Developing a circular business model for the municipality of Apeldoorn

Deliverable WP 2

Saxion University of Applied Sciences, Business Models Research group, School of Finance & Accounting

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Abstract	This report investigates the circularity of CDW leading to circular new business models, strategic decision making and operationalization of CDW handling and management.
Keywords	Construction and demolition waste, circular economy strategies, circular business model, tooling.
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Table of contents

List of abbreviations

CDW	Construction and Demolition Waste
BMT	Business Model Template
TLBMC	Triple Layer Business Model Canvas
BCM	Business Canvas Model
CBM	Circular Business Model
Loops	the term “Loops” is meant as a shortening of ‘Closing the material loops’ meaning the reduction and regeneration of a given material, which is the core subject of the CityLoops project. In chapter 5 is a description of a set of matrices given with the term ‘Loops’ such as the ‘Material Loops Matrix’ which should be understood as ‘Closing the loops” Material Matrix’.
CE	Circular Economy
BSR	Brand Strategy Research model
b2b	Business to Business

List of figures

List of tables

1. Introduction

Saxion University of Applied Sciences has been appointed by the European Union Horizon 2020 program to conduct research for the CityLoops project to investigate a number of areas pertinent to construction and demolition waste (CDW). The municipality of Apeldoorn is one of the seven cities selected in the project as case study. This report is part of work package 2 and contains results of the research conducted between March and December 2020 by Saxion University of Applied Sciences in Deventer (The Netherlands), more specifically by the Business Models research group.

The research conducted is related to the development of a business model for the circular renewal of roads in connection with an existing material depot and the concept of a material databank. However, the input of the Business Model research group is limited to the business model aspects being business economics related rather than technology orientated.

The technical aspects specifically related to the analysis of the materials and handling thereof have been done by the Saxion school of Business, Building and Technology. The material depot and material databank are merely mentioned in this report to give the background context of the research. More specific details about these are to be found in a separate report (Willoughby, Poutianinen, Otten, 2020) (Entrop 2020).

This report consists of eight chapters. In Chapter 1 a short introduction is given about the context of the research, what will be researched and why. Chapter 2 introduces the research set up, objective, main questions and methodology used. The Business Model Template (BMT), which is leading throughout the document, is briefly described in this chapter however a fuller description is given in appendix 7. A review and argumentation for use of all research methods and tools used are also presented in Chapter 2.Chapter 3 includes the literature study and theoretical framework. Chapter 4 are the results, followed by the data analysis in Chapter 5, discussion in Chapter 6, conclusion in Chapter 7 and finally the recommendations in Chapter 8.

1.1. Organisational context

The municipality of Apeldoorn is one of seven cities in Europe which has been selected to take part in the European funded research CityLoops about construction and demolition waste (CDW). The municipality of Apeldoorn strives to find a way to develop an integral circular economy approach in dealing with construction and demolition waste. An area of Apeldoorn named Griffiersveld has been selected as pilot for the research. Griffiersveld, located in the area De Maat, is a populated neighbourhood where a number of roads have to be recycled in the coming years. A number of aspects have been investigated in relation to the re-use of materials coming from the road in conjunction with an existing material depot.

The purpose of the CityLoops research is to evaluate opportunities available in Apeldoorn and the other selected cities (Bodø, (Norway), Mikkeli (Finland), Porto (Portugal), Seville (Spain)

and Roskilde/Høje-Taastrup (Denmark) when it comes to re-use and recycling of construction and demolition waste. This means investigating the subject from a number of perspective including which business models fit best. The results of the combined research from the experiments conducted in these cities are planned to lead to up-scaling of methods for re-use and recycling of CDW throughout Europe.

Apeldoorn is a city with 161,139 inhabitants (Apeldoorn municipality, 2020) situated north west of The Netherlands. In the coming years, Apeldoorn plans to renovate several neighbourhoods built between 1965 and 1985. The public spaces and roads in these neighbourhoods typically consist of materials such as concrete and asphalt that have a high circular potential. Through its participation in CityLoops, Apeldoorn aims to build the capacity to retain these resources for its municipality. This will require new business models and accounting methods, but it will also create new financing methods and bring Apeldoorn closer to becoming a truly circular city (Apeldoorn municipality 2020).

The roads concerned with the recycling plans are in Griffiersveld, in an area called 'De Maten'.

'Griffiersveld' is a residential area in the neighbourhood of 'De Maten' located in the south-east of Apeldoorn. 'Griffiersveld' and its streets are in the south-west side of the neighbourhood. In total seven areas make up 'De Maten', namely Matendonk, Matendreef, Matengaarde, Matenhoek, Matenhoeve, Matenhorst, and Matenveld. Griffiersveld is located in Matenveld.

'De Maten's' population is 26 255 inhabitants making up 11 275 households.

The current pavements in 'Griffiersveld' was built in 1977 and includes 3690 m^2 of concrete slabs and 850 m^2 concrete bricks and other recyclable materials.

Figure 1 Location of Griffiersveld (de Maat)


Figure 2 Concrete bricks from Griffiersveld

1.2. Facilitating circular material use

In general the thought is that a circular material usage can be facilitated by introducing a material depot and material databanks to manage material quantities and qualities.

The material depot of the municipality of Apeldoorn is currently used to store materials such as sand, mainly provided by regular maintenance of roads and other municipality objects (for further reading please refer to the new conference paper of Bram Entrop).

Figure 3 Aerial view of the material depot (by courtesy of Aerodata International Surveys)

A material databank is a concept gaining interest in the construction industry. The idea of a material databank is to identify all materials used in construction and building of infrastructures in order to be able to improve the re-use of secondary materials and increase recycling potential (Heinrich and Lang 2020). The emergence of such concept is presently leading to share type B2b digital platforms such as excess material exchange (Excess Materials Exchange 2020).

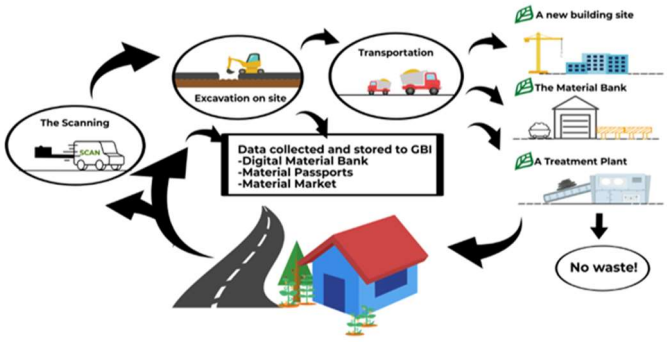

Figure 4 Circular flow in project Griffiersveld (Willoughby, Poutiainen, Otten 2020)

In order to contribute to the circular economy, materials need to be identified and properly managed, hence the concept of material passport is facilitating this process. Material passports are (digital) sets of data describing defined characteristics of materials and components in products and systems that give them value for present use, recovery and reuse (Debacker et al. 2017)(Heinrich and Lang 2020).

2. Research set up

2.1. Research objective

The research objective is to investigate which business model could be best applied to the municipality of Apeldoorn for the recycling of its roads. The business model should contribute to the ongoing efforts the municipality has deployed over the years to develop policies and activities leading to the development of a circular economy. In that context the business model should encompass the three types of values (Financial, Environmental and Social). The recommendations for the business model should also provide advice on both strategic and operational aspects.

2.2. Main research question

The main research questions and sub questions are:

1. Which business model and working framework could be best applicable for the recycling of roads in Apeldoorn?
   a. What are business models? What is a circular business model?
   b. To what extent is Apeldoorn actively involved with the principles of a circular economy?
2. To what extent can the circular economy be embedded in the choices of the business model?
   a. What are the values (economic, environmental, social) which can be derived from the recycling of roads?
3. What goals and strategies could be derived to make the business model work?
   a. Who are the partners involved in the recycling of roads? And what do they do?

2.3. Research methodology

The nature of the research is exploratory whereby existing theories are used and applied to the context of the researched subject. Qualitative and quantitative techniques have been used. A total of 22 interviews have been conducted and six focus groups involving in total 36 participants. Table 1 provides a sample of the details (see Appendix 4 for the full list).

Iteration cycles have been applied to sharpen the quality of the data collected and to come up with new ideas and questions. The Business Model Template (BMT) and method (Jonker and Faber 2019) have been selected as a relevant framework and effective tool. The reason for this choice is that BMT uses a step by step approach to find the most relevant BM depending on the context. The selected approach has produced the main output of this research comprising a framework and tooling for the Apeldoorn municipality to use in the future. Figure 5 below shows the research process followed which integrated the BMT and later on produced

a framework and tooling as an end result. In Appendix 7 is a full explanation of what the BMT entails.

Table 1 Sample list of interviewees

Research list of interviewees CityLoops

Phase	Research technique	Expected outcome	Participant function	Organization	Date
Orientation (problem/ambition)	interview	Understanding of Apeldoorn municipality policies and work of the Apeldoorn Energiek initiative.	Director	Apeldoorn Energiek	03.03.2020
Orientation (problem/ambition)	interview	Understanding of the requirements of the CityLoops research for Apeldoorn municipality	Demonstration manager CityLoops	Apeldoorn municipality	30.04.2020
Definition dream	focus group	Identification "dream" for municipality employees	Director	Apeldoorn Energiek	12.05.2020
			Demonstration manager CityLoops	Apeldoorn municipality	
Definition dream	focus group	Identification "dream" for municipality employees	Project leader circular economy	Apeldoorn municipality	04.06.2020
			Policy advisor recycling and circularity	Apeldoorn municipality	
			Senior advisor purchasing and tendering	Apeldoorn municipality	
Definition dream	focus group	Identification of "dream"for Apeldoorn inhabitants	Inhabitant Apeldoorn	Apeldoorn youth group	06.07.2020

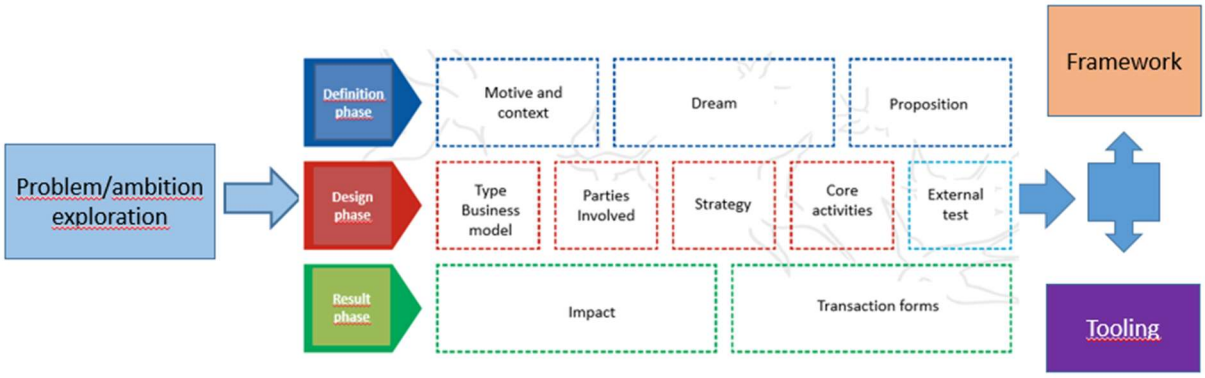

Figure 5 Research process leading to a framework and tooling using BMT

2.3.1. Business model template

For this research an established circular Business Model Template (BMT) has been used in order to facilitate the expected outcome of the research. The business model developed for this research is based on the work of Jonker and Faber (2019) . Their BMT is divided in three phases: Definition, Design and Results. Each phase contains a number of foundation blocks linked into a flow. The BMT offers a very suitable and relevant structure to investigate the issues at hand for its capacity to evaluate what business models best fit depending on the context. Furthermore, the multi-stakeholders and value driven approach are relevant, when trying to close material loops as closing any material loops involves different parties each of them with its own perspective on materials.

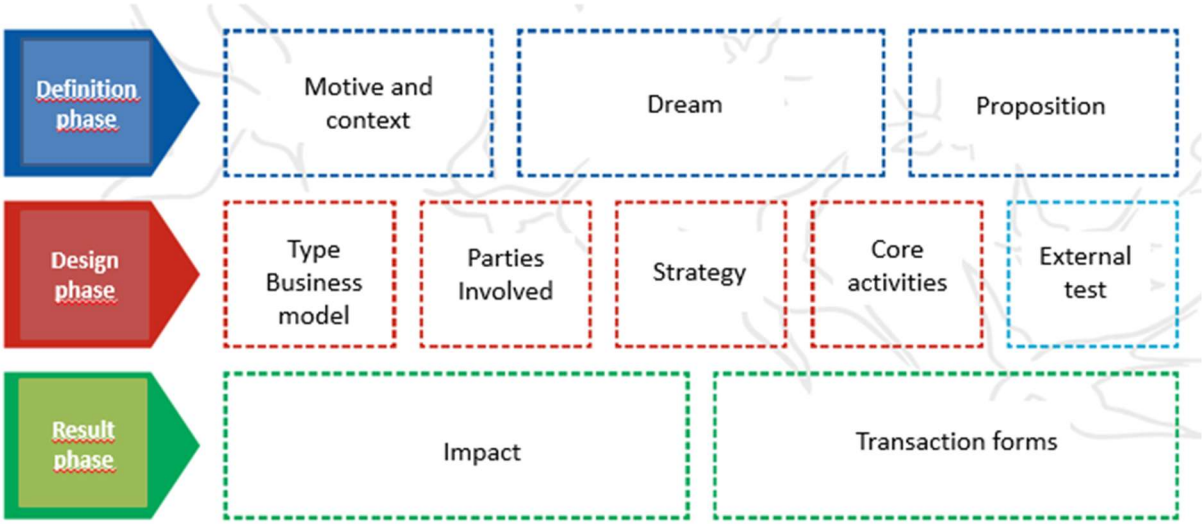

Figure 6 Translated version of the Business Model Template (Jonker and Faber 2019)

The resulting foundation blocks from the results phase ultimately give an impact (values created) and a description of transaction forms.

2.3.2. Focus groups

Focus groups were used to establish the 'Dream' leading to the 'Proposition' and identify the 'Parties. Five focus groups were set up amongst the key target groups inhabitants (one focus group, n=5), municipality personnel (three focus groups, n=7) and industry partners (one focus group, n=2). One focus group identified the 'Parties'. Participants establishing the 'Dream' were asked to share their thoughts on the values they saw in the CityLoops project, regarding the recycling of the roads. They were specifically asked to provide values from three perspectives: economic, environmental and social.

The sessions were recorded on both video and automatic transcribing software. Furthermore, hand notes were also taken. Sessions lasted an average 60 minutes and used the 'placemat consensus' technique being part of Delphi technique approach. This technique was chosen for its effective sharing of ideas and experiences amongst participants ultimately leading to a consensus statement.

The Delphi technique "*is a group process involving an interaction between the researcher and a group of identified experts on a specified topic, usually through a series of questionnaires*" (Yousuf 2007 p 1). Linstone (1975) suggests that the Delphi technique helps "*developing causal relationships in complex economic or social phenomena*" (Yousuf 2007 p 1). This technique provides a positive platform to discuss a subject as "*the individuals needed to contribute to the examination of a broad or complex problem have no history of adequate communication and may represent diverse backgrounds with respect to experience or expertise* " (Steurer 2011). Participants are asked to answer a specific question and/or to agree with a statement and write down individually their answers on a piece of paper. After a few

minutes, once all have completed the task they are asked to share their findings orally one at a time. When everyone has shared their thoughts, participants are asked to find a consensus to keep a number of ideas, these are symbolically placed in the middle of an imaginary mat. In a pre-COVID-19 time the 'placemat consensus' technique would involve a large piece of paper on which each participant could write. The piece of paper (mat) would have in its middle a square for collection of the consensus ideas.

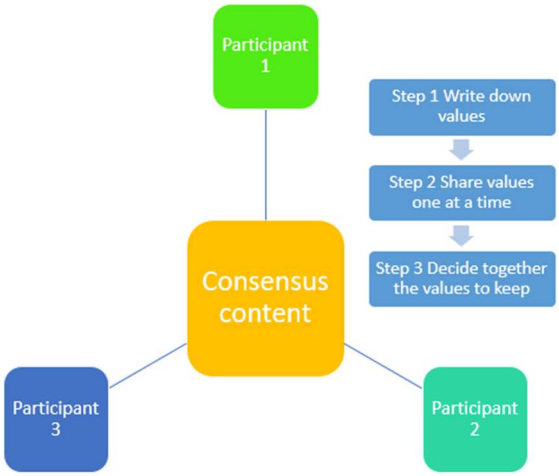

Figure 7 Steps followed using the 'Placemat consensus' technique

The technique outlined above in figure 7 allows for a maximisation of understanding of each other's viewpoint through open dialogue, sharing of opinions ultimately ending in a consensus which binds participants.

2.3.3. Interviews

In total 22 semi-structured interviews were conducted. Video recordings were made as well as automatic transcribing software technology and hand notes. Transcripts were open coded.

2.3.4. External test and validation grid

In the design phase of the BMT an external test has to be performed following five steps. For the fifth step (feedback from experts) a validation grid was designed to collect the feedback from five municipalities made of two councillors and five senior executives involved in CE project management and three industry partners about the loops matrices as key tooling. The choice for participants was to have a representative selection of the two levels at the municipality. One perspective would be made of council members representing the position of policy decision making. Another perspective would be from CE municipality experts responsible for both policy making and operationalization. Industry partners participants are all senior CE executives with over 20 years' experience in the field of CE project management for municipalities. Triangulation of the data is achieved on three levels.

Chosen criteria for the grid were adapted from the criteria of “Best practices in green procurement” (Curver A, Reeve T, Duronio N, Panciera K, Calahan Klein R 2016). No such tool was found in the literature to validate the matrices hence it was chosen to design a tailor made one. Green procurement was identified as a relevant area to link onto as procurement play a significant role in municipalities and is by default linked to circular principles.

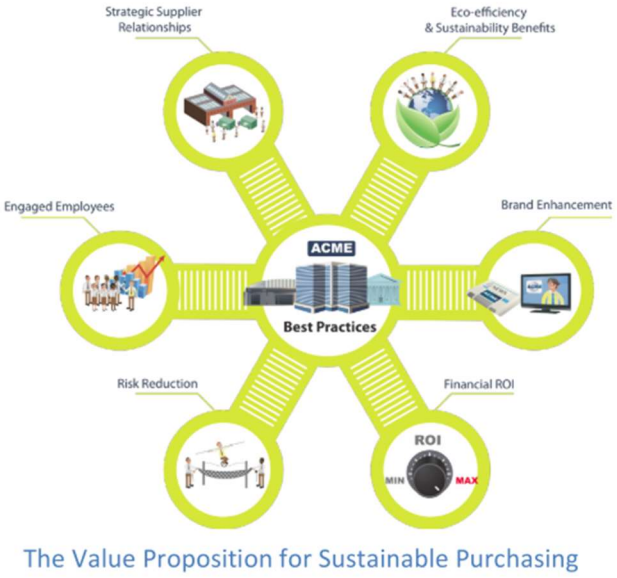

Figure 8 The six main areas to achieve sustainable purchasing (Curver et al 2016 p 13)

Selected criteria and statements for evaluation adapted from the value proposition for sustainable purchasing were as follows:

Table 2 Validation criteria and related statements

CRITERIA	STATEMENTS
Economic impact	S1 The loops matrices help identify key material loops for each project.
Ecological impact	S2 The possible chosen strategies for material loops are useful for financial control and budget forecast.
Social impact	S3 The loops matrices can give an insight into the social impact of each project.
Procurement	S4 The loops matrices can help the council take decisions in the future by setting up clear strategies for material loops. S5 The loops matrices can be used as a tool by the council to build on the municipality brand management.
Risks and control	S6 The loops matrices can help identify the needed procurement specifications to work towards a circular economy in a streamlined way.
Policy making	S7 The loops matrices set a common base for employees to discuss circular projects. S8 The loops matrices help individual project managers to set up a circular project.
Project coordination and running,	S9 The loops matrices can be an efficient control tool for management team and project employees alike.
Strategic relationship and local economy	S10 The loops matrices help identify available key partnerships to strengthen the local economy.

The grid offered participants 10 statements to rank on a Likert-type scale ranging from 1 (completely disagree) to 10 (completely agree). Participants were offered the opportunity to comment on their choices, audio transcribing software was used as well as hand notes to collect feedback.

2.3.5. BSR model, 'Organisata' and 'Persona'

The Brand Strategy Research Model (BSR-model), the 'Organisata' and 'Persona' concepts were used to help identify the "parties involved" in the design phase. The BSR-model is a Dutch developed psycho-ethnographic methodology to help marketing population segmentation by identifying key values and character traits. The model is based on a sociological dimension evaluating individualism and a group orientation and psychological dimensions evaluating introversion and extroversion. The analysis of the data creates four possible lifestyles types identified by different colours as follows:

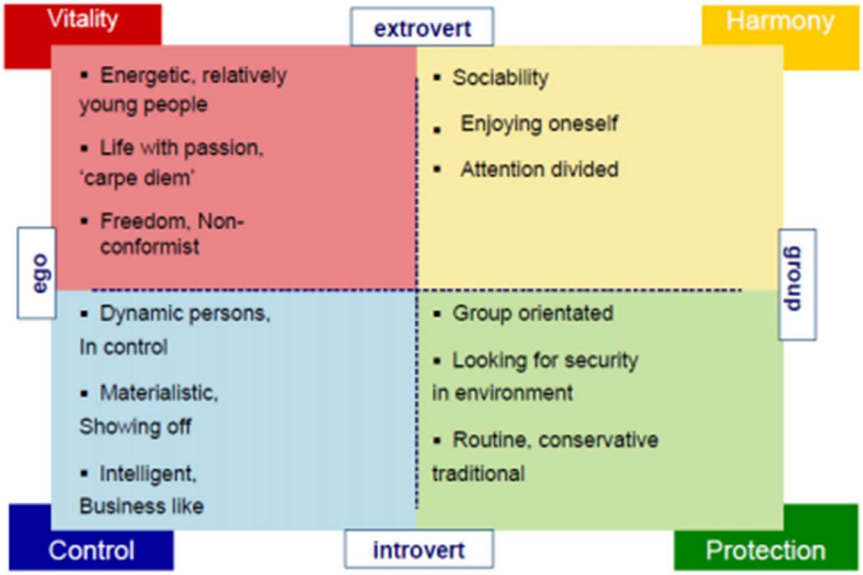

Figure 9 BSR-Model with its four lifestyles characteristics

- The red lifestyle means vitality. People with a red lifestyle are ego-oriented and extravert. They are free-spirits and want a lot of freedom in their lives. Enjoying life, besides work and family, is for them the most important thing.
- The yellow lifestyle represents harmony. People with a yellow lifestyle are spontaneous and very social, they are extravert and group-oriented. It is easy for them to make new friends. Besides a big social network, family and the neighbourhood are a central point in their lives.
- The green lifestyle means security. People with a green lifestyle are group-oriented but also introvert. Their family, neighbourhood and their privacy are all important for them. They don't like changes and want everything as normal as can be.
- The blue lifestyle means control over life. People with a blue lifestyle are introvert and ego oriented. They want to have a high social status and a luxury lifestyle. They make strategic decisions about their career to be successful. (Smart Agent Market response 2017)

An ‘Organisata’ is a tool (Haaker, Reuver, and Bouwman 2017) designed to capture the essential characteristics of a given organisation in order to understand how that organisation is functioning in its market. It uses 14 criteria (see Figure 10) which are: Name, Industry, Products & services, Company size, Revenue, Location, Offering, Mission, Goals in context, Target customers, Channels, New trends and developments, Frustrations in context and Threats. Each criterion requires a simple description in order to help the analysis of a given situation. The ‘Organisata’ is particularly useful in context where multi stakeholders are involved, each with a potentially different perspective.

The ‘Organisata’ data for this research is using multiple data collected from the industry partners and municipality interviews. The data filled is meant to give a realistic profile of a typical organization involved in that sector.

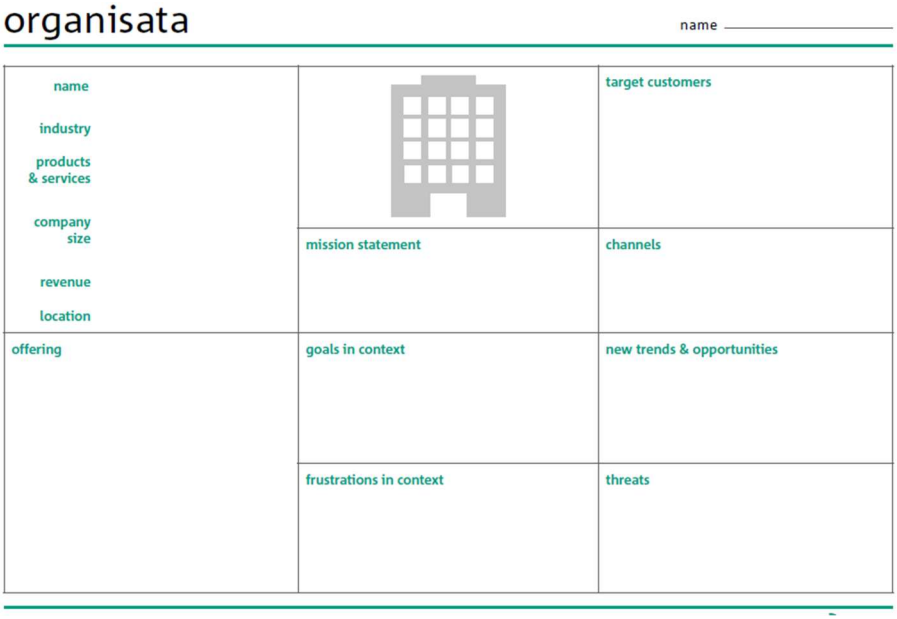

Figure 10 'Organisata' template (Haaker, Reuver, and Bouwman 2018 p 75)

A ‘Persona’ (Cooper 1999) is a tool designed to capture the essential characteristics of a fictitious typical target client in order to support strategic marketing decisions. The descriptive is made of 14 criteria, being Name, Gender, Age, Status, Occupation, Location, Personality, Quote, Goals in context, Biography, Interests, Preferred channels, Brands and Frustrations in context. By connecting data from the different criteria, a profile of a given ‘Persona’ is created as can be seen in Figure 11. The profile enables the organization to “give a face” to the data.

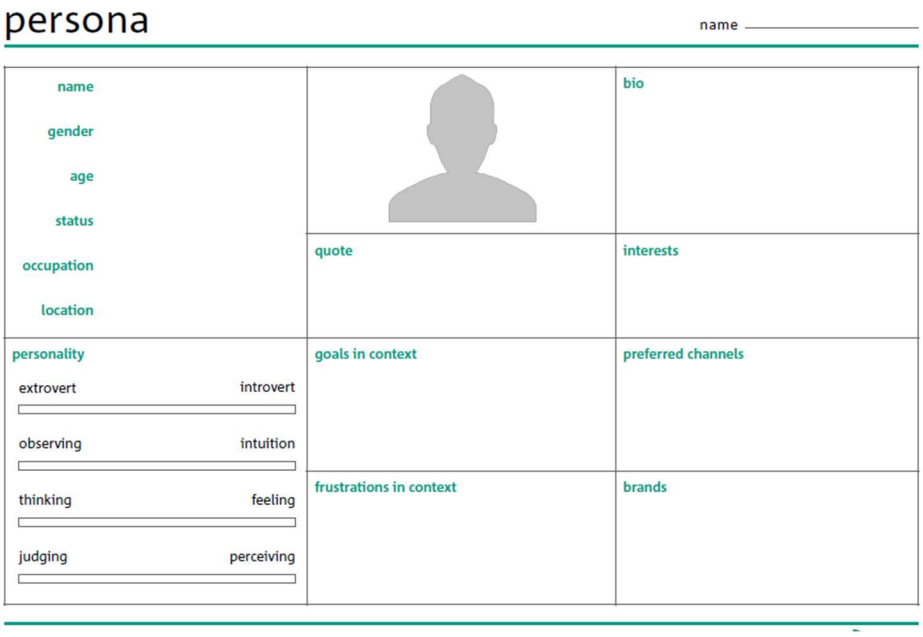

Figure 11 'Persona' template (Zambito, n.d)

2.3.6. Partner radar

The partner radar tool and accompanying matrix (Innovalor 2018) were used to map out the various stakeholders involved and to understand their relationships. The stakeholders are divided into four main types:

- Suppliers: organisations supplying goods or services against a fee;
- Collaborators: organisations or person(s) involved in working towards achieving a similar goal which might are not always related to a transactional relationship;
- Investors: organisations or third parties contributing financially to an organization and expecting financial returns from its activities;
- Others: other organizations and third parties enabling support of the organization's internal or external activities (Innovalor 2018).

The relationship level of the stakeholders is indicated based on a level of influence (great, limited or little influence). These tools have been specifically developed by Saxion Business Model lab (Saxion University of Applied Sciences 2020) to help with BM design and application. They are readily available online at http://www.businessmodellab.nl.

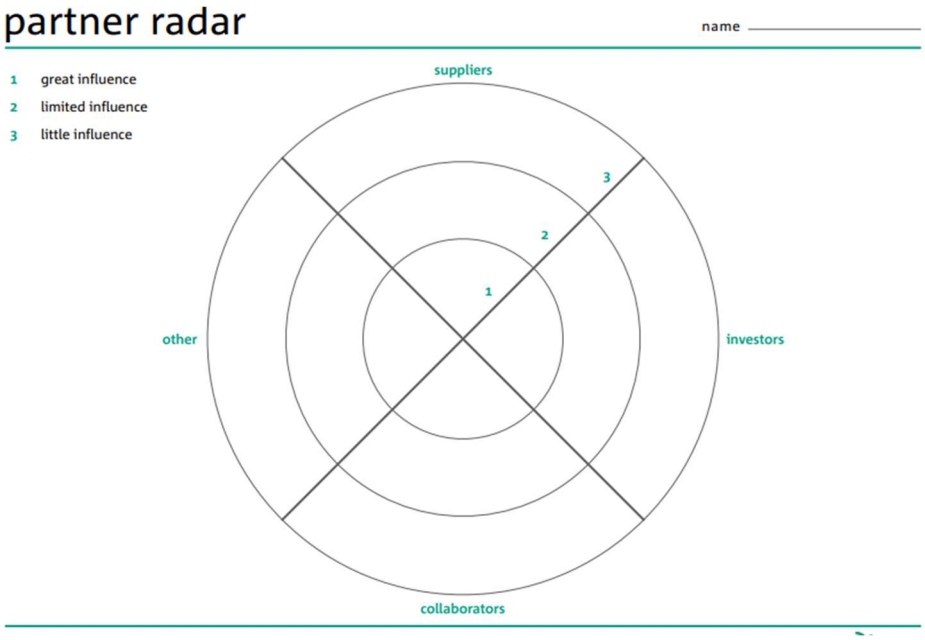

Figure 12 Partner radar tool (Innovalor 2018)

2.3.7. Limitations and constraints

During the research, the language for communication and data collection was mainly in English. However, a number of interviews or presentations were conducted in Dutch as participants did not have a sufficient English proficiency to be able to conduct the research satisfactorily. This relative language barrier might have slowed the interview process down and the flow of ideas and suggestions.

The research originally started in March 2020 and was delayed by many months due to the difficulties in reaching individuals during the (ongoing) COVID-19 pandemic. Although the availability of people online has increased overall, the priorities of many respondents were not always to participate in interviews or join focus groups. Simultaneous research lines from different Saxion schools often targeted the same individuals at the municipality which could on occasions restrict the scope of the data collected as people could not be realistically asked twice of three times to be interviewed. Alternative solutions were found which created delays in the research process but did not alter the quality of the data collected. An example of this was for example an interview with the director of the Dutch CDW branch organisation although he is not directly involved in the activities in Apeldoorn. Original research methods planned were successfully adapted to an online environment and no other major repercussions can be reported.

3. Composing the theoretical framework

The concept of circularity in general terms is best expressed by the need to reduce any existing waste streams produced by manufacturing and human activities as well as maximising secondary materials through any possible means for instance circular design, recycling or improved material recovery techniques (Korhonen et al. 2018). The idea being to break the 'take, make, dispose' cycle which still typifies our linear based economies and move on to a circular based economy where resources are fully utilised with close to a zero waste (Ellen Mac Arthur Foundation 2015). The diagram below in Figure 13 shows the ideal situation of the flow of resources in a society based on the principles of a circular economy.

In this transitional phase moving towards a circular economy, technology and understanding of the physical and chemical characteristics of materials can help but are not sufficient to solve these issues. The complexity of the re-use or transformation of the materials over time involves many logistic processes and other technical aspects that makes it a real challenge to achieve.

Materials used in construction or infrastructure have a certain value at the time of use and then further over the lifespan of these materials. The value(s) can be different depending on the perspective taken, therefore the stakeholders view is important when discussing values. For example, a natural stone used in a building can have a financial value for the building promotor when building as well as a social value for the person who will live there when the stone originates from a local quarry whose product is the pride of that region.

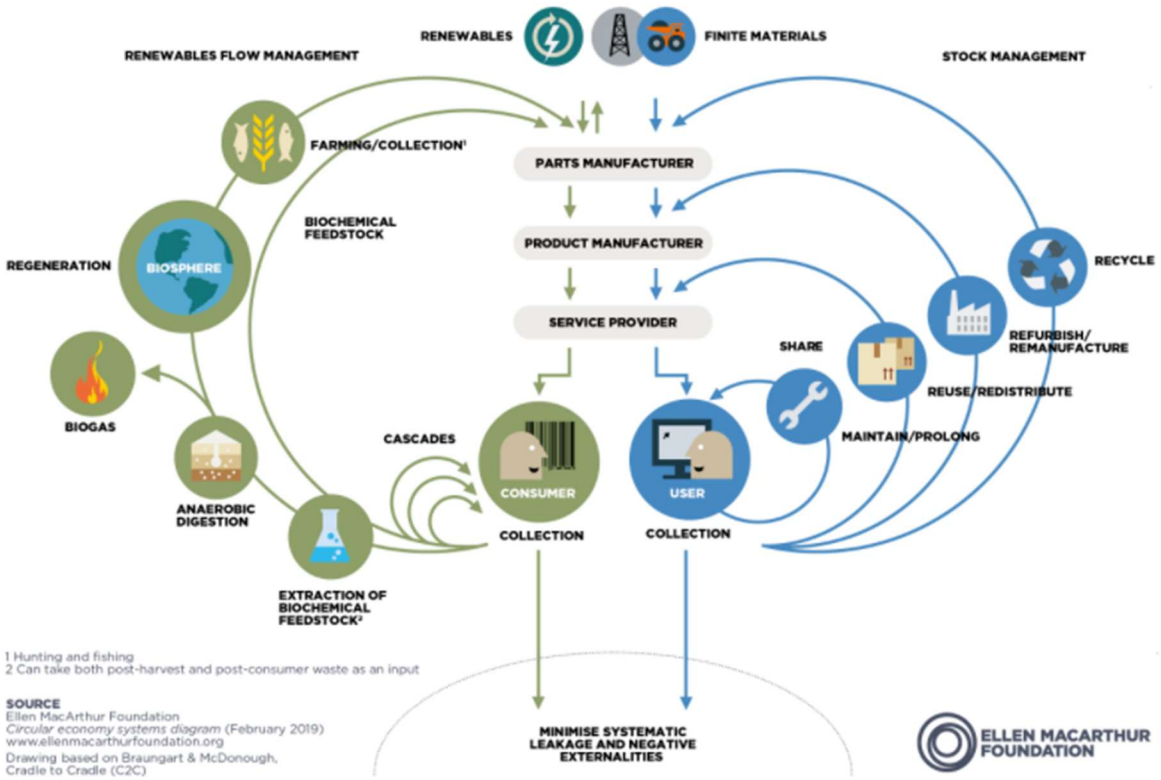

Figure 13 Circular economy systems diagram (Ellen Mac Arthur foundation 2019)

Values therefore stand at the core of the equation. What values do we give to the recycling of road materials such as asphalt, sand or gravel? How can we identify the type of values available and for whom are these values important? Poldner of the University of The Hague during her inaugural address as lector highlight this point: *"We believe that a transition to a circular economy is not just a transition of materials, nor technologies - it is most of all a transition of values"* (Kim Poldner 2019)

Business models help finding answers to these questions as a business model is by definition a conceptual framework enabling the understanding of value creation (Chesbrough 2007). It describes an organization's logic to create and capture value for its stakeholders(H, Bouwman, E, Faber, T, Haaker, H 2008) (Chesbrough and Rosenbloom 2002), (Linder, J, Cantrell 2000), (Osterwalder, A, Pigneur 2010), (Lüdeke-Freund, Gold and Bocken 2019). Bouwman et al (2008) links this description to 'how an organization or network of organizations intends to create and capture value with its products and services'. Values in traditional business models are central to business model and derived in four widely accepted types (Gassman, O, Frankenberger, K, Csik 2014),(1) Value creation (how is the value created?);(2)Value proposition (what value is delivered to the customer?); (3)Value capture (how is the value offered to the customer?) and (4) Value generation (what is the financial value of that transaction?).

A business model as a term should not be confused as a synonym for revenue model which is only a component of a business model and concerned with how the organization is generating

an income in order to operate. This clarification is needed during the ongoing economic transition from a linear to a circular economy, where the financial perspective in particular still dominates the debate. Values reflect the relationship with stakeholders which is presently more prominent as organizations are pressured to make more long term decisions over time.

In recent years the social value has gained great momentum and is being fully integrated in BM (Lüdeke-Freund, Gold, and Bocken 2019)(Joyce and Paquin 2016). The necessary paradigm shift from an economic to environmental and social value based view will continue to exert pressure on organizations that will need to adapt as consumers (B2c) and clients (B2b) are actively seeking values beyond an acceptable transactional price.

Values based views can be seen as a positive development for innovative management approaches (Breuer 2017). The terminology to express value is also evolving from a "Value" often synonym with financial value to "Values" representing a wider and more human related empirical notions of values criteria such as collaboration or societal or global values (H Breuer 2017 p 28). Values are also linked to new trends with relation to innovation (H Breuer 2017), values-based innovation management as a forward moving movement is leading towards a social economy (OECD 2020) where shared values are leading in a new type of capitalism (Porter and Kramer 2019)(Volans ventures Ltd 2020).

From a marketing perspective, organizations providing goods/services or ideas need to anticipate, identify and satisfy the needs, wants and demands of consumers (B2c) and clients (B2b) (Chartered Institute of Marketing 2015). The main focus of these efforts lies in the concept of creating a value of some denomination which often will be exchanged through a financial transaction. In order to understand how this value is created by the organization a number of models and canvasses have emerged over the years to help organizations identify how they operate by providing insight in a number of key areas pertinent to the functioning of their organization such as revenue generation or target group definition (Porter 1985).

From a management and organization perspective the concept of a business model has merged where value creation is central (Teece 2010). "*A business model describes the design or architecture of the value creation, delivery and capture mechanisms employed. The essence of a business model is that it crystallizes customer needs and ability to pay, defines the manner by which the business enterprise responds to and delivers value to customers, entices customers to pay for value, and converts those payments to profit through the proper design and operation of the various elements of the value chain". (p. 179)*

The most famous and widely used in business is the business model canvas (Osterwalder, A, Pigneur 2010) with nine criteria covered (key partners, key activities, key resources, value proposition, customer relationship, customer segments, channels, revenue streams and cost structure). Other models have used the concept of the business model canvas and developed versions of it with subtle change of focus. Organizational structure for the lean canvas model, or value proposition (STOF Model) (H, Bouwman, E, Faber, T, Haaker, H 2008). In recent years models are now integrating environmental and social dimensions due to consumer pressure and national or international legislations (European Commission 2020). The triple layered business model canvas is the easiest to understand as it has simply added an

environmental and social canvas to the original economic model canvas of the business model canvas. Sustainable business models are now capturing values beyond the economic perspective.

Schaltegger et al propose the following definition: "*A business model for sustainability helps describing, analyzing, managing, and communicating (i) a company's sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries".* (Schaltegger, Hansen, and Lüdeke-Freund 2016, p 6)

In comparison to sustainable business models, circular business models specifically relate to the focus on reduction of materials and maximization therefore closing of the loops. "*A circular business model is how a company creates, captures, and delivers value with the value creation logic designed to improve resource efficiency through contributing to extending useful life of products and parts (e.g., through long-life design, repair and remanufacturing) and closing material loops"* (Nußholz 2017) .

Choosing one model over another should therefore be dictated by the context of the organization and what is the objective at hand. For a non-profit organization such as a municipality in charge of running a city on behalf of inhabitants, the needs, wants and demands of inhabitants might be related to affordable housing, the quality of the local infrastructure (e.g. roads) or its social amenities.

Business modelling is about evaluating opportunities and considering options leading to the creation of values. A circular economy approach requests by definition to evaluate the value set (economic, environmental, social). A recently developed template, the business model template (Jonker et al. 2018) helps define what business model should be used based on the context of the organization. The outcome is similar of business models in that the values are now derived in terms of impact of these values. Other similar tools include the value hill business model tool (Achterberg, Hinfelaar, and Bocken 2016) or the Lean Thinking (Schwarz et al., n.d.) and many more that have their own specific relevance in a particular context (Dentchev et al. 2018). However unlike the BMT, they lack in practicality when it is not clear what business model would best fit a given context.

The business model template made of so called "building blocks" allows to identify critical requirements and make choices depending on the context.

The theoretical framework and choices made for this research are essentially based on characteristics of socio-constructivists' theories. Organizations can be seen as social constructs, which are "representations of cooperation and coordination, based on intertwined habits and mutual commitments that are often expressed in sign structures such as agreements, contracts and plans"(Helmhout, Gazendam 2005).

Individuals learn together in a social context favourable to individual and collective development leading to collective learning (Illeris 1999)(Hogan, DM, Tudge 1999). The

concept of learning is felt relevant as closing the loops integrate a multi-stakeholders dimension where people have to work together and learn together in the process.

The framework started with an orientation phase to understand the purpose of the research process similar to theories of design science research where the research idea had to be 'problematized' (Alvesson and Sandberg 2011). It followed through by using the business model template, most relevant in a circular economy based context.

4. Results

4.1. Definition phase

4.1.1. Motive and context

The various interviews with municipality employees have revealed that Apeldoorn is actively busy with the circular economy in a number of projects such as Grieffiersveld. However from the various interviews held with the municipality there seems to be no comprehensive policy nor vision related specifically to the handling of construction and demolition waste as such. Departments and project managers although linked through a formal internal circular economy network group work mostly independently from each other and request assistance or share data on an ad-hoc basis.

Also from the information provided by the municipality and interviews we can report that the raw data about volumes and types of material transiting through the material depot is not managed in a way that is neither useful for control nor efficient required re-distribution. The lines of responsibilities are difficult to identify. Boundaries of functions versus responsibilities and projects are not always clear.

4.1.2. Dream

The “Dream” composed from the focus groups is shown in Table 3.

Dream Municipality: On the economic side many aspects relate to the way of accounting for material use (e.g. true pricing, total cost of ownership). Social aspects are centred around the idea that making a new road is a social act in itself whereby inhabitants should see the result of the CE involvement of the municipality and actively contribute and benefit from it. Environment aspects focus mainly on CO_2 emissions reduction, increased materials use and reduction of virgin materials used.

Dream inhabitants: On the economic side the potential use of secondary materials and reduction of virgin materials in making of the roads could mean that the overall costs of roads would be decreased and the resulting “saved” money could fund other CE initiatives. Social components relate to possible local employment being created and re-purpose of materials they could benefit from. Environment aspects mainly related to CO_2 emissions reduction and the recyclability of materials used.

Dream industry partners: On the economic side, the accounting methods are important (e.g. true pricing) and the way materials are produced. Social aspects relate to the local economy with potential for jobs and pride to be part of it. Environmental aspects relate to the

importance of not mixing high grade materials together and maximal use of secondary materials whenever possible.

Table 3 'Dreams' of the three main parties (municipalities, inhabitants & industry partners)

DREAMS OF STAKE-HOLDERS	ECONOMIC VALUE PERSPECTIVE	SOCIAL VALUE PERSPECTIVE	ENVIRONMENTAL VALUE PERSPECTIVE
Municipality	Internal change through a different mind-set Moving from an economic value to a social value-based view Saving material Concept of material ownership Value for money Municipality and inhabitants should share the same interests Trust is each other as value for the longer term Right material selection for the expected lifetime use Total costs of ownership principle Repurposing of material True pricing	Importance of concept of living together Local engagement of citizens Explaining the recycling process and creating awareness New road is a social value in itself (design, construction and maintenance) Local involvement of contractors (increased knowledge of recycling of roads and CDW) Citizens inspiration to recycle Local employment Building of the community Local welfare Supporting local economy for the short and longer term Re-use as a societal trend Reinforcing authenticity	Decrease virgin material use Maximisation of used material Increased material functionality Reduced through CO_2 emissions through less transport. Circular based road design Ownership of the road
Inhabitants	Recycling of the road should lower costs of the new roads Secondary materials can be sold Money "saved" through recycling can fund another initiative	Unemployment reduction Repurposing of materials	CO_2 emissions reduction Material recyclability
Industry partners	Shadow costs should be included Way materials are produced Way materials are priced (true pricing)	Adaptability Local for local concept Increased employment Pride to live in the area Pride in having contributed to the road recycling (in whatever capacity)	Use of secondary materials No mixing of high grade materials

A clear common denominator across the three parties is the goal of CO_2 emissions reduction. Other similarities include the maximisation of the available resources and careful selection of future ones for further use. All methods of accounting are mentioned (life cycle analysis, true pricing,..) relate to a budget like control of costs versus recyclability in the short and longer term.

4.1.3. Proposition

Based on the "dream" expressed by the three main stakeholders, the suggested proposition is to: use the Apeldoorn material depot and concept of material databank as a way to fulfil a combined goal incorporating the three perspectives (economic, social, environmental):

1. A comprehensive municipality vision and policy on handling construction and demolition waste in the context of a circular economy
2. Strengthening a sense of community with inhabitants around the subject
3. Developing the pride and effectiveness of a rich local economy with industry partners

The proposition was formerly validated by Apeldoorn municipality through a feedback opportunity given to the participants of the municipality via email. For two of them leading the project a short presentation using PowerPoint was given.

4.2. Design phase

4.2.1. Type of business model

For the choice of type of business model, a circular BM was favoured due to the relation to the material depot and material databank. A circular business model is more relevant when identification of material streams is desired as is the case when attempting to close the material loop.

Due to the fact that three different perspectives are linked together leading to different values one of the most suitable business model could be the triple layered business model canvas. This model can be seen as an extended canvas business model with an extra two layers one environmental layer evaluating the life cycle perspective, one social layer based on a stakeholder's perspective. The leading choice for one specific model is not restrictive. Aspects from other business models like for instance community (people's input) and platform (digital reach) can be added to the chosen business model. The triple layered business model canvas (Joyce and Paquin 2016) like the BMC has nine criteria per layer as per below:

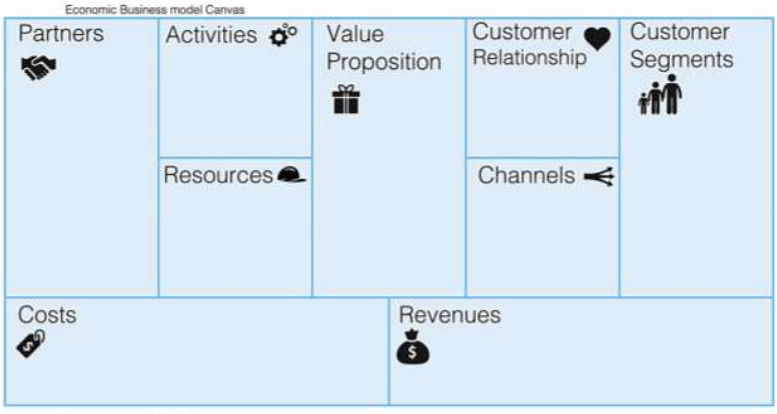

Figure 14 Economic business model canvas

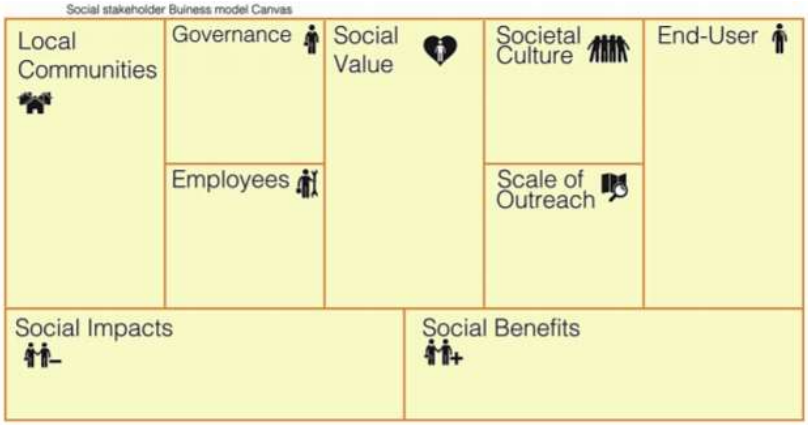

Figure 15 Social stakeholder business model canvas

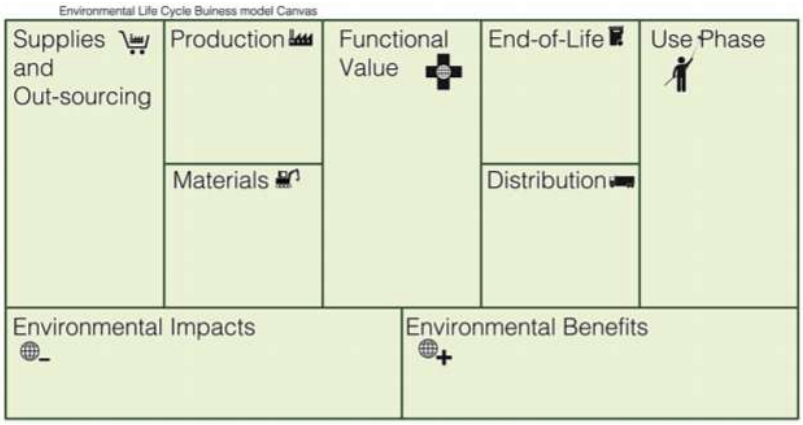

Figure 16 Environmental Life cycle business model canvas

Using data collected from interviews and focus groups, the circular business model can be filled in in the following way:

Economic perspective

The economic perspective of the new business model is to sell secondary materials onto local materials markets using an online platform and create revenues to invest in CE projects. This strategy/effort would use many different organizational resources in a structured way. True pricing and total costs of ownership based on a life cycle analysis would identify costs. Taxpayer's money can this way be best utilised. Trust is the binding element to share with other stakeholders involved.

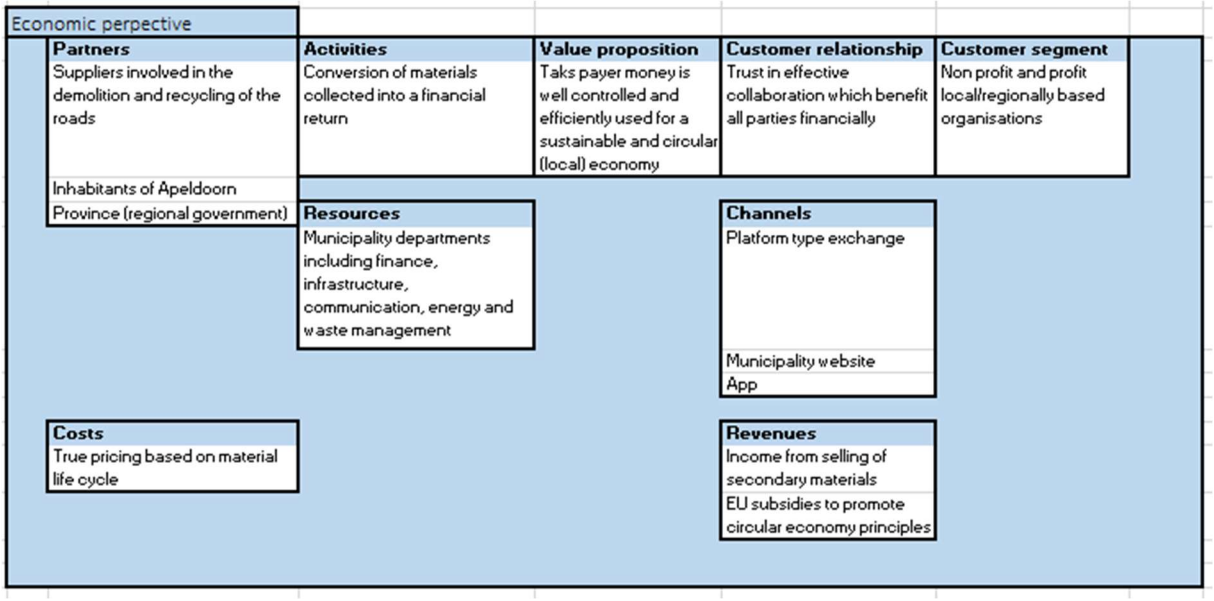

Figure 17 Economic business model canvas for Apeldoorn

Social perspective

The social perspective is strongly highlighting the opportunities for increased social cohesion and binding through the concept of pride to live and work in Apeldoorn. Opportunities are available to use the recycling of the roads initiative to provide local employment and connect onto inhabitants to engage them in the process. Local communities and possibly regional ones can be contributing as a multi-stakeholder eco-system to contribute ideas for the betterment of the recycling project.

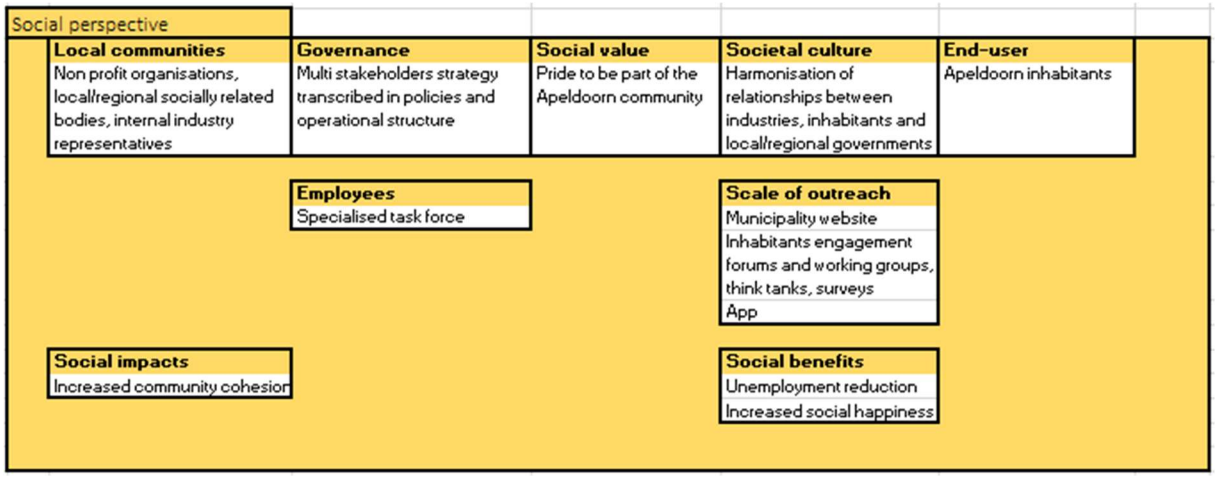

Figure 18 Social stakeholder business model canvas for Apeldoorn

Environment perspective

The environment perspective clearly focused on whatever way possible materials could be either reduced in use (virgin materials) or further used (recycling or re-use). This is done as locally as possible using procurement specifications to reduce transport as much as possible to reduce CO_2 emissions. Materials are stocked locally in the material depot. Fauna and flora will benefit from this from environmentally friendly road design and implementation, air quality will increase through reduction of traffic and better road being constructed.

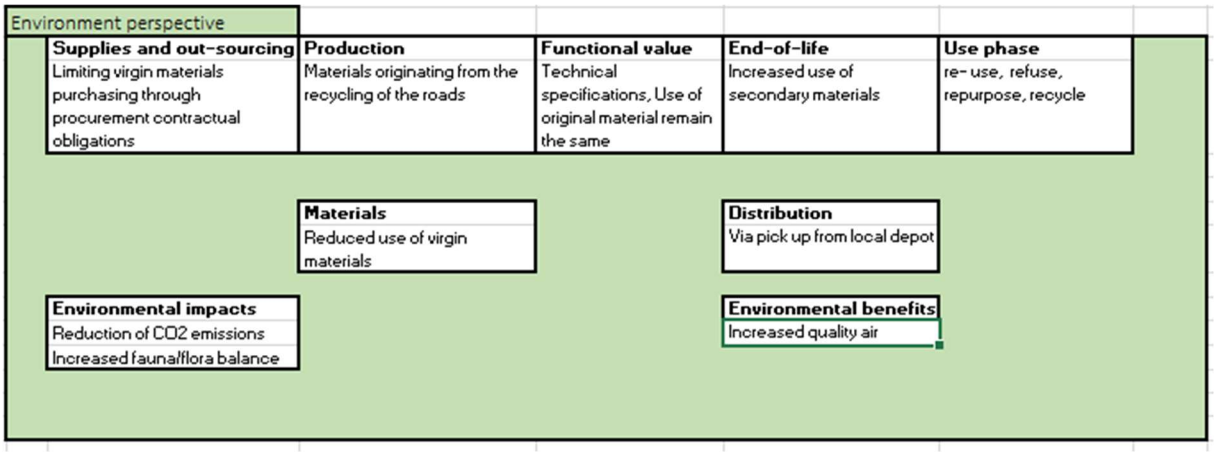

Figure 19 Environmental Life cycle business model canvas for Apeldoorn

4.2.2. Parties involved

Parties identified are inhabitants, municipality executives and industry partners. The partner radar tool was used to provide more in depth understanding of how the parties relate to each other. An anonymised version is available in Appendix 6. For the recycling of the roads in Griffiersveld, there are in total three suppliers (one of great influence, two of limited influence); no investors, five collaborators (one of little influence, four of great influence) and two other partners (one of great influence, one of limited influence). In order to represent the inhabitants, a Persona was developed based on the finding of a previous social composition of the inhabitants of Apeldoorn.

The social profile for inhabitants of Apeldoorn is similar to the one for adjacent cities (Deventer, Zutphen), for the adjacent province (Gelderland) and The Netherlands as a country. It shows that the 'yellow' and 'green' world where namely social harmony and individual contribution thereof have the highest percentage (30%) followed by the 'blue world' (24,5%) representing individual performances and status with finally 16% related to the 'red world' for self-enjoyment and freedom. In Grieffiersveld these percentages are in line with these findings (see Appendix 5). For the municipality and industry partners Organisata's were developed from data collected during the definition phase. However, for confidentiality reasons the organisata's made from the data collected cannot be shown.

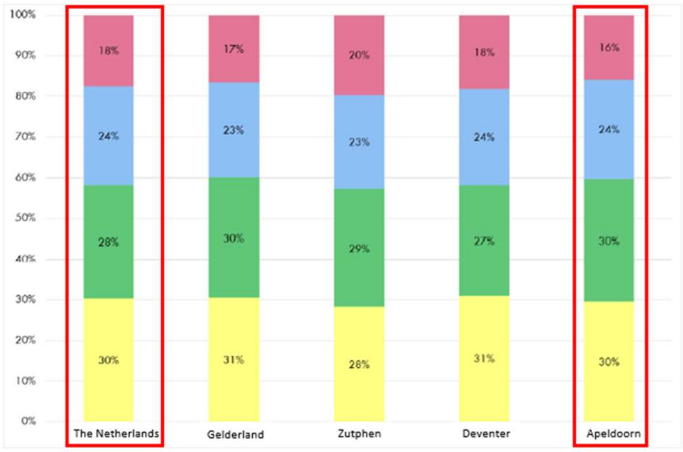

Figure 20 Socio-demographic profiles (Smart Agent Market response 2017)

In Appendix 6 is the Persona made for Apeldoorn based on the data as an example.

4.2.3. Strategy

Each identified material used in the road recycling can fit one of these activities with a view to establish a system converting in key performance indicators which can be used by all stakeholders for their own specific purpose and ambition. The most relevant and actual R's will be selected to be investigated in the first instance linked to the actual result of the material depot research conducted by the building and technology school. Later on once the business model is implemented other R's can be added over time.

4.2.4. Core activities

Since the material depot and material databank form the core of the proposition there is a high emphasis on materials. The depot can be used to manage the materials for further sorting and re-use. The material databank supports the identification of the materials as part of a more technical investigation not taken into account here.

As at this point in time the municipality of Apeldoorn is still investigating how best make use of the various materials which could be recovered from Griffiersveld. In order to help identify which material can be used, for what purposes and on what timeline, a set of matrices have been developed by the researcher using two main components of the BMT, the 12 R's and six strategies combined with the partner radar tool. From these three components, three matrices have been designed, namely:

- Material Loops Matrix (MLM) to identify the various materials available in the recycling of the roads.
- Partner Loops Matrix (PLM) to identify which partner can help with dealing with a given material.
- Strategy Loops Matrix(SLM) to identify the choices made over time

These strategies are further developed in this chapter in the results phase under impact.

4.2.5. External test

The external test has been done by answering the five key questions below using data collected during interviews. The feedback evaluation is extensive with 10 participants being used to control the usefulness of the suggested framework and tooling.

1. **Does the business model already exist?** In which case it may be useful to evaluate experiences and results of similar or related initiatives to improve or establish in a faster way. The TLBCM is a relative recent development as BM archetype. It is widely used for its easy to understand structure related to the BMC. It is suitable for any profit and non-profit organization. The literature shows a wide variety of application in the building sector (Pardo-Bosch, Cervera, and Ysa 2019)(Pardalis, Mahapatra, and Mainali 2020). The set of matrices and framework do not exist as such.
2. **Is it allowed by law?** Are there legislations preventing or supporting the business model? There is no legislation preventing the new business model, framework and tooling. However EU legislations possibly preventing (e.g. competition legislation) or supporting (e.g CO_2 reduction emissions) and national laws need to be taken into account and have not been fully investigated.
3. **Which contribution is the new business model making to the circular economy?** The new business model, framework and tooling help the transition to a CE by creating a realistic thinking process based on a time phased plan (short, medium and long term)
4. **What are possible unexpected negative effects of the business model?** The unexpected possible negative effects of the new BM, framework and matrices is the acceptance and introduction at the municipality. The set up requires much leadership and structural changes in order to work and that may cause frictions at first.
5. **Receiving feedback on the suggested actions:** For the feedback session using the validation grid, a total of nine interviews took place with 10 participants including municipalities and partners involved in handling of CDW with municipalities as listed in the table below:

Table 4 External test validation participants list by function and numbers

Municipalities	Number of inhabitants	Function (number of participants)
Hof van Twente	35.017 (Kennis Punt Twente n.d.)	Councillor (1)
Hengelo	81.155 (Kennis punt Twente 2020)	Project leader circular economy (1)
Tiel	41.984 (Central Statistic Bureau 2020)	Senior advisor sustainability and energy transition (1)
Deventer	100.762 (Deventer municipality 2020)	Councillor (1) Senior environmental advisors (2)
Haarlemmermeer	155.185 (Haarlemmermeer municipality 2020)	Deputy program manager Energy transition (1)
Partners		**Function (number of participants)**
ReinteInfra BV	n/a	Project manager circular economy/ Planner Circular economy Province Overjissel (1)
KplusV BV	n/a	Expert circular economy (1)
Pioneering Foundation	n/a	Expert circular building economy (1)

The results of the evaluation using the ten statements are as follows:

Table 5 Validation grid grading of statements

Evaluation ranking external test matrices

statements	council	project management	project management	project management	project management	council	project management	project management	project management	project management	average	median	ranking
	municipality Hof van Twente	Partner Reindeinfra	Partner Kplusv	municipality Hengelo	municipality Tiel	municipality Deventer	municipality Harlemmermeer	municipality Deventer	municipality Deventer	Partner Pinnering			
S1	8	7	10	8	7	8	9	8	8	8	8.10	8	5
S2	8	8	7	8	7	7	7	8	10	9	7.90	8	6
S3	7	8	9	5	7	6	8	8	8	8	7.40	8	8
S4	9	10	9	5	8	8	8	9	9	8	8.30	9	1
S5	8	9	9	7	8	6	8	8	8	8	7.90	8	6
S6	9	8	8	8	8	9	9	7	7	9	8.20	8	3
S7	8	9	9	7		8	8	8	8	9	8.22	8	2
S8	8	8	8	8		8	9	8	8	8	8.11	8	4
S9	7	8	9		8	7	7	7	7	8	7.56	7	7
S10	8	8	7	7	7	8	9	8	8	9	7.90	8	6
Average	8	8.3	8.5	7.5	7.5	7.5	8.2	7.9	8.1	8.4			
Median	8	8	9	7	7.5	8	8	8	8	8			

Could not give a number to the statement because more explanations are needed to see if that would work

The grading of all statements (see Table 2) are very high with the lowest average being 7.40 (S3) and highest 8.30 (S4). Eight statements have a median calculation of 8, one of 7 and one of 9. The top three ranked statements are:

S4 Policy making

The loops matrices can help the council take decisions in the future by setting up clear strategies for material loops.

S7 Project coordination and running

The loops matrices set a common base for employees to discuss circular projects.

S6 Procurement

The loops matrices can help identify the needed procurement specifications to work towards a circular economy in a streamlined way.

From the coding of the interviews transcripts a number of aspects can be reported:

Functionality of the set of matrices

The majority of participants indicated that the strongest quality of the matrices is the transparency of the process and the ease of use for users. However caution was applied to the use of the matrices by councillors and law makers who might find the presentation too complicated and technically challenging to grasp. Advice was given to have the same data presented in a way which would make it more readable and less technically challenging through using examples. Statement S4 being the top ranked statement confirms that participants found strongly that the matrices could *"help the council take decisions in the future by setting up clear strategies for material loops"*

Need for a "common language"

Although municipality employees working on circular related projects are linked via internal network groups such as the Apeldoorn Circular Economy Network group, the matrices would

act as a “common language“ tool which would facilitate internal communication and data sharing across different departments over different projects.

Same tool, multi-level use
The fact that the matrices would be the same in the three different levels (council level, internal organization level and project management level) was found very useful and efficient for purposes of key performances indicators which could all relate to the original vision.

Decision making with a focus over time
Given the fact that municipalities councils are elected every four years and that the challenges to transit to a circular economy will take years, participants commented that it is a possible advantage that the suggested matrices will enable some continuity across different elected councils over time. Furthermore the strategic decisions can have a specific focus for the longer term like for instance making housing affordable which is a serious issue at present in The Netherlands (TuDelft 2020).

” For me as city councillor one aspect I find very useful is that the strategies decided by the council could have a specific focus”

Quote from a participant in the external validation

4.3. Results phase

4.3.1. Impact

Measuring impact is at this point an expected impact which can be eventually measured using a number of indicators for the various areas of interests from the proposition. For instance the number of tons of sand collected and deposited in the material depot and percentage of use for a new project per year (environmental value), the costs savings by reducing material buying (economic value) or number of inhabitants engagement actions through the Apeldoorn youth think tank (social value). The various impacts will be further evaluated and measured in value creation.

Before an impact can be evaluated a policy document needs to be written highlighting the boundaries and context of the construction and demolition waste for the Municipality of Apeldoorn. The vision and mission must be clearly outlined with clear objectives to be reached with a certain timeframe. It is suggested that the operationalization of this policy would be supervised by one individual called a Circular Economy officer whose role would be to coordinate all actions related to CDW for Apeldoorn. The boundaries of responsibilities of such officer would go beyond CDW and cover all related CE aspects such as energy transition. Interviews conducted indicated a clear compartmentation of projects through diffusion of tasks, responsibilities and operationalization to different departments with insufficient horizontal exchanges.

KPI 1 Relation to the six strategies
Using the loops matrices requires to evaluate which strategies will be used and why. The strategies KPI needs to be directly related to the main council decision choice/focus (e.g. reduction of CO_2 emissions)

KPI 2 Relation to the circular core activities (12 R's)
The core activities taken into account for CDW can be related to the various recycling and re-use can be spaced over time to offer a realistic development and achievement of the policy over time. Key performance indicators can be represented in the number of projects per year from each R as well as the tonnage of material, e.g. Re-use, X tons of sand from project X.

KPI 3 Relation to value(s) created
Once there is a clearer indication of the impact in value(s) terms, KPI's can be useful to monitor the situation and ultimately fulfilling the BM's objectives and council's vision.

4.3.2. Transaction forms

Transaction forms are at this point difficult to evaluate or to foreplan as it is linked to the chosen strategies and the actual flow of materials and money. When and if this is properly mapped out the transaction flows can be a useful tool to monitor the activities in the various ongoing material loops. Indicators can be built and/or can be added based on the norms and control mechanisms formerly used by the municipality of Apeldoorn such as total cost of ownership, true pricing or social return on investment calculation.

5. Data analysis

The aim of this research was to investigate what business model could be best applied for the municipality of Apeldoorn for the recycling of its roads in the broader context of handling of construction and demolition waste. Furthermore in the context of a circular economy, the business model should encompass the three types of values (economic, environmental and social). The recommendations should lead to advice on both strategic and operational aspects.

The main research question was: “Which business model and framework are best applicable for the recycling of roads in Apeldoorn? To what extent can the circular economy be embedded in the choices of the business model? What goals and strategies are relevant and suitable to make the business model work?”

Based on the findings we can establish that the setup of a framework and tooling relying on a three parts structure can help close the material loops. The framework is made of the partners (investors, collaborations partners, suppliers and others), the materials available in a given project and the strategies to close the loops in the short, medium and longer term.

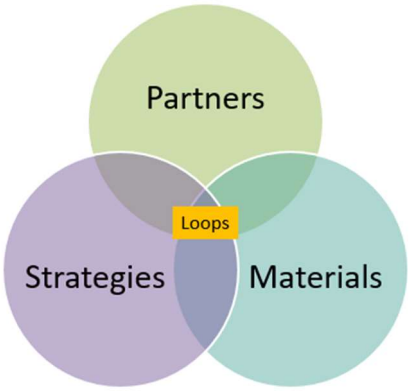

Figure 21 Trio relation to close the material loops

The framework and tooling outlined below have been validated through triangulation during the external test. The individual and group feedback sessions have led to improvements of the proposed set up, the results are outlined below using the essential components to an effective circular economy as suggested by the Netherlands Environmental Assessment Agency in its latest bi-annual report on circular economy. Figure 22 shows the various needed components for creating the transition to a circular economy.

Material coordination (Coordination)

Coordination of the materials is needed for an efficient management of the volume of materials from different projects. According to Homan (2019), *“the components of an organisation such as a municipality (units, divisions, clusters) functions de facto with relative autonomy and can operate independently from forms of central rules, strategies, objectives and such like”.* For the material coordination a complete overview is needed from an organizational viewpoint.

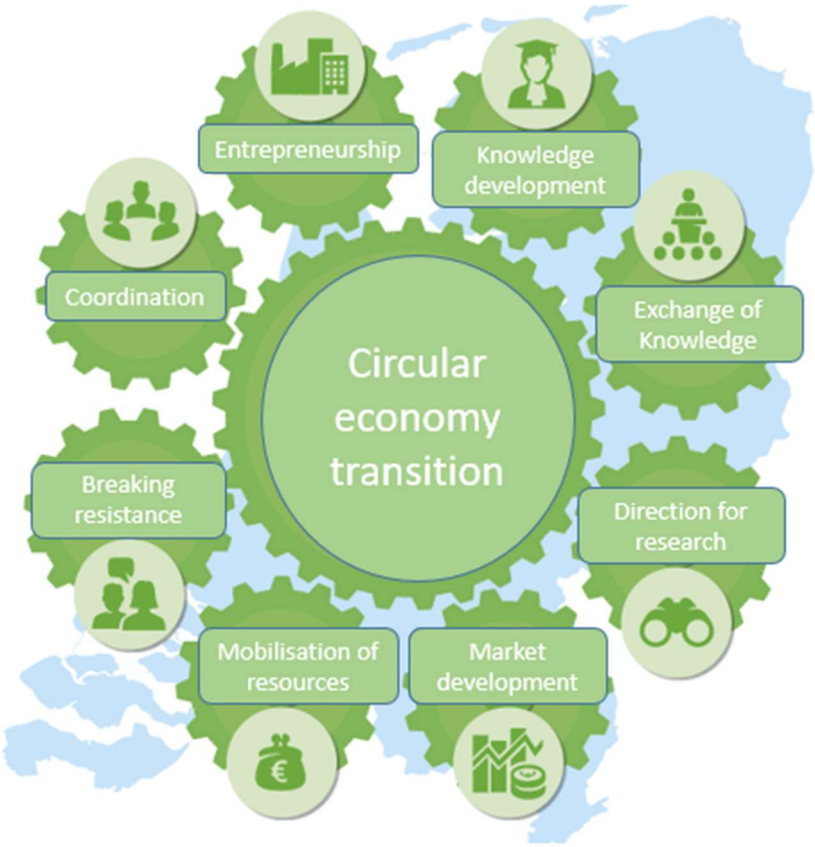

Figure 22 Components needed for a circular economy transition (PBL, 2021 p 25)

Therefore, a CE officer should be appointed to oversee and manage all materials in order to increase efficiency and control of the material streams. This is needed as multiple projects in an overall vision and strategy are being rolled out. This needed centralised management and control for materials can be compared with successful Smart cities incorporating a wide range of Smart applications and where digitalization is key. Their success in terms of efficiency and management is widely recognised in the responsibility of a single individual, namely a digital IT architect. In Helsinki, second best Smart city in the world, (Brussels Smart City 2020) the project Forum Virium operates very successfully using this set up (Pardo-Bosch, Cervera, and Ysa 2019)(Hämäläinen 2020).

Social value

The results show that the social value aspect of handling and treatment of CDW should play a major role in decision making in terms of identification of social value and embedding in a sustainable business model.

Data collection and measuring (Knowledge development)

Results also show that the economic aspects cannot be properly evaluated and analysed due to the multitude of projects being undertaken from different departments and different individuals with different perspectives. The need for an “open playing field” is critical for the efficiency and the transparency of the projects.

Material use efficiency (Mobilisation of resources)

Over time materials collected will be efficiently handled and managed in multiple projects of the municipality with possibly different project leaders/managers in charge. The overview of what materials are available and the decision making process about where these materials will go will also prevent possible cannibalisation of resources by project managers who need the materials. The suggested CE officer will be critical in making sure a fair and relevant dissemination of the materials is done.

Common language (Exchange of knowledge)

The suggested combined set of matrices being used at different levels of the organization (council, organization, project management) brings a common language to all stakeholders.

"What I like is that you make it very transparent with doing what and why"
Quote from a participant to the external validation

Shared key performance indicators (KPI's) (Direction for research)

As the council gives a clear goal for the ultimate objective(s) to reach in the handling of CDW (e.g CO_2 emissions reduction (environmental value); cheaper materials for construction of affordable housing (social value)) it is possible to set up KPI's for each project. These KPI's would be the common denominators for the entire municipality. Material loops based on a tripartite effort. Although the subject of closing material loops is very complex, the suggested view from the combination set offers a simple way to tackle the issue.

Framework for handling CDW for the municipality of Apeldoorn (Coordination; Exchange of knowledge):

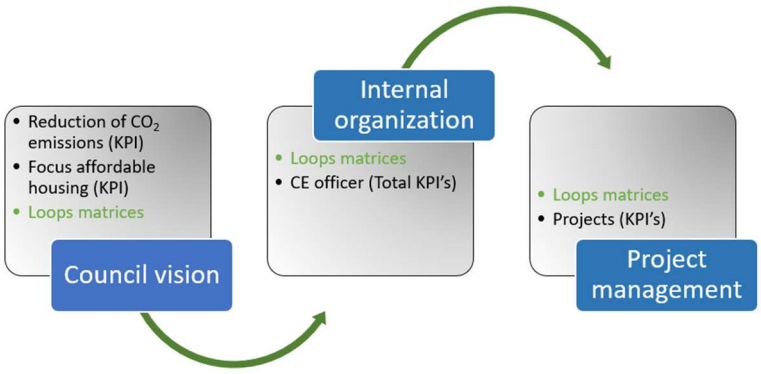

Figure 23 Framework for handling CDW using an example vision

1. Council level: introduce/establish a clear vision, mission and objectives for the handling and treatment of CDW linked to one or more of the (economic, environmental, social) values.
2. Internal organization level: use the triple layered business model canvas as an internal tool to go beyond the pure economic output and maximize other (environmental, social) values.

3. Project Management level: set up and running of a materials related project needs to work towards the strategic objectives set up by the council. KPI's will enable to evaluate performances and relation to these objectives.

Tooling for setting up strategies (Market development):

The suggested tooling to help closing the loops is called the Loops matrix set made up of three matrices; the Material Loops Matrix (MLM), the Partner Loops Matrix (PLM) and the Strategy Loops Matrix(SLM):

Step 1: Fill in the MLM by linking circularity options (R's) to the identified materials in the project.

Step 2: Fill in the PLM by linking circularity options (R's) to the identified partners which can offer solutions.

Step 3: Link results of MLM and PLM to decide on SLM strategies for all identified materials.

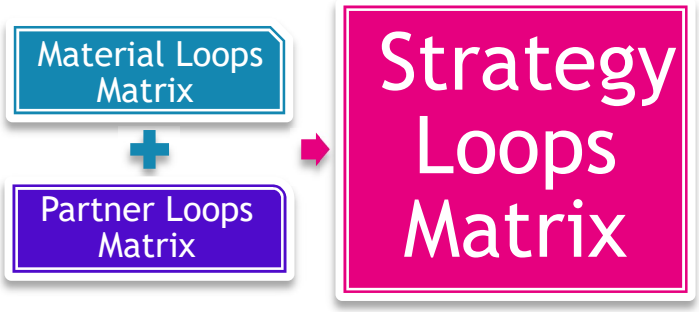

Figure 24 Relation between three Loops Matrices

The strategies will ultimately lead to the fulfilment of one or more of the CE perspectives (economic, environmental, social). The strategies in this context can be seen as a plan but also as a process using Mintzberg's theories on strategies (Mintzberg, Ahlstrand, and Lampel 1998). The framework and tooling offer a blueprint or design for closing the material loops in processes as well as an operational timeline to achieve this as a plan.

This systematic (framework and tooling) is clearly supported by the just published 2021 Dutch report on the circular economy in The Netherlands. Amongst the conclusions of this comprehensive study are that in order to reach the ambition to be circular by 2050 there is need for an intensification of policies and a wider vision supporting the objectives and activities engaged. Further, there must be clear and measurable objectives. It is further concluded that the government should support relevant innovation through for instance public procurement for circular products and engage the responsibility of the producers Government, market players and other instances must create 'transition teams' in a combine government/private sector combination (Planbureau voor de Leefomgeving 2021 p 178, 210).

6. Discussion

Through the development of a new business model, framework and accompanying tooling, the research has shown that business modelling for a circular economy could possibly contribute positively to ongoing efforts to streamline and harmonise a technically dominated research field where the solutions are generally focused on the capacity of the materials to be used again in some ways (12R's of circularity).

This material technical "dominance" has yet to deliver a substantial and durable outcome that all industries can agree with. Competing interests or legal constraints at whatever level continue to slow the transition process to achieve a circular economy. Semantic issues add further disruption. Comparing secondary materials as waste for instance has contributed over the years to a discussion still going on which has taken us off the main real issue which is what materials should be used, why and how? Business models should be embedded in circular thinking right from the start but are mostly introduced at the end of the thinking process. In a recent Horizon 2020 European research on material passport business models are barely mentioned and tend to be associated as a process rather than a concept. In this context business models are supposed to support the technological advancements but presently are merely viewed as an actor of the material passport concept (Heinrich and Lang 2020 p 8).

Working towards a circular transition requires a different mind-set starting with a clear vision and not only technical possibilities (Chesbrough 2007). With values central to the equation, sustainable or circular business models are tools to help think of what and how values can be fulfilled on the three perspectives economic, social and environmental. On the other hand organisations need time to adapt to this transition, many are reluctant to do so until or unless they have no other choices. In this context some even argue that corporate social responsibility policies used by organizations are nothing more than green washing and that it cannot resist hard core capitalism principles (Fleming 2013)(Doane 2014).

However there are now emerging lines of thoughts indicating that capitalism needs to be reinvented and a shared value perspective will lead the future through innovation and collaboration (Porter and Kramer 2019)(Volans ventures Ltd 2020).

As much as organizations and society at large have to work towards a circular economy, efforts are slow and limited. Overall companies are mostly concentrating their activities on recycling with other R's lagging behind. The figure below shows the R strategies of Dutch companies with a pre-dominance for recycling.

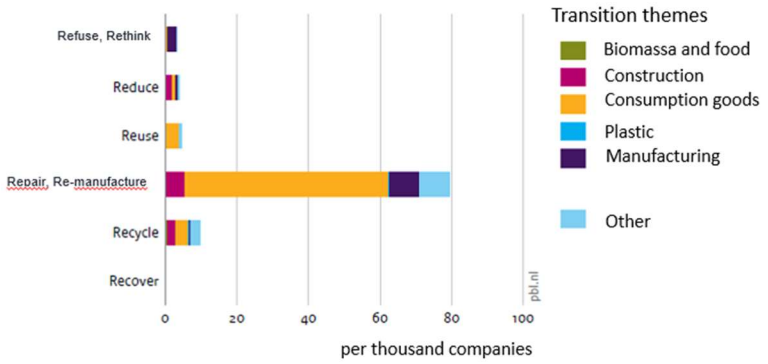

Figure 25 Circular companies per R strategy 2020 (Royal Haskoningh DHV 2021)

The relative low level use of the other R's is also the situation in companies that innovate as illustrated by Figure 26 below which shows the ratio of circular innovative projects per type of R.

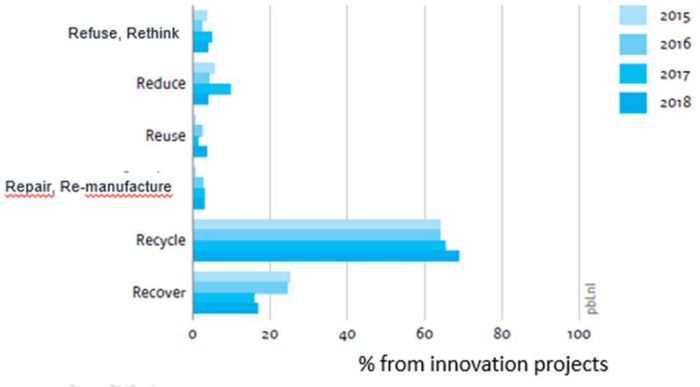

Figure 26 Ratio of circular innovative projects per R (RVO, 2020)

As companies primarily choose recycling over other R's it limits and slows down the efforts needed for an effective circular transition. Other important R's like Refuse and Rethink and others are underutilised.

Instead of solely looking at the materials from their capacity to be recycled we need to focus on their value(s).

Values have been central in the research set up and remain a key element in the solutions. Different types of values highlight the different stakeholder's perspectives and therefore their expected contribution in that process. The values discussion brings in a friction between the old world (a linear world) hanging on to a capitalist view that all resources can be sold for as long as they can be sold, to a new world (a circular world) whereby resources should be adequately handled to sustain long term exchanges. Capitalism as we know it, is moving to new forms which requires new ways of thinking. The bi-annual report on the state of the Dutch circular economy published on 21st Jan 2021 highlights these issues and raises the alarm in relation to the need for a much higher percentage of recovery of secondary materials in The Netherlands (Planbureau voor de Leefomgeving 2021).

The research fills a gap in the existing body of knowledge related to strategic decision making and operationalization of circular economy processes.

It is further argued that the two main outputs developed (set of matrices and strategy matrix) should serve as an extension to the BMT work of Jonker and Faber. The combination of the framework and tooling (set of matrices and strategy matrix) tend to demonstrate that common ground is available for stakeholders to discuss their various views and that it is possible to come to a "shared values" outcome. This "shared values" concept is prevalent in recent development in business model design (Lüdeke-Freund, Gold and Bocken 2019) as well as societal shifts (OECD 2020).

Furthermore, values are intrinsically related to circularity as natural resources become more scarce and the stakeholder's relationship is strengthened by the need to come up with practical solutions in a collective effort.

Such efforts are noticeable in new trends in procurement like the so called 'Public procurement of Innovation (PPI)' promoted by the European Union where the emphasis is not so much to pressure the supplier to satisfy specifications but to play a role in solving a problem/ achieving a circular ambition collectively. The 'Public procurement of Innovation' is *"particularly useful in certain areas such as ,…waste management, recycling where the public sector accounts for a big part of demand and can use procurement as a means to address key societal challenges such as sustainable transport, eco-efficiency or health and ageing"* (European Commission 2014 p 12)

'Public Procurement of Innovation' research calls from the European Union highlight these efforts and introduces a mind shift in the way we need to work towards a circular economy.(European Union 2020)

The research findings contribute to the main body of knowledge by suggesting that business modelling is critical to the further advancement of circular principles for CDW. However, the presented "Impact" is based on literature review data and needs to be corroborated. The developed framework and tooling needs to be further tested in the field to prove its practical efficiency.

The concept of values for the group "Inhabitants" could be further researched using larger samples to sharpen the reliability and quality of the data.

Impact on the organizational aspects of the Apeldoorn municipality and the lines of decision making from the council have not been formerly investigated and would be useful for further research to make these suggested processes (framework and tooling) more easily applicable.

7. Conclusions

Based on the research findings, it can be concluded that the process of closing the material loops should start by developing an effective circular business model specifically related to the context of the municipality. In the development of the new business model, the values of the relevant materials should be investigated from the three perspectives (economic, environmental and social). The municipality should actively involve inhabitants and industry partners in the decision making process. Municipality employee workforce involved in these projects should have a comprehensive and collegial infrastructure and communications line to enable them to be working as one unit.

The municipality's council can benefit from having clear objectives and long-term ambition described in a policy document about CDW. Evaluation tools such as the proposed framework and set of matrices (material loops matrix, partner loops matrix, strategy loops matrix) would be very useful to embed these efforts in the municipality's organisation and operations.

This research contributes to the CityLoops project by offering a new insight into the needed processes leading to the possible closing of material loops by moving away from the pure technical ability of a specific material to be re-use or recycled. It is suggested that closing of the loops is highly dependent on the local situation as far as which type of material is concerned, wishes of the municipality and inhabitants of that city. Therefore, although the suggested framework and tooling can be up-scaled to other cities in Europe, the results and decisions taken might vary per material depending on the local context.

The research contributes to the body of knowledge by reflecting on issues to do with closing the material loops from a strategic level and providing clear directions for its operationalization. The field of research is further enhanced by proposing an extension of two extra phases of the BMT.

Further research is suggested to effectively use the proposed framework and tooling for different municipalities. Partnerships and concept of eco-systems (municipality, industry partners and inhabitants) in this setting are also worth further researching to better understand how to promote mutual needs, wishes and demands.

A framework and tooling has been developed as a result of this research following a number of steps outlined below. We finally conclude that following these steps will offer a strategic and operational way to :

1. Use the developed Triple Layered Business Model Canvas filled in from now on to monitor the situation and build upon it.
2. Suggest that the council would establish at least one clear objective to work towards from a strategic viewpoint (i.e. reduction of CO_2 emissions to meet the green deal law)
3. Use the developed Material loops matrix (MLM) in relation to specific materials to be recovered for the Griffiersveld roads in De Maat area.

4. Use the developed Partner Loops Matrix (PLM) in relation to the specific role and possible impact each partner involved in the recycling of the roads in Griffiersveld could have. Engage in a discussion with these partners.
5. Once both MLM and PLM have been filled in, fill in the Strategy Loops Matrix(SLM) and work on different loops closing materials scenarios linked to the council objective (see point 2)
6. Align the activities of the material depot with the chosen strategies as operational tool and incorporate if relevant the material passport concept.
7. Based on the evaluation of the strategies and discussions with the council, draft a proposition policy document highlighting a short, medium and long term strategy about CDW.
8. Introduce the concept of the framework and tooling to employees involved with circular economy related projects. Train them to use the framework and tooling and implement the system for all new projects.
9. Appoint a dedicated CE officer responsible for all CE related activities where the framework and tooling is being used. Make all projects coordinators report to that person who directly reports to the council.

8. Recommendations

The transition to a circular economy demands a consistent and long term commitment to looking for innovative solutions in closing the material loops for construction and demolition waste. That is best accomplished when all involved parties work together in a structure way as suggested in our conclusions.

We recommend that national and local governments pay attention to the need of an effective dialogue on this subject and take into consideration the challenges it brings for each stakeholder.

For the municipality of Apeldoorn, we suggest that they implement the framework and tooling and organise pilots possibly bringing in neighbouring cities such as Deventer who are also actively engaged in these issues. Industry associations and members contributing to these developments should build closer bridges with municipalities to embrace the potential for 'Public Procurement of Innovation'.

Finally about further research, we recommend that further studies would prove the concept as one case study is not sufficient. Pilots on experiencing with the framework and tooling using multiple municipalities should be started using surrounding cities such as Deventer or Hengelo. That can also hopefully happen within the CityLoops research project in years to come.

Special thanks

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Appendices

Appendix 1 Material Loops Matrix (MLM)

Material Loops Matrix (MLM)				Griffiersveld Apeldoorn		
	Primary material according to GBI categories					
	Beton stones (30X20X10)	Beton stones other	Asfalt beton	Ornemental paving	Tiles (30x30) - grey	Tiles Other
R's of circularity (M for Material)						
RM1 Refuse						
RM2 Redesign						
RM3 (Bio based) Redesign						
RM4 Rethink						
RM5 Reduce		X				
RM6 Re-use	X		X	X		X
RM7 Repair						
RM8 Refurbish						
RM9 Repurpose						
RM10 Recycle	X					
RM11 Recover			X		X	X
RM12 Reconvert						

Appendix 2 Partner Loops Matrix (PLM)

Partner Loops Matrix (PLM)			Griffiersveld Apeldoorn	Use drop menu in cell Type and select a Parties type				
	Partners (Investors(I), Collaboration Partners(P), Suppliers(S), Other(O))							
	Organization 1(O1)	Type	Organization 2 (O2)	Type	Organization 3 (O3)	Type	Organization 4 (O4)	
R's of circularity (M for Material)								
RM1 Refuse								
RM2 Redesign								
RM3 (Bio based) Redesign								
RM4 Rethink								
RM5 Reduce			Jansen BV	Suppliers(S)	Adac	Others(O)		
RM6 Re-use	Cemtex	Collaboration Partners(P)						
RM7 Repair								
RM8 Refurbish								
RM9 Repurpose								
RM10 Recycle	Cemtex	Suppliers(S)						
RM11 Recover	Cemtex	Others(O)						
RM12 Reconvert			Jansen	Collaboration Partners(P)				

Appendix 3 Strategy Loops Matrix (SLM)

Strategy Loops Matrix (SLM)				Griffiersveld Apeldoorn		
Strategies		Timeframe		Timeframe		Timeframe
S1 Eco-efficiency	RM5 02, RM5 03	1-2 years	RM6 O1	2-3 years	RM4 O2	
S2 Merit						
S2 1 Product orientated service						
S2 2 Use orientated service						
S2 3 Result orientated service						
S3 Use optimalization	RM10 O1, RM11 01	4-5 years				
S4 Life extension						
S5 Cascading						
S6 Community building	RM12 02	5-6 years				

Appendix 4 List of interviewees

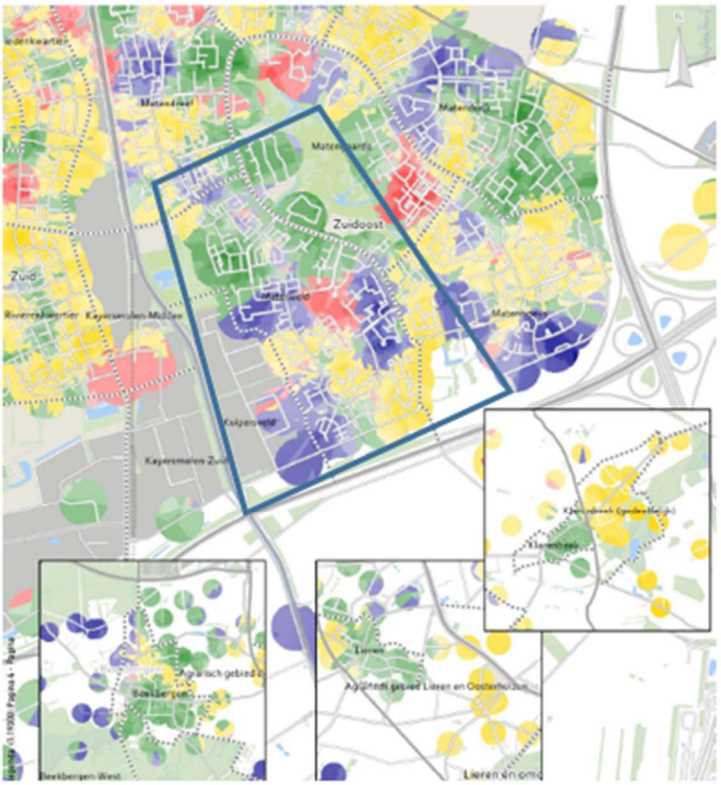
Research list of interviewees CityLoops

Phase	Research technique	Expected outcome	Participant function	Organization	Date
Orientation (problem/ambition)	interview	Understanding of Apeldoorn municipality policies and work of the Apeldoorn Energiek initiative.	Director	Apeldoorn Energiek	03.03.2020
Orientation (problem/ambition)	interview	Understanding of the requirements of the CityLoops research for Apeldoorn municipality	Demonstration manager CityLoops	Apeldoorn municipality	30.04.2020
Definition dream	focus group	Identification "dream" for municipality employees	Director	Apeldoorn Energiek	12.05.2020
			Demonstration manager CityLoops	Apeldoorn municipality	
Definition dream	focus group	Identification "dream" for municipality employees	Project leader circular economy	Apeldoorn municipality	04.06.2020
			Policy advisor recycling and	Apeldoorn municipality	
			Senior advisor purchasing and tendering	Apeldoorn municipality	
Definition dream	focus group	Identification of "dream"for Apeldoorn inhabitants	Inhabitant Apeldoorn	Apeldoorn youth group	06.07.2020
			Inhabitant Apeldoorn	Apeldoorn youth group	
			Inhabitant Apeldoorn	Apeldoorn youth group	
			Inhabitant Apeldoorn	Apeldoorn youth group	
			Inhabitant Apeldoorn	Apeldoorn youth group	
Definition dream	focus group	Identification "dream" for municipality employees	Strategic advisor, public affairs	Apeldoorn municipality	14.07.2020
Definition dream	focus group	Identification "dream" for municipality employees	Strategic advisor, public affairs	Apeldoorn municipality	14.07.2020
			Policy executer spatial areas		
Definition dream	focus group	Identification "dream" for industry partners	Director	BRBS Branch association for breaking and sorting	24.09.2020
			Operational director	Kamphuis sloopwerken & Asbestsanering	
Definition proposition	interview	Understanding municipality internal processes in an international context.	IT architect	Cardiff municipality	7.10.2020
Definition proposition	interview	Exploring best practices in procurement.	Project leader	Helsinki municipality	15.10.2020
Definition proposition	interview	Exploring best practices in project management.	Project leader Fabulos	Helsinki municipality	22.10.2020
Definition proposition	interview	Update in Apeldoorn technical capacity for secondary material treatment.	Project leader material depot	Apeldoorn municipality	22.10.2020
Design phase business model archetype	focus group	Understanding set up new material depot, technical challenges	Project leader CityLoops	Saxion university	23.10.2020
			Project leader	Apeldoorn municipality	
Design phase parties involved	interview	Understanding partners relationship	Advisor sustainability	Apeldoorn municipality	02.11.2020

Design phase parties involved	interview	Understanding partners relationship	Demonstration manager CityLoops	Apeldoorn municipality	11.11.2020
Design phase parties involved	interview	Understanding material collected in orad recycling	Project assistant	Apeldoorn municipality	12.11.2020
Design core activities	interview	Understanding partners relationship	Program director/Policy advisor	Deventer municipality	13.11.2020
Design phase parties involved	interview	Understanding partners relationship	Commercial director	Vandersanden	30.11.2020
Design phase parties involved	interview	Understanding partners relationship, Understanding material databank, industry standards	Founder	Excessmaterialsexchange.com	2.12.2020
Design external test	interview	Feedback on loops matrices	Councillor	Hof van Twente municipality	07.12.2020
Design external test	interview	Feedback on loops matrices	Project leader circular economy	Reinteinfra	08.12.2020
Design external test	interview	Feedback on loops matrices	Project leader circular economy and sustainability	KplusV	08.12.2020
Design external test	interview	Feedback on loops matrices	Project leader circular economy	Hengelo municipality	09.12.2020
Design external test	interview	Feedback on loops matrices	Senior adviseur sustainability and energy transition	Tiel municipality	09.12.2020
Design external test	interview	Feedback on loops matrices	Councillor	Deventer municipality	10.12.2020
Design external test	interview	Feedback on loops matrices	Senior environmental officer	Deventer municipality	14.12.2020
Design external test	interview	Feedback on loops matrices	Project manager extern safety	Deventer municipality	14.12.2021
Design external test	interview	Feedback on loops matrices	Senior adviseur sustainability and energy transition	Pionnering foundation	14.12.2020
Design external test	interview	Feedback on loops matrices	Advisor energy transition	Harlemmemeer municipality	14.12.2020

Appendix 5 Socio-demographics De Maten

Apeldoorn South East area



De Maat area
socio-demographic profile

(Smart Agent market response 2017)

34,6% 29,7%

21,2% 14,5%

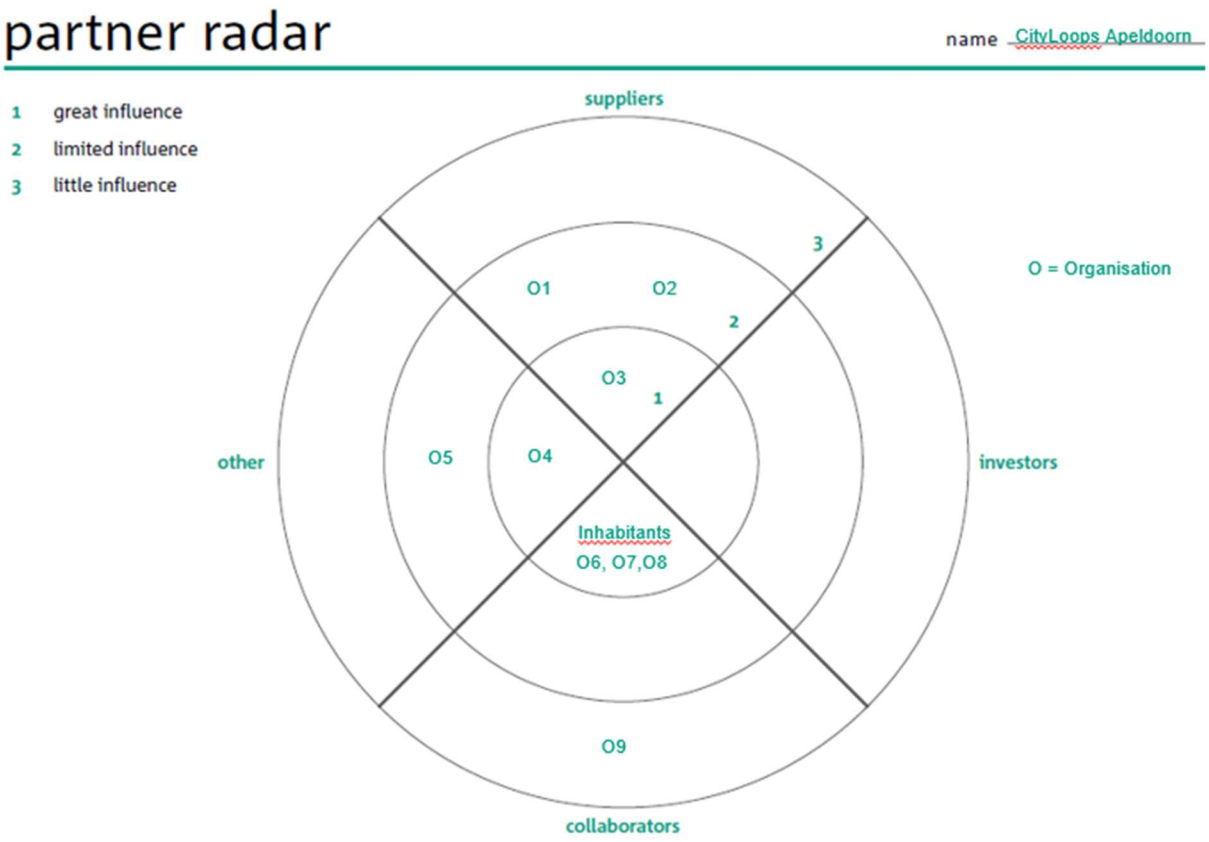
Appendix 6 Persona

persona

name CityLoops Apeldoorn

name Jansen Veronica **gender** Female **age** 33 **status** Unmarried in a relationship **occupation** Nurse **location** Apeldoorn		**bio** Veronica is a young professional involved in the care sector. She is very much involved with the local life in her street and is keen to contribute to possible improvements for her city. She is concerned about social and planet related issues.
	quote "We can solve any problems together if we put our mind to it"	**interests** Nature, going out, people, arts, politic
personality extrovert – introvert observing – intuition thinking – feeling judging – perceiving	**goals in context** To live in harmony in a pleasant surrounding, working together with the municipality for a sustainable future	**preferred channels** Smart phones, internet based applications
	frustrations in context Veronica seeks to be consulted more when it comes to local, national decisions which can affect her environment directly. Municipalities should be careful with tax payers money but should be making clear decisions for a more sustainable future.	**brands** Traditional Dutch brands (Hema) and others quality and sustainable orientated.

Appendix 6 Partner radar



Appendix 7 Business Model Template

The Business model template presented below is a translation of the workbook. An English version of an updated BMT will be soon available as a book.

The description of the various building blocks is as follows:

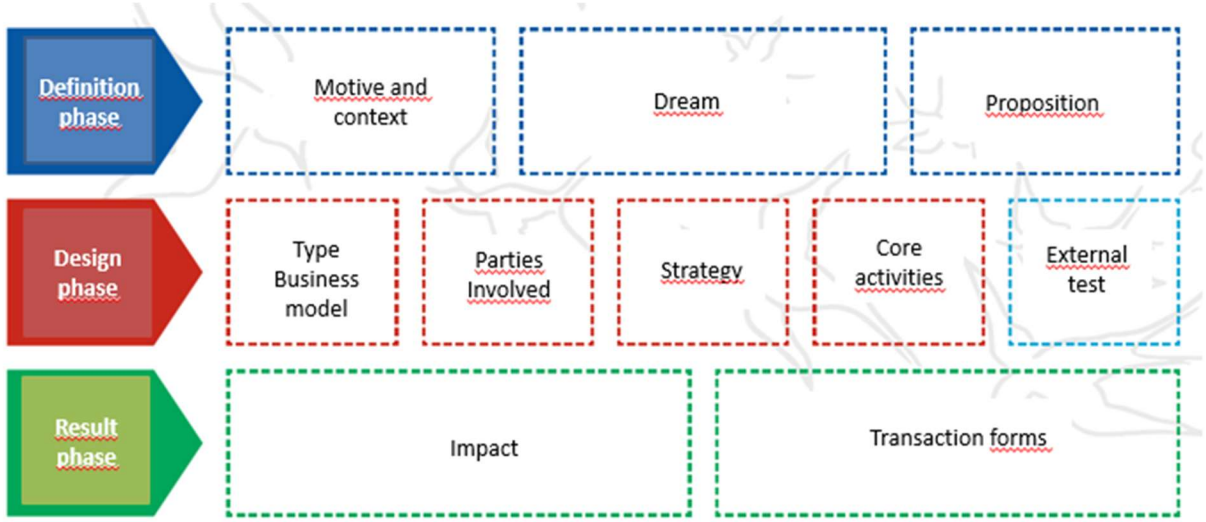


Figure 27 Translated Business Model Template (Jonker and Faber 2019)

Definition phase

MOTIVATION AND CONTEXT:

The motivation and context answer many questions related specifically to the research at hand. Questions being answered in this orientation phase allow to crystallize the underlying reasons for starting the research.

- What do you want to do and why?
- What is the problem, opportunity or challenge you want to address, and in what context?
- What is your internal drive and motivation?

Once the motivation and context is clear, it is time to identify a “Dream”. Something which might seem impossible to reach, the ideal situation in that described context.

Again a number of questions will help identify that “Dream” to move forward.

DREAM

- What Dream goal do you want to achieve?
- Where are you going to make a real difference?
- What do you think the ‘gap in the market’, or ‘the gap in society’ is?

PROPOSITION

- What contribution will your business model make to sustainability challenges now and in the future?
- Who are you going to do it for (who are your key stakeholders) and how will you sense-check whether they view the problem in the same way as you do?

Design phase

TYPE OF BUSINESS MODEL

A number of business model types can be chosen to fulfil the ambition of the proposition and creating value. Choice is mainly made of three types:

1. Platform business models whereby the focus is on the maximisation of the capacity of a given specific material or service.
2. Circular business models based on identification of secondary materials, re-use and maximisation.
3. Community based business models where the central input is of people trying to solve a problem together or work towards a common ambition.

PARTIES INVOLVED

The parties involved is an inventarization of all relevant stakeholders involved with their reasoning to be involved.

STRATEGY

In order to transform the proposition into reality there is a need for a strategy to be chosen. Strategies can be of derived in six types:

1.**Eco efficiency:** the eco-efficiency strategy focuses on the 'low-hanging fruit', the reduction of the use of material and energy throughout the life of a product, but also increasing output using the same amount of input.

2. **Product as a service/servitization:**

2.1 Product-orientated service strategy: This consists of the sale of a product with, for example, a (mandatory) maintenance package, or the more or less compulsory purchase of consumables that enable the product to function

2.2 Use-orientated service strategy: The supplier remains the owner of the product and grants access to its use through a rental or lease contract. The supplier remains responsible for the maintenance of the product.

2.3 Result-orientated service strategy: Here agreements are made about the result, and not about the product. The customer pays for the purchase of a unit of the product (for example per print, per wash, per night), or for the functional result.

3. **Use optimization:** The use optimisation strategy builds on the premise that many assets and products (chairs, buildings, cars) are not fully utilised ('idle capacity'). We make, organise, and arrange a lot that we do not use and then discard it.

4. **Life use extension:** The essence of the lifespan extension strategy is maximising the value retention of a product. Extending service life – sometimes referred to as lifespan extension – starts with the design of a product and is guided by, among other things, choice of material, 'design for repair', and 'design for recycling'.

5. **Cascading:** Cascading involves the joint design of a loop with multiple parties. By creating the cascade together, you also create a business model together. The essence of cascading is the maximum use of materials and/or residual flows between these parties. One type of cascading is conversion: the conversion of residual flows into new raw materials (for example, the conversion of sewage sludge into biogas). Another form is substitution that focuses on the replacement of materials and raw materials by more sustainable alternatives (for example, lignin from roadside grass as a binder in asphalt).

6. **Community building:** The community building strategy is about consciously organising joint value creation for and within a community, often focused on facilities such as energy, care, or food.

In the light of the data collected and analysed so far it seems that there cannot be a single strategy used but a combination diffused over time.

CORE ACTIVITIES

The core activities are therefore centred on the R's of circularity namely:

1. **Refusing:** raw materials or products that are harmful to people and the environment, or that make it difficult to reuse a product at the end of its life in whatever form (e.g, asbest made products).
2. **Redesigning:** products and components so that they can be repaired and the materials can be recovered at the end of the life cycle (e.g auto engine).
3. **Bio-based redesign:** is the commitment to develop and valorise renewable raw materials to replace fossil fuel-based virgin raw materials (e.g, potato peels can be used to make cellophane)
4. **Rethinking:** whether the use of the product can be intensified (e.g sharing assets such as machines, buildings, vehicles).
5. **Reducing:** the use of raw materials and energy in production and use.
6. **Reusing:** the product, for instance by finding another user or application.
7. **Repairing:** defective products without replacing crucial parts.
8. **Refurbishing:** product and parts so that they can be put on the market again (e.g old phones refurbished sold as official second hand/refurbished products).
9. **Repurposing:** the components of a product for another application.

10. **Recycling:** products to recover raw materials for use in new products (e.g glass to make glass)
11. **Recovering:** by capturing energy from products at the end of their life cycle when all other Res have been exhausted (e.g incineration).
12. **Reconverting:** of waste into raw materials with another application (e.g converting CO_2 into methanol (fuel)) .

EXTERNAL TEST

In order to test externally the new business model a number of criteria are suitable to validate the suggested new business model.

1. Does the business model already exists? in which case it may be useful to evaluate experiences and results of similar or related initiatives to improve or establish in a faster way.

2. Is it allowed by law? Are there legislations preventing or supporting the business model?

3. Which contribution is the new business model making to the circular economy?

4. what is the possible unexpected negative effects of the business model?

5. What positive feedback and feedforward can be obtain from discussions with third parties (stakeholders)?

Result phase

Measuring the impact and identifying which transaction forms are relevant are the last two building blocks. Impact is the “raison d’être” of the business model. It should be measurable using key performance and other indicators ideally using the SMART method (specific, measurable, achievable, relevant and time-bound) what has been in real terms the impact on the short, medium and longer terms. These can be linked to the organizations existing measurement methods if they use them (e.g life cycle analysis, GRI guidelines or integrated reporting methodology).

Transaction forms in the result phase are the evaluation of “return on the business model” from an economic, environmental and social perspective. Maybe a monetary transaction through the sale of some material (economic value), the reduction of CO_2 emissions (environmental value) or sustaining social contacts (social value). The list of possibilities is dependent on the choices made.

CITYLOOPS

CityLoops is an EU-funded project focusing on construction and demolition waste (CDW), including soil, and organic waste (OW), where seven European cities are piloting solutions to be more circular.

Høje-Taastrup and Roskilde (Denmark), Mikkeli (Finland), Apeldoorn (the Netherlands), Bodø (Norway), Porto (Portugal) and Seville (Spain) are the seven cities implementing a series of demonstration actions on CDW and soil, and OW, and developing and testing over 30 new tools and processes.

Alongside these, a sector-wide circularity assessment and an urban circularity assessment are to be carried out in each of the cities. The former, to optimise the demonstration activities, whereas the latter to enable cities to effectively integrate circularity into planning and decision making. Another two key aspects of CityLoops are stakeholder engagement and circular procurement.

CityLoops started in October 2019 and will run until September 2023.

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