devices*”. These statements originate, amongst others, from publications on the so-called “Maker Movement” (Anderson, 2012) and the theories of Jeremy Rifkin about the third industrial revolution and collaborative commons (Smith, 2014).

2.2 Open source in the built environment

In the article “Open Source Architecture: An Exploration of Source Code and Access in Architectural Design”, Vardouli and Buechley (2014) state that in translating the term open source from the domain of ICT to the built environment and architecture, the term is susceptible to different interpretations and uses. Even misuse. This gives rise to the question “what is open source architecture”? Or: “what should it be?”. It is clear that there is no unequivocal, indisputable definition of such a thing as “open source architecture”. In practice, the term is often used in situations where different stakeholders are invited to participate or collaborate more intensively than one is used to in traditional cases. Or where there is a need for openness and sharing.

Vardouli and Buechley (2014) question themselves what the equivalent of open source code in ICT is for the domain of the Built Environment. Is this all the information needed to erect a building? In other words, the digital drawings, technical details, planning, calculations and so on? If this is the case, BIM (Building Information Modeling), which has gained ground in recent years, will contribute to open source architecture without doubt.

For the research described in this paper, the authors will use the following self-defined, preliminary definition of the term “open source” in the built environment:

The whole of the free accessible/adjustable, digital infrastructure (e.g. platform) and its protocols, as well as the technical data (e.g. drawings) of building-methods, that enable everyone, in collaboration, to self-develop, -design, -produce and –construct built structures with limited professional knowledge and means.

Aside from the question what open source architecture means exactly, the question remains: can an open source approach to designing and building our built environment revolutionize the way we build? And will it cause the (dramatic) change in traditional (construction) industry as predicted?

The preliminary definition of “open source” as described above will be applied and tested, amongst others, in the case-study “Hof van Cartesius” described below. In future, these and other studies must demonstrate whether or not the definition is justifiable. It must also prove whether or not “open source” is the next promising era in architecture and urban planning, that will accelerate innovation in the built environment or just an empty promise.

2.3 An example: Wikihouse

Examples or case-studies of open source initiatives in the built environment are not widely spread (yet). Probably the most well-known and promising example at the moment is Wikihouse (see picture 1).

Wikihouse is an initiative by Alistair Parvin of Architecture 00 in London. In the article “Architecture (and the other 99%): Open-Source Architecture and Design Commons”, Parvin (2013) presents Wikihouse as a new model of open source practice.

Wikihouse is an open-source construction system. The idea is that everyone should be able to access the designs and knowledge of Wikihouse world-wide and customize, print and assemble structures by themselves. The materials used are widely available materials like plywood (18 mm thickness). The building-parts can be digitally produced with a CNC machine. Assembling can be done with basic do-it-yourself (DIY) tools.

Newly gained experiences and knowledge is shared within the so-called “creative commons”, ensuring the constant development and progressing of the body of knowledge.





Picture 1. Example of a Wikihouse-structure: WikiHouseNL pavilion at the Meelfabriek-area in Leiden, Dag van de Architectuur 2014. Photograph by Jan Willem de Groot.

Alastair Parvin not only shared his thoughts on Wikihouse through the article mentioned above, but also in a TED-talk. Since then, the Wikihouse-movement grew with the foundation of different “Wikihouse-chapters” worldwide. Also in the Netherlands, a Dutch chapter of Wikihouse: WikihouseNL was founded. At this moment, six students of HU are working on the preparations for an Utrecht-chapter, in cooperation with WikihouseNL. The authors of this paper have initiated this Utrecht-initiative. The goal is to gain insight in the possibilities and limitations Wikihouse has to offer. And to find answers to research-questions concerning the phenomenon of open source architecture.

One of these questions links both topics of this paper: what other materials than the standard 18 mm plywood can be used within the Wikihouse-concept? Especially those, gained from demolition waste from within the city of Utrecht and thus, amongst others, reducing emissions (transition zero).

What (small-scale) applications can these Wikihouse-structures made of demolition waste have? For instance in terms of small expansions of dwellings or home-improvements? And how can these developments be linked to “Hof van Cartesius”, as described below?

3. CIRCULAR ECONOMY IN THE BUILT ENVIRONMENT

3.1 In general

The Ellen MacArthur Foundation (2012), a “global thought leader” in the field of circular economy urges governments, businesses and institutions to make the transition from a linear economy to a circular economy. The Foundation defines the circular economy on their website as follows:

“A circular economy is one that is restorative and regenerative by design, and which aims to keep products, components and materials at their highest utility and value at all times, distinguishing between technical and biological cycles.”

There are numerous reasons why this transition is necessary and even inevitable. One of them being the increasing scarcity of (raw) materials. At the same time, it can be an impelling force behind innovation.





3.2 In the built environment

For the built environment, focus is on eliminating waste through re-use of materials and re-designing building components, systems and logistics. The authors of this paper believe that major reductions in CO₂ emissions and improvements in energy-efficiency amongst others can be achieved by doing so. Thus fostering the transition zero.

Most materials in the construction industry are part of the technical cycle as defined by the Ellen MacArthur Foundation (2012). This means we should design for remanufacturing and refurbishing to keep components and materials circulating in, and contributing to the economy. Circular systems use tighter, inner loops (e.g. maintenance, rather than recycling) whenever possible, thereby preserving more embedded energy and value. The technical cycle involves the management of stocks of finite materials. Use replaces consumption.

3.3 Increased (regional) attention

A recent publication by the Ellen MacArthur Foundation (2015) states that, attention towards the circular economy has increased.

In the city of Utrecht this is shown by activities deployed by the Utrecht Sustainability Institute (USI) of which HU is a main sponsor. An example is the most recent publication of Cramer (2015) of USI, called “Circulaire economie: van visie naar realisatie”, which translates “Circular Economy: from vision to realization”.

In an earlier document of Cramer (2015) of USI, called “Green Deal Cirkelstad – Voorwaarden voor een marktconforme aanpak”, she describes how a number of stakeholders in the construction and demolition industry have committed themselves to “close the chain of construction and demolition”: the “Green Deal”. The thought behind this initiative is to enhance the re-use of demolition waste in the construction circuit in a sustainable way. In other words: to restore or recuperate the quality of used building materials and elements for use in new structures.

One of the parties involved in the “Green Deal” is “Cirkelstad”. Cirkelstad offers a platform for progressive, innovative public and private parties that strive towards cities without waste, without jobless people and without (CO₂-)emission. The main focus is to achieve this by re-using demolition waste. Cirkelstad operates in a number of cities including Rotterdam, where practical experience has already been gained in several projects.

3.4 Circular city HUB

In 2015, students of the Institute for Engineering and Design (IED) of HU have researched the possibilities and feasibility of a so-called “circular HUB” in the city of Utrecht. This “HUB” is a physical site, where demolition waste can be gathered, processed and stored, before being re-used as construction material. Since the offering of demolition waste and the demand for construction materials will not appear simultaneously, the need for such a “circular HUB” to enhance the circular economy is obvious. The outcome of the research, as published in an article by Henket (2015) in the Dutch professional journal “Cobouw”, stated that a “circular HUB” in Utrecht is indeed feasible and will decrease CO₂ emissions significantly because of a higher efficiency in logistics.

Interesting in the context of the above is the document “Verkorte versie Actieplan Goederenvervoer (2015-2018)” by Gemeente Utrecht (2015) – the municipality of Utrecht. In this document measurements and innovations that can contribute to smarter, cleaner, safer and more efficient city logistics are enumerated. The document emphasizes that the city strives towards supplying goods in the city with zero-emission in 2025. Specific attention is paid to optimizing building-logistics. The document includes an interview with dr. ir. Ruben Vrijhoef (lector of the research group Supply Chain Redesign in the Built Environment) in which he emphasizes the potential of HUB’s for city logistics. And the fact that these HUB’s will become circular ones in future.

In 2016 research on the “circular HUB” is being continued at HU by three groups of students with different companies. For each company involved, the way the company can participate in and benefit from the “circular HUB” is questioned. Practical cases, amongst which the renovation of several HU-buildings, are used to test different aspects during the projects.





4. “HOF VAN CARTESIUS”: THE FIRST OPEN SOURCE AND CIRCULAR SMALL URBAN AREA DEVELOPMENT IN UTRECHT?

4.1 Case introduction and location

The authors of this paper are currently - in close collaboration with professionals and stakeholders from the field - preparing projects and assignments for students of HU in which open source and circular economy in the built environment are combined. The goal is to gain practical insights in open source & circular urban area developments and building projects. Including the potential added value of combining both topics. The Wikihouse-Utrecht initiative as mentioned above is one of these projects. “Hof van Cartesius” (“HvC”, www.hofvancartesius.nl) is another one. This part of the paper focusses on the plans for “HvC” and the opportunities and challenges that accompany this promising initiative. Information was gained, amongst others, by meetings, talks and an interview with Charlotte Ernst, one of the initiators, and Simone Tenda, project coordinator at “het Uitvindergilde”, which is one of the planned end-users of “HvC”.

“HvC” is an initiative by Charlotte Ernst – architect and urban planner – and LINT landscape architecture and won the “open call for initiatives” for the urban transformation of the wasteland called “Vlampijpzone” in Utrecht in May 2014.

The “Vlampijpzone” is a strip of currently unused land between the Vlampijpstraat and the railway-tracks from Utrecht to Amsterdam. It is part of the mixed business/industrial park “Cartesiusweg” (recently renamed to “Werkspoorkwartier”), which is approximately 60 hectares in size and located in the northwest of Utrecht. The area originated in the settlement of the “Werkspoor”-factory. This factory left in the 1970’s and since then the area evolved to a place where traditional industrial companies co-exist with offices, creative industry, leisure complexes and municipal city-care services.

In 2012, Gemeente Utrecht published the document “Ontwikkelingsvisie Werkspoorkwartier – De transformatie van een bedrijventerrein”, which describes the history, current situation and potential of the regarded area. It characterizes the area as one with problems (lack of unity, no coherence, little interaction, untidy appearance) as well as potential. In recent years, a new appreciation of the area has gained ground, especially by (smaller) creative industries. The municipality of Utrecht states, that a traditional approach towards the urban development of this complex area is not suitable. Key-words in the development should be innovative initiatives, flexibility and adaptation, combined with a strong and distinctive vision towards the future. Especially the potential and desire for a transformation into a creative, unconventional industrial hotspot is described.

“HvC” is a plan for an experimental, flexible and green working-environment at the Vlampijpzone. A testing-ground for Utrecht’s circular economy, DIY architecture, collectivity and interaction, bottom-up-initiatives and temporary urbanism. The latter as a result of the fact, that the municipality has granted usage of the property for only ten years. This short term is unattractive for professional investors and developers, but the more interesting for small independent & creative entrepreneurs and businesses from within the city.

“HvC” aims to become a catalyst for the transformation of industrial park “Werkspoorkwartier” into a creative, industrial hotspot in Utrecht. Furthermore, the initiators of “HvC” consider it to be a potential “platform for experiments and crossovers in sustainability, technology and construction”.

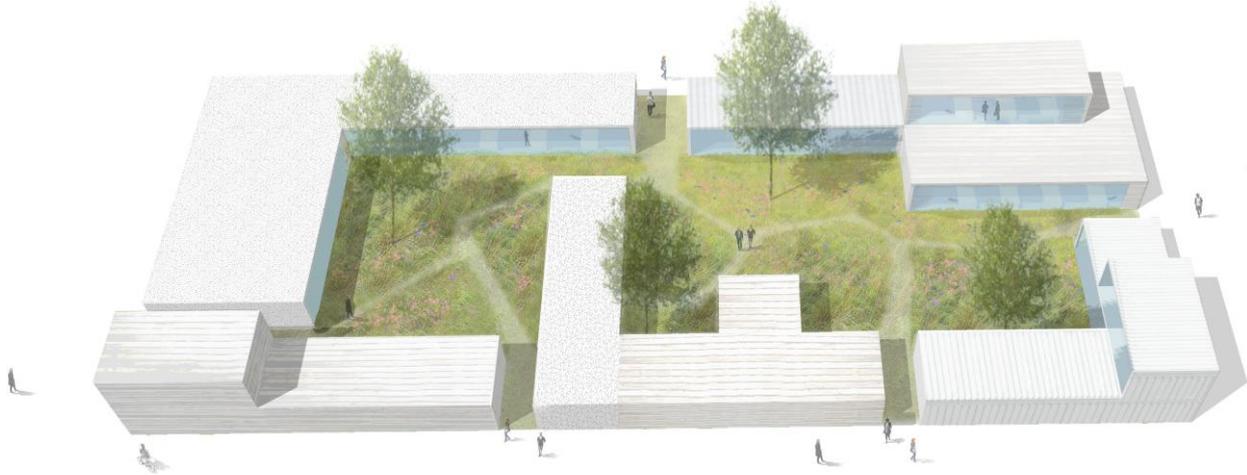
4.2 Concept

The concept of the design is based upon the typology of pavilions, clustered around courtyards. The pavilions open themselves towards the inside, thus creating an intimate, collective atmosphere. At the same time, the courts will be publicly accessible, enabling users and inhabitants of nearby areas to also enjoy it. The “green working-environment” will stimulate labor productivity. One of many ideas is to use the inner-gardens for urban farming.





“HvC” will be realized in phases. Starting with one cluster of three pavilions around a central courtyard, expanding to both sides, creating a “strip” of buildings interconnected by courtyards during the process (see picture 2).



Picture 2: Hof van Cartesius in a future, intermediate phase of realization (design and image by Charlotte Ernst and LINT Landscape Architecture).

The “organic urban development” and temporary character of the plan forces the users/designers to think and act in flexible, creative solutions. The final outlines of the plan are not fixed. When, over time, other users or other demands arise, the design should be flexible enough to respond to these changes. The structures should be easy and quick to assemble, preferably without professional help and with little means. If necessary, they should be easy to alter and easy to disassemble, transport and assemble elsewhere. Hence the similarities with the concept of the open source initiative of Wikihouse. When successful, the concept can be replicated to other urban wastelands in need of transformation.

4.3 Social purpose, collaborations and changing roles

Essential to “HvC” is the fact, that it has a social purpose. The aim is creating value for the area and the people involved, instead of making (financial) profit. The initiative aims for creating new urban quality. Bottom-up initiatives like these fill the gap for a certain need, that is seemingly not yet present. It also means a change in roles and responsibilities. The inhabitants that “built their own dream” are often designers, artists, architects or urban planners. In processes like the realization of “HvC”, they also become developers, managers and contractors.

This change also alters the (traditional) role of the municipality. In case of “HvC”, the city of Utrecht is no longer the initiator. Nor the financer or supervisor. In fact, the city of Utrecht should fulfill a role in facilitating the process of the development. This is a new situation for a local government like the municipality. Both parties in the process - initiators and government - have to find new ways of co-operation. This is one of the challenges “HvC” faces today.

For the “collective” of builders and users another question is, how to organize themselves. Who will coordinate the building-activities, maintenance, finances, communication etcetera?

The combination of being a testing-ground for circular economy combined with open source knowledge-sharing is obvious in case of “HvC”, according to Charlotte Ernst. The nonprofit-character of the project makes it especially suitable for an open source approach. Traditional, established companies have a certain “fear” for sharing their knowledge, because it can threaten their (short-term) results. Whereas more social-driven initiatives can benefit from it. Initiatives like “HvC” can become future accelerators





for innovation and transformation. Precisely because of the absence of fear for sharing. On the other hand, financial funding in these cases is much harder. Where large, established companies have sufficient financial means, small bottom-up initiatives, often struggle to raise funds. This is one of the reasons why the initial idea of mainly attracting small creative businesses is no longer the case. Also larger, more settled companies are welcomed to participate. They can use “HvC” as a showcase for innovative, sustainable developments and/or use it as a testing ground for circular ambitions. They can stimulate, enhance and co-operate with smaller initiatives as part of “HvC”.

An important example is the collaboration with SITA. SITA is one of the biggest waste disposal companies in the Netherlands. SITA not only collects and processes waste-products, but also focusses on finding new ways of re-using products. The initiators of “HvC” and SITA are collaborating in finding new ways to re-use demolition waste as building materials in the project.

4.4 Current status

At this moment, the initiators of “HvC” are raising funds in order to realize the first phase. After applying for building-permits, start of realization is planned in the second quarter of 2016. The first phase will consist of three pavilions of 850 m² in total (2000 m² of ground surface with gardens included). The total size of “HvC” can become 6000 m² in coming years.

The authors of this paper are planning two types of (research and design) projects with regard to “HvC”, starting February 2016. The first is a graduation-project for two architecture students of the Institute for Built Environment. The other one is a project for a multidisciplinary group of 6th semester-students of the Institute for Engineering and Design. Both groups will approach the project with regard to their own field of expertise, but always in close collaboration and thus enhancing and complementing each other's work. Both authors of this paper will guide and supervise these processes.

The preliminary research questions the students will be working on focus on three areas:

1. Construction methods & materials
2. Logistics
3. Organizational model/growth

4.5 Similar initiatives

In regard to “HvC” and the research described in this paper, a lot can be “learned” from predecessors and resembling projects. For instance “De Ceuvel”. This project on a former ship wharf in the North of Amsterdam is, like “HvC”, the result of a tender won by a bottom-up, collective initiative and a ten-year lease from the municipality. The initiators turned the former industrial plot – a polluted wasteland - into a “regenerative urban oasis”: wasted houseboats from the city were turned into offices and ateliers for creative and social enterprises. These were placed in a landscape of soil-purifying plants. By doing so, after ten years the city council, who co-financed the project, will retrieve a less polluted parcel of land.

“De Ceuvel” is currently in use and has generated a significant amount of publication and attention. In a personal conversation with architect Wouter Valkenier, one of the initiators and team-member of “De Ceuvel”, experiences and “lessons learned” were discussed. One of these experiences is, that the project already has a positive impact on the surrounding areas. In a way, that it attracts numerous new and other users.

“De Ceuvel” has a high level of self-sufficiency. “Mainstream” technology (e.g. solar panels) could not be used to achieve this, because the (long-term) investment needed for such technology did not suit the temporary, short-term use of the project. Instead, self-developed innovations and technologies were developed and used. This “first-generation” technology, self-evidently, showed flaws, which had to be dealt with.

Another experience worth mentioning concerns the communication of the collective. Especially with external parties. It has proven essential to invest time and energy in communication-processes in order to prevent miscommunication and mutual frustrations.





Future interviews and collaborations with “pioneers” like the initiators of “De Ceugel”, but also for instance “Plug In City” in Eindhoven, will provide further valuable input for the research described in this paper and “HvC”.

5. CONCLUSIONS

In 2016, the outcomes of the described researches and case-studies will provide answers to the questions both authors have. Most importantly, it will proof whether or not (the development of small urban areas in) cities can benefit from re-using demolition waste and a circular HUB. And whether or not an open source approach has the potential to accelerate these innovations. And if so: in what way and with which “protocols”? In addition, it will help to further define the concept of “open source” in the built environment.

Furthermore it will tell us, whether or not a bottom-up and non-profit driven concept like “HvC” is successful in turning wastelands into use. And if it might be possible to replicate it to other urban wastelands in need of transformation.

By doing so, this research contributes to the challenges addressed to as the “Transition Zero”.

This research is part of the research-program of the research group Supply Chain Redesign in the Built Environment of HU. It is in multiple ways related to other researches within this group. The authors would like to refer to other papers as part of the SBE16- Transition Zero Conference for gaining further insight in these relationships.

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